

TEAC FD-005U-397
USB INTERFACE MICRO FLOPPY DISK DRIVE

HARDWARE SPECIFICATION

Rev. A

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1. GENERAL

This is the hardware specification of the TEAC FD-005U, 90mm (3.5-inch) double-sided 5.3-track/mm (135-tpi) micro floppy disk drive (hereinafter referred to as FD-005U) with a data capacity of 1.44MB/1.2MB/720KB (formatted) and a USB interface board.

(Table 1.-1) Specification outline

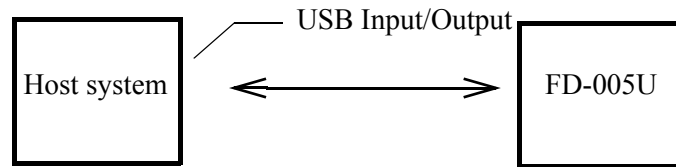
Model name		FD-005U		
TEAC P/N		19308703-97		
Operation mode		720KB mode, write/read	1.2MB mode, write/read	1.44KB mode, write/read
Disk used		Normal density (2DD)	High density (2HD)	High density (2HD)
Data transfer rate	Internal FDD	250k bits/s	500k bits/s	500k bits/s
	USB	Full speed mode (12M bits/sec)		
Disk rotational speed		300rpm	360rpm	300rpm
Track density		5.3 track/mm (135-tpi)		
Required power		+5V single (4.75 ~ 5.25V) (Supplied from a USB interface board)		
Front bezel		Black		
Eject button		Black		
Flap (shutter)		Black		
LED indicator color		Green		
Signal interface		USB (Universal Serial Bus): USB Specification Ver.2.0		
Terminator		Provided (at factory), 1.5k \pm 5% (Conforming to the USB Specification Ver.2.0)		
Other optional function		Not equipped		

This FD-005U uses two disks and has three write and read modes with an unformatted data capacity of 1.44M bytes/1.2M bytes/720k bytes, and the interface with the host system is USB. This FD-005U has a switch for the detection of the high-density identification hole (HD hole) in the disk cartridge, and can identify the type of cartridge now loaded in the FD-005U.

2. SYSTEM CONFIGURATION

2.1 System Configuration

The following system configurations are available with the FD-005U.



(Fig. 2.1-1) System configuration

2.2 Disconnection of Connector

The FD-005U should not be disconnected under the following conditions

- (a) During formatting
- (b) During write
- (c) During read

3. DISK

3.1 Work Disk

90mm (3.5-inch) micro floppy disks in Table 3.1-1 which are mutually agreed between the customer and TEAC.

(Table 3.1-1) Disk used

Operation mode	Disk type	Name	Magnetic powder	Magnetizing method
720KB	Normal density	DD	Co- γ -Fe ₂ O ₃	Surface recording
1.2MB/1.44MB	High density	HD	Co- γ -Fe ₂ O ₃	Surface recording

3.2 Cleaning Disk

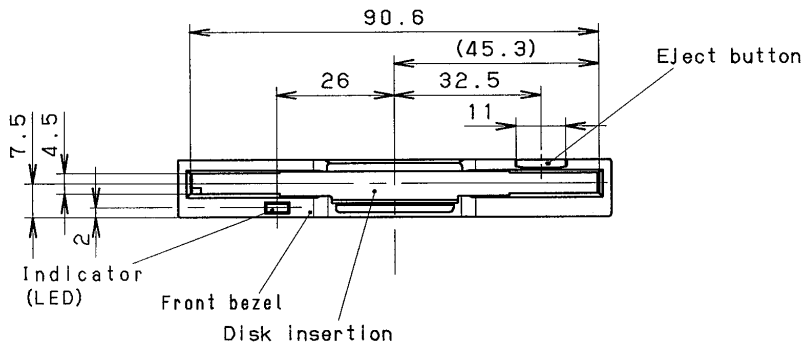
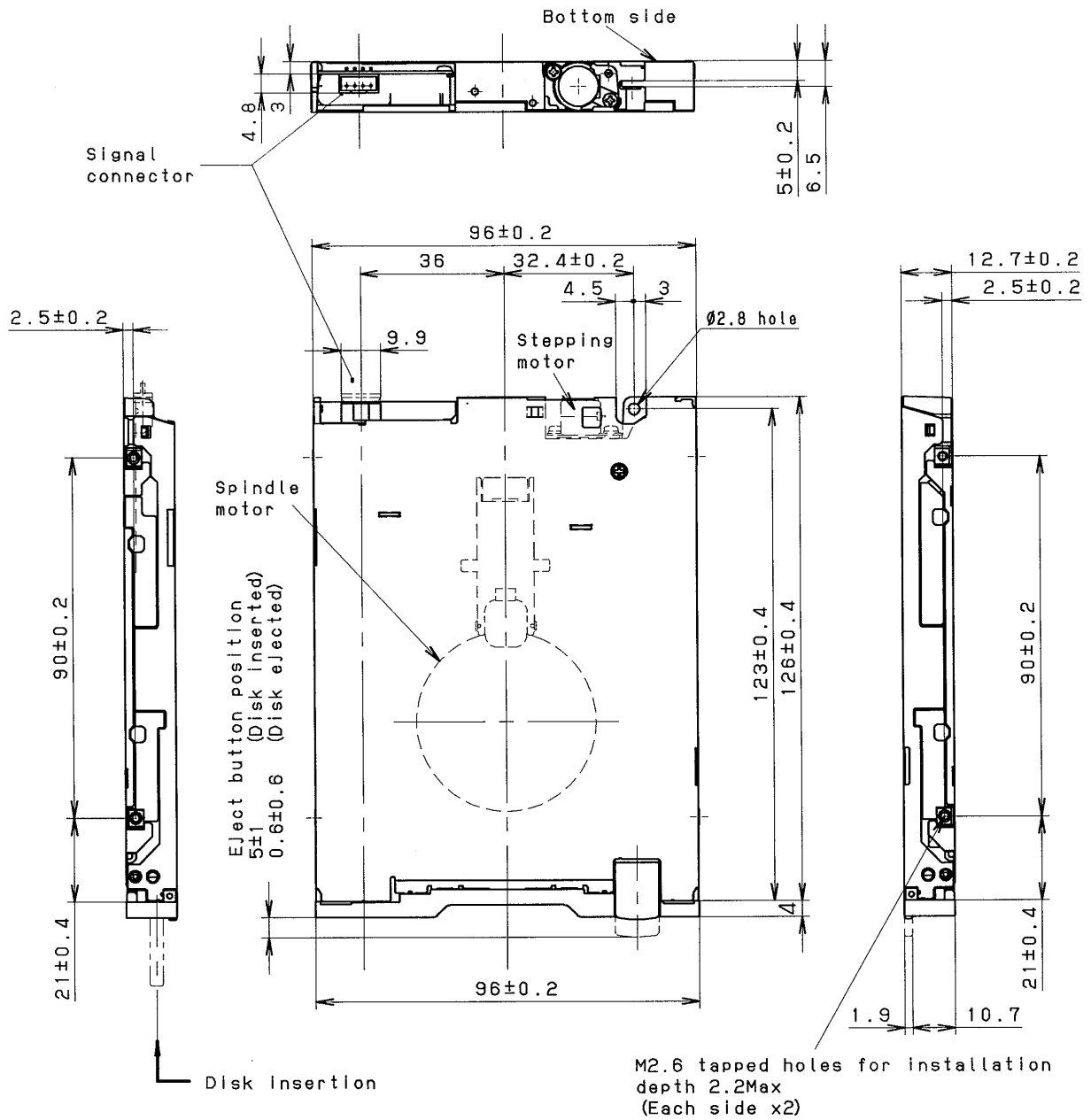
The use of a cleaning disk is not required for the FD-005U. However, if for a compelling reason it has to be used, be sure to use a dry type which is mutually agreed upon between the customer and TEAC.

4. PHYSICAL SPECIFICATIONS

4.1 Physical Specifications

(Table 4.1-1) Physical specifications

Width	See Fig. 4.1-1
Height	See Fig. 4.1-1
Depth	See Fig. 4.1-1
Weight	160g typ., 170g max.
External view	See Fig. 4.1-1
Cooling	Natural air cooling
Operating position	Do not use with eject button down.

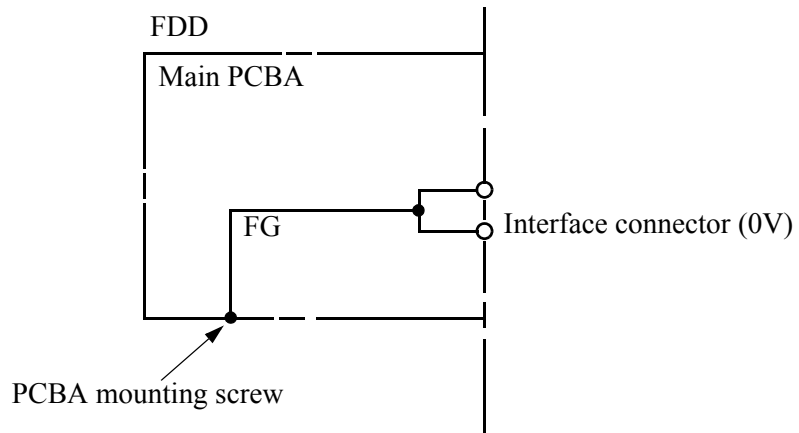


(Units: mm)

(Fig. 4.1-1) External view

4.2 Frame Grounding

The FDD frame is electrically connected to DC 0V by a PCBA mounting screw.



(Fig. 4.2-1) Frame ground internal connection

5. FUNCTIONAL SPECIFICATIONS

5.1 1.44MB Mode Data Capacity

(Table 5.1-1) 1.44MB mode data capacity

Recording method			MFM		
Data transfer rate in FDD (k bits/s)			500		
Tracks/disk			160		
Innermost track bit density (bpmm), Side 1			686.38		
Innermost track flux density (fcpm), Side 1			686.38		
Data capacity	Unformatted		k bytes/track	12.50	
			k bytes/disk	2,000	
	Formatted	18 sectors/track	k bytes/sector	0.512	
			k bytes/track	9.216	
			k bytes/disk		1,474.56

5.2 1.2MB Mode Data Capacity

(Table 5.2-1) 1.2MB mode data capacity

Recording method			MFM	
Data transfer rate in FDD (k bits/s)			500	
Tracks/disk			160	
Innermost track bit density (bpmm), Side 1			571.97	
Innermost track flux density (fcpm), Side 1			571.97	
Data capacity	Unformatted		k bytes/track	10.416
			k bytes/disk	1,666.56
	Formatted	15 sectors/track	k bytes/sector	0.512
			k bytes/track	7.680
			k bytes/disk	1,228.80
		8 sectors/track	k bytes/sector	1.024
			k bytes/track	8.192
			k bytes/disk	1,310.72

5.3 720KB Mode Data Capacity

(Table 5.3-1) 720KB mode data capacity

Recording method			MFM	
Data transfer rate in FDD (k bits/s)			250	
Tracks/disk			160	
Innermost track bit density (bpmm), Side 1			8,717	
Innermost track flux density (fcpmm), Side 1			8,717	
Data capacity	Unformatted		k bytes/track	6.25
			k bytes/disk	1,000
	Formatted	9 sectors/track	k bytes/sector	0.512
			k bytes/track	4.608
			k bytes/disk	737.28

5.4 Disk Rotation Mechanism

(Table 5.4-1) Disk rotation mechanism

Spindle motor		Direct DC brushless motor
Spindle motor speed		300rpm/360rpm
Motor servo method		Frequency servo by ceramic oscillator
Motor/spindle connection		Motor shaft direct
Disk rotational speed		The same as the spindle speed
Long term speed variation (LSV)		±1.5% or less
Instantaneous speed variation (ISV)		±3% or less
Average latency	1.44MB mode/720KB mode	100ms
	1.2MB mode	83.3ms
Speed change time		480ms (300rpm → 360rpm)

5.5 Index Detection

(Table 5.5-1) Index detection

Number of index	1 per disk revolution
Detection method	Rotor revolution detection of the spindle motor by Hall IC or FG output
Detection cycle	200ms \pm 1.5%
Index burst detection timing error (with specified test disk)	\pm 400 μ s or less

5.6 Track Construction

(Table 5.6-1) Track construction

Track density (nominal)	5.3 tracks/mm (135tpi) (track pitch 187.5 μ m, nominal)
Number of cylinders	80 cylinders
Number of tracks	160 tracks/disk
Outermost track radius (track 00)	Side 0 39.500mm (1.5551 <i>in</i>)
	Side 1 38.000mm (1.4961 <i>in</i>)
Innermost track radius (track 79)	Side 0 24.6875mm (0.9719 <i>in</i>)
	Side 1 23.1875mm (0.9129 <i>in</i>)
Positioning accuracy	\pm 15 μ m or less, with specified test disk

5.7 Magnetic Head

(Table 5.7-1) Magnetic head

Magnetic head	Read/write head with erase gap, 2 sets
Effective track width after trim erase	0.115 \pm 0.008mm (0.0045 \pm 0.0003 <i>in</i>)
Read/write gap azimuth error	\pm 18' or less, with specified test disk

5.8 Track Seek Mechanism

(Table 5.8-1) Track seek mechanism

Head positioning mechanism	Stepping motor with lead screw
Stepping motor	4-phase, 20 steps per revolution
Stepping motor drive	2 steps per track
Track 00 detection method	Photo-interrupter

5.9 Others

(Table 5.9-1) Others

Head load mechanism	Not equipped (The FDD becomes head load condition whenever a disk is installed.)
File protect mechanism	Detection of write inhibit hole by mechanical switch
Disk detection mechanism	Detection of disk installation by mechanical switch
Disk inserting force	6.86N (700g) or less at the center of a disk
Disk ejecting force	11.76N (1,200g) or less
Acoustic noise at 50cm	45dBA or less at 4ms seek operation
Disk type discriminating mechanism	Detection of HD hole by mechanical switch

6. ENVIRONMENTAL CONDITIONS

(Table 6.-1) Environmental condition

	Operating	Storage	Transportation
Ambient temperature	4 ~ 51.7°C (39 ~ 125°F)	-22 ~ 60°C (-8 ~ 140°F)	-40 ~ 65°C (-40 ~ 149°F)
Temperature gradient	20°C (36°F) or less per hour (no condensation)	30°C (54°F) or less per hour (no condensation)	30°C (54°F) or less per hour (no condensation)
Relative humidity	20 ~ 80% (no condensation) Max. wet bulb temperature shall be 29.4°C (85°F).	5 ~ 90% (no condensation) Max. wet bulb temperature shall be 40°C (104°F).	5 ~ 95% (no condensation) Max. wet bulb temperature shall be 45°C (113°F).
Vibration	14.7m/s ² (1.5G) or less (10 ~ 100Hz, 1octave/min. sweep rate)	—	19.6m/s ² (2G) or less (10 ~ 100Hz, 1/4octave/min. sweep rate)
	9.8m/s ² (1.0G) or less (100 ~ 200Hz, 1octave/min. sweep rate)		
	4.9m/s ² (0.5G) or less (200 ~ 600Hz, 1octave/min. sweep rate)		
Shock	Write & read: 49m/s ² (5G) (11ms, 1/2 sine wave) or less	—	980m/s ² (100G), single (11ms, 1/2 sine wave) or less
	Read only: 98m/s ² (10G) (11ms, 1/2 sine wave) or less Soft errors are allowed if they are recoverable within three retries.	—	
Transportation conditions	The above requirements are applied for the FD-005U without shipping box. When a long period for transportation such as by ship, storage environmental conditions should be applied.		

7. RELIABILITY

(Table 7.-1) Reliability

MTTF		30,000 power on hours or more (for typical usage)
Design component life		5 years
Disk life		3×10^6 passes/track or more
Disk insertion		1.5×10^4 times or more
Seek operation life		1×10^7 random seeks or more
Preventive maintenance		Not required (for typical usage)
Error rate	Soft read error	1 or less per 10^9 bits read A soft (recoverable) error is defined that data can be read correctly within three retries.
	Hard read error	1 or less per 10^{12} bits read A hard (unrecoverable) error is defined that it cannot be read correctly within three retries . However, it is recommended to be followed by a recalibration to track 00 and six additional retries or more.
	Seek error	1 or less per 10^6 seeks A seek error is defined that a target track can be sought within one retry.
Safety standard		Approved by UL, CSA, TÜV and BSMI

8. USB INTERFACE

(Table 8.-1) USB interface connector terminal number table

Contact Number	Signal Name	Comment
1	Vcc	Cable power
2	-DATA	
3	+DATA	
4	Ground	Cable ground

8.1 Power Supply

The USB interface power supply of the FD-005U is defined below.

The power conditions that assure the operations are as follows:

Supply power (VBUS) Minimum: 4.75V Maximum: 5.25V

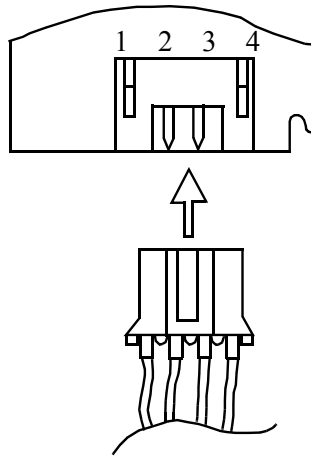
Supply current (ICC) Maximum: 500mA

The current limit circuit of the FD-005U functions at 500mA or more.
(Note that surge current at power-on (when inserting the connector) is excluded.)

(Table 8.1-1) Interface connector and cable

Signal interface connector	FDD side connector		Manufactured by J.S.T. Electronic Products, P/N S 4B-PH-K-S
	Number of poles and pitch		2mm pitch, 4 poles
	Connector view		Refer to Fig. 8.1-1.
	Connector pin assignment		Refer to Table 8.-1.
	Applicable connector	Housing	Manufactured by J.S.T. Electronic Products, PHR-4
Contact		Manufactured by J.S.T. Electronic Products, SPH-002T-P0.5S	
Signal interface cable	Applicable cable		Complies with the USB specification Ver.2.0

FDD side
signal interface connector



(Fig. 8.1-1) Signal interface connector view

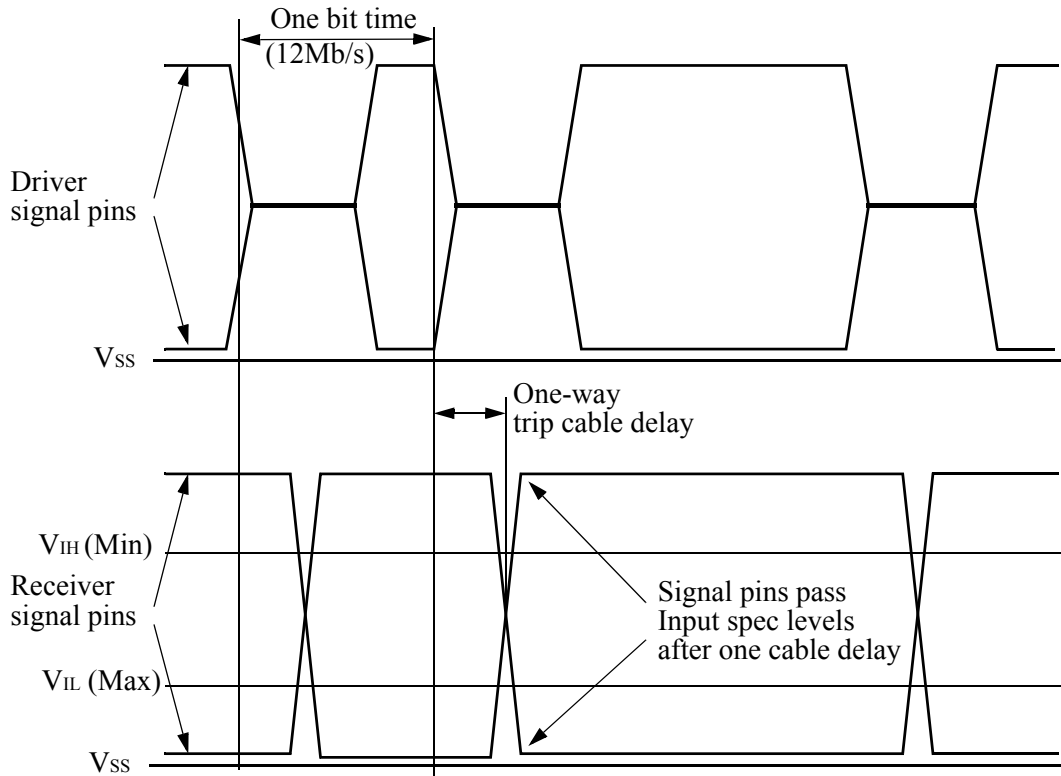
8.2 Signal

8.2.1 Transceiver

- Driver characteristics

Operational output driver is used. (The 3-state operation is supported.)

The driver signal waveforms are given in Fig. 8.2.1-1.

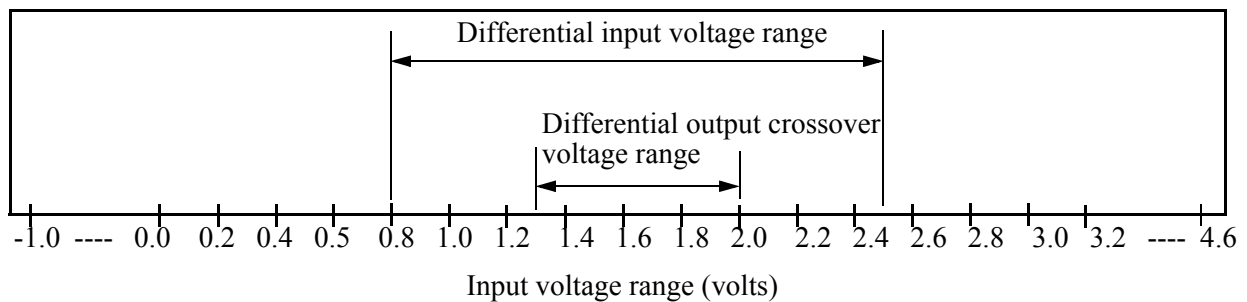


(Fig. 8.2.1-1) Driver signal waveforms

- Receiver characteristics

The differential input receiver is used.

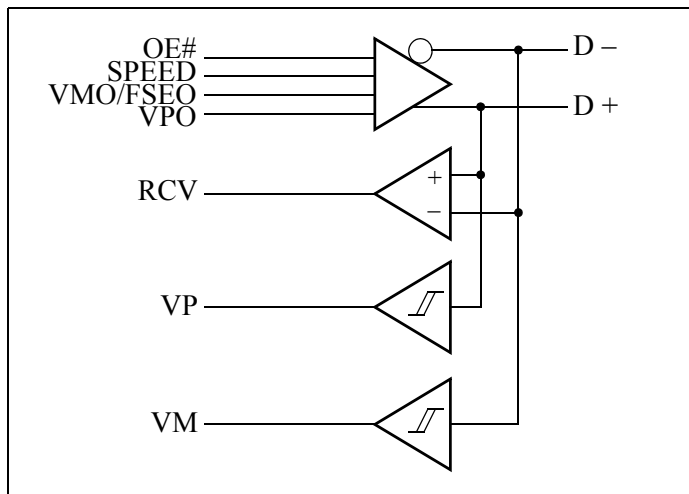
The "common mode input voltage range" where data reception is assured is given in Fig. 8.2.1-2.



(Fig. 8.2.1-2) Differential input sensitivity range

- Transceiver configuration

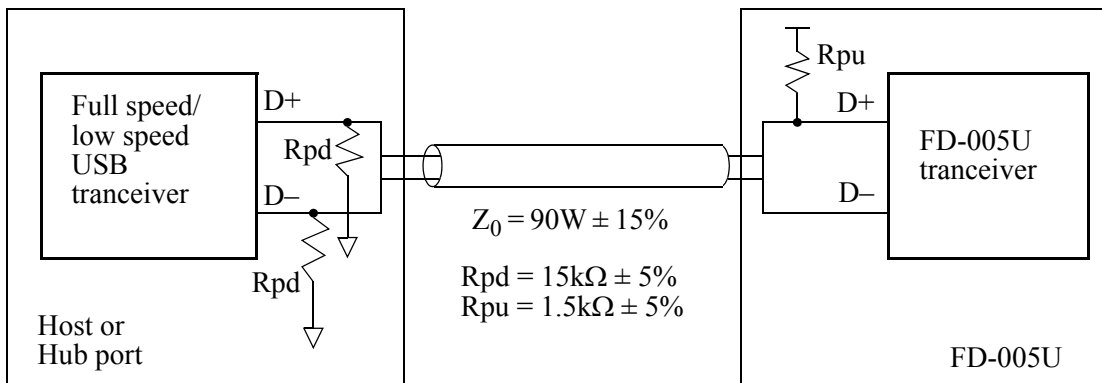
The transceiver configuration is given in Fig. 8.2.1-3.



(Fig. 8.2.1-3) Transceiver configuration

8.2.2 Termination

The signal termination processing diagram of the FD-005U is given in Fig. 8.2.2-1.



(Fig. 8.2.2-1) Signal termination processing

8.2.3 Signaling levels

The signaling levels at each bus state are given in Table 8.2.3-1.

(Table 8.2.3-1) Signaling levels

Bus State	Signaling Levels
Differential "1"	$(D+) - (D-) > 200\text{mV}$ and $D+ > VSE (\text{Min})$ or $D- \rightarrow VSE (\text{Min})$
Differential "0"	$(D+) - (D-) > 200\text{mV}$ and $D+ > VSE (\text{Min})$ or $D- \rightarrow VSE (\text{Min})$
Data J State	Differential "1"
Data K State	Differential "0"
Idle State	Differential "1" and $D+ > VSE (\text{Max})$ and $D- < VSE (\text{Min})$
Resume State	Differential "0" and $D- > VSE (\text{Max})$ and $D+ < VSE (\text{Min})$
State of Packet (SOP)	Data lines switch from Idle to K state.
End of packet (EOP)	$D+ < VSE (\text{Min})$ and $D- < VSE (\text{Min})$ for 2 bit times followed by an Idle for 1 bit time
Reset	$D+ < VSE$ and $D- < VSE$ for $\geq 10\text{ms}$

8.2.4 Suspend/resume

- Suspend

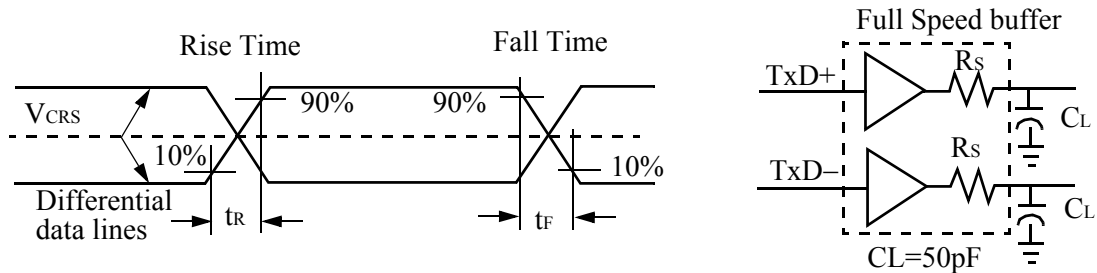
The suspend mode is entered by detecting the idle state continuously for 3.0ms or more on the bus line.

- Resume

Resume is performed by receiving the signal other than idle state on the bus.

8.2.5 Data signal rise and fall time

The FD-005U data signal rise and fall times are given in Fig. 8.2.5-1.



(Fig. 8.2.5-1) Data signal rise and fall times

8.2.6 Jitter

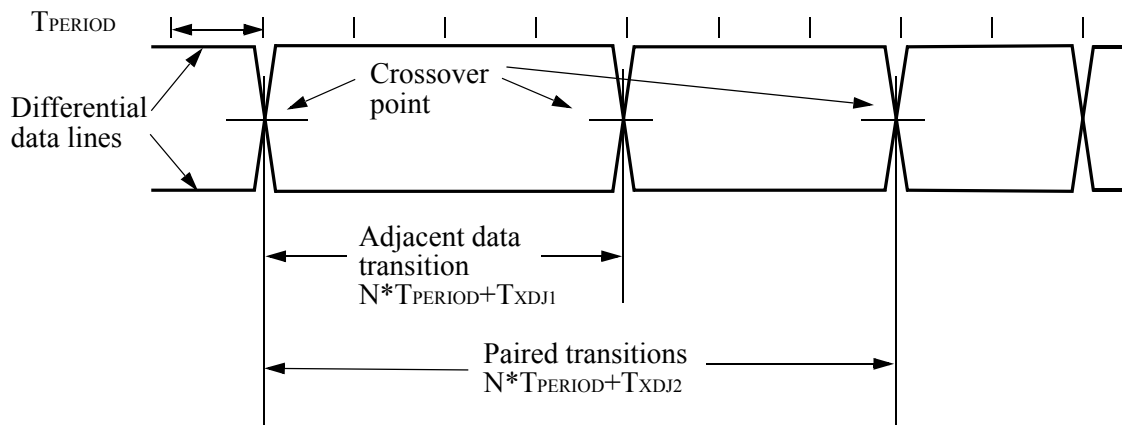
The jitter of the FD-005U is defined below.

The allocation of each jitter source is given in Table 8.2.6-1.

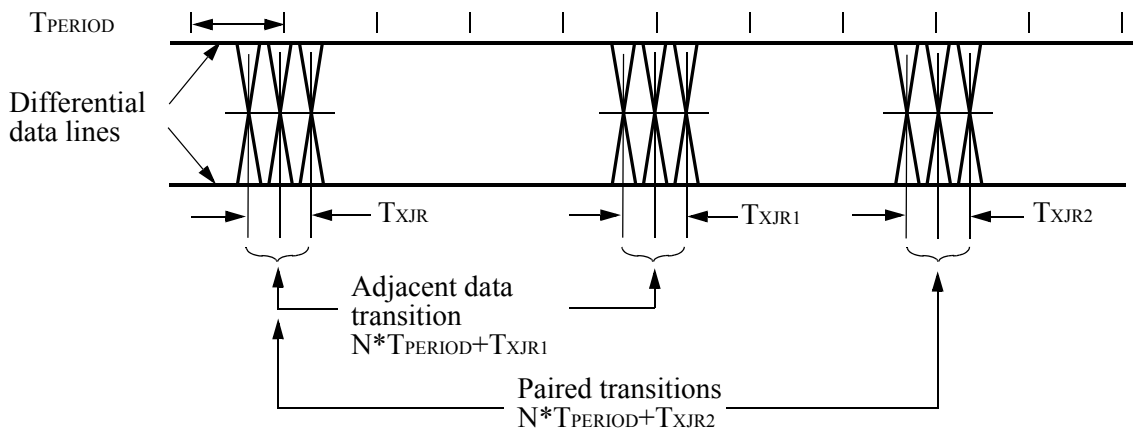
(Table 8.2.6-1) Jitter allocation

Jitter source	Next Transition		Paired Transition	
	Each (ns)	Total (ns)	Each (ns)	Total (ns)
Source driver jitter	2.0	2.0	1.0	1.0
Source frequency error - worst case	0.21/bit	1.5	0.21/bit	3.0
Source jitter total		3.5		4.0
Hub Jitter	3.0	15.0	1.0	5.0
Jitter specification		18.5		9.0
Destination frequency error	0.21/bit	1.5	0.21/bit	3.0
Receiver jitter allocation		20.0		12.0

The FD-005U jitter and jitter range timing waveform are given in Fig. 8.2.6-1 and Fig. 8.2.6-2 respectively.



(Fig. 8.2.6-1) Jitter timing waveform

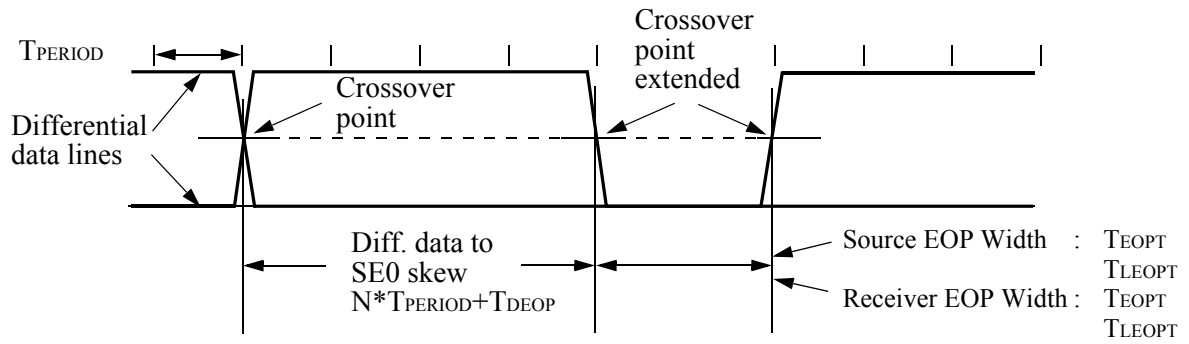


(Fig. 8.2.6-2) Jitter range

8.2.7 Data source EOP

The EOP width of the FD-005U is defined below.

Min: 150ns Max: 175ns



(Fig. 8.2.7-1) EOP width timing

8.3 List of Electrical Characteristics List

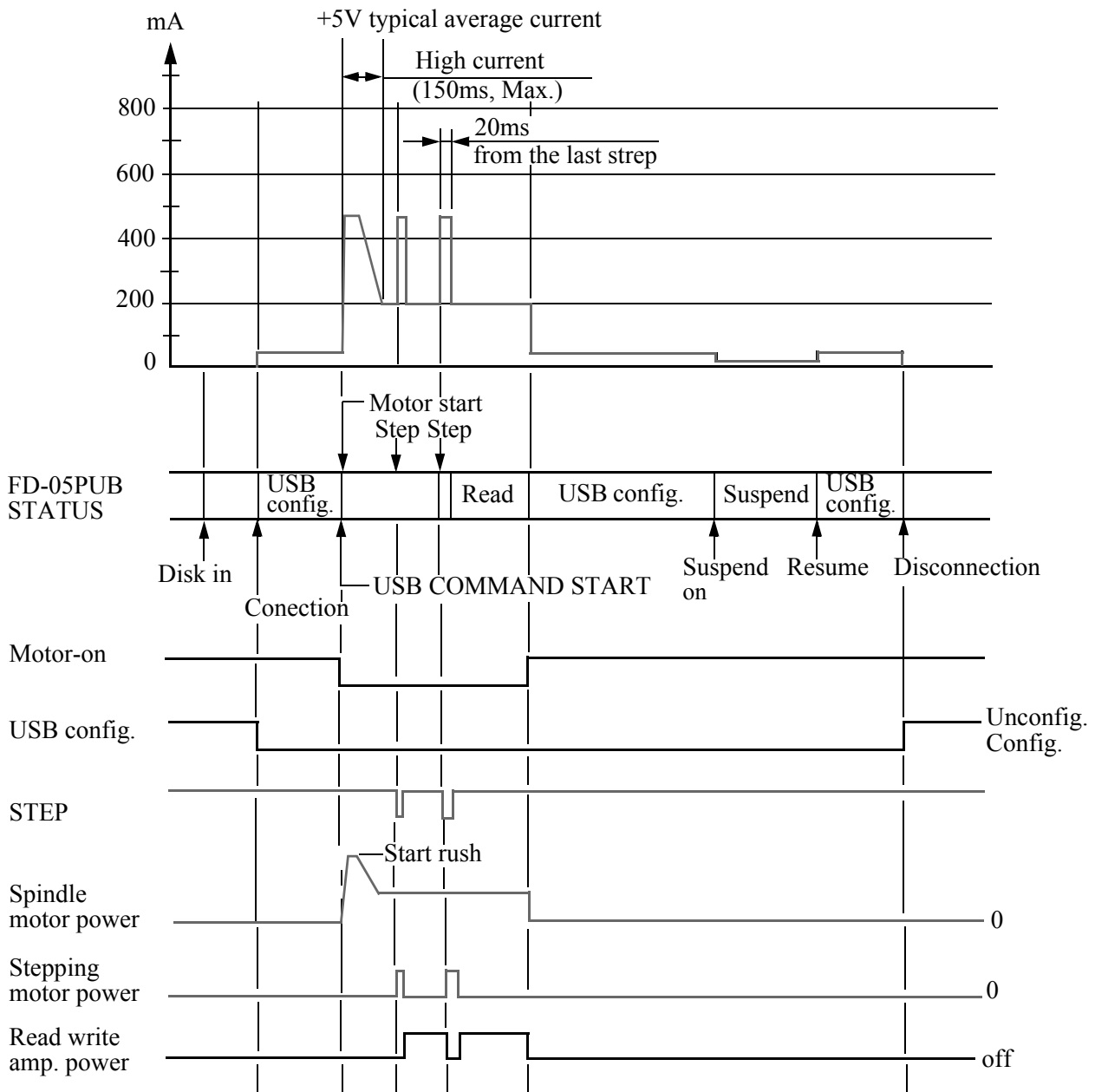
(Table 8.3-1) DC electrical characteristics

Parameter	Symbol	Conditions	Min.	(Standard)	Max.	Unit	
Supply Voltage	Assured range	V _{BUS}	4.75	5.00	5.25	V	
Supply Current	During non-operation	I _{IDOL}	V _{BUS} =5.25V, Max.	65	80	mA	
	During suspend	I _{SUS}	V _{BUS} =5.25V, Max.		500	μA	
	During read	I _{READ}	V _{BUS} =5.25V, Max.	220	300	mA	
	During write	I _{WRITE}	V _{BUS} =5.25V, Max.	220	300	mA	
	During seek (4ms)	I _{SEEK}	V _{BUS} =5.25V, Max.	400	450	mA	
	At SPM activation	I _{SPM}	V _{BUS} =5.25V, Max. Max150ms	450	500	mA	
Supply Power	During non-operation	W _{IDOL}	V _{BUS} =5.25V, Max.	0.33	0.42	W	
	During suspend	W _{SUS}	V _{BUS} =5.25V, Max.		2.63	mW	
	During read	W _{READ}	V _{BUS} =5.25V, Max.	1.10	1.58	W	
	During write	W _{WRITE}	V _{BUS} =5.25V, Max.	1.10	1.58	W	
	During seek (4ms)	W _{SEEK}	V _{BUS} =5.25V, Max.	2.00	2.36	W	
	At SPM activation	W _{SPM}	V _{BUS} =5.25V, Max. Max150ms	2.25	2.63	W	
Leakage Current	Output leakage in high-impedance state	I _{LO}	0V < V _{IN} < 3.3V	-10	+10	μA	
Input Levels	Differential input sensitivity	V _{DI}	(D+) - (D-) Refer to Fig. 8.2.1-2.	0.2		V	
	Differential common mode range	V _{CM}	Includes V _{DI} range	0.8	2.5	V	
	Single ended receiver threshold	V _{SE}		0.8	2.0	V	
Output Levels	Static output low	V _{OL}	RL 15kΩ to 3.6V		0.3	V	
	Static output high	V _{OH}	RL 1.5Ω to GND	2.8	3.6	V	
Capacitance	Transceiver capacitance	C _{IN}	Pin to GND		20	pF	
Terminations	Bus pull-up resistor	R _{PU}	(1.5kΩ ±5%)	1.425	1.5k	1.575	Ω

(Table 8.3-2) AC electrical characteristics

	Parameter	Symbol	Condition	Min.	(Standard)	Max.	Unit
Driver Characteristics	Rise transition time	T _R	CL = 50pF Refer to Fig. 8.2.5-1.	4		20	ns
	Fall transition time	T _F	CL = 50pF Refer to Fig. 8.2.5-1.	4		20	ns
	Rise/Fall time matching	T _{RFM}	(TR/TF)	90	100	110	%
	Output signal crossover voltage	V _{CRS}		1.3		2.0	V
	Driver output resistance	Z _{DRV}	Steady State	28		43	Ω
Data Source Timings	Data rate	T _{DRATE}	(12Mb/s = 0.25%)	11.97	12.00	12.03	Mb/s
	Frame interval	T _{FRAME}	1.0ms = 0.05%	0.9995	1.0	1.0005	ms
	Source differential driver jitter To next transition	T _{DJ1}	Fig. 8.2.6-1	-3.5		+3.5	ns
	Source differential driver jitter For paired transition	T _{DJ2}	Fig. 8.2.6-1	-4.0		+4.0	ns
	Differential to EOP transition skew	T _{DEOP}	Fig. 8.2.7-1	-2		+5	ns
	Receiver data jitter To next transition	T _{JR1}	Fig. 8.2.6-2	-18.5		18.5	ns
	Receiver data jitter For paired transition	T _{JR2}	Fig. 8.2.6-2	-9		9	ns
	Receiver EOP width must reject as EOP	T _{EOPR1}	Fig. 8.2.7-1	40			ns
	Receiver EOP width must accept as EOP	T _{EOPR2}	Fig. 8.2.7-1	82			ns

9. CURRENT CONSUMPTION TIME CHART



(Fig. 9.-1) Current consumption time chart