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1.0 INTRODUCTION

This document describes the organization and operation of a HEX-BUS floppy disk system with a built-in dual-density, single-sided drive. This system is capable of interfacing, through straight cables, with up to three additional drives. These drives are 5-1/4 inch floppy disk drives of single or double data density and one or two heads.

2.0 APPLICABLE DOCUMENTS

1. Software Specification for the TI 99/4 Disk Peripheral version 2.0 dated 3/28/83.
2. Functional Specification for the 99/4 Disk Peripheral version 3.0 dated 3/28/83.
3. GPL Interface Specification for the 99/4 Disk Peripheral version 2.0 dated 3/28/83.
4. Approaches to a Double Density Disk Controller Design for the 99/4X dated 1/11/82.
5. 99/4 Interface Considerations, DS/SD Disk Controller Electrical Specifications dated 7/13/82.
6. HEX-BUS Interface Peripheral Specification dated 10/8/82.
7. ANSI Standard X3.80-1981 Interfaces Between Flexible Disk Cartridge Drives and Their Host Controllers.
8. HEX-BUS Cable sketches dated 4/11/83.
9. Intelligent Peripheral Bus Structure, Timing, and Protocol Specifica Revision 3.5 dated 4/8/83.
10. Data Sheet for FDC9216 Floppy Disk Data Separation from Standard Microsystems Corporation dated 1981.
11. TI GRAS 10237.
12. TI GRAS 10348.
13. FCC part 15, subpart J.
14. Disk Drive without Power Supply, TI Specification 1040367.

3.0 SPECIFICATIONS

3.1 COMPATIBILITY

This system will be compatible with the all TI Home Computers. This goal implies that the system must be able to meet the following requirements:

- * The system must be capable of reading any type of file currently supported from a diskette formatted on a TI-99/4A Home Computer or any diskette distributed through authorized retail channels.
- * Diskettes formatted by the HEX-BUS system must be able to be read by a TI-99/4A system with a HEX-BUS Interface Peripheral.
- * All HEX-BUS-compatible devices must be able to store and use

information from diskettes by using the HEX-BUS Floppy Disk System
 NOTE: This last requirement does NOT imply that all information
 (data stored by one type of computer) will be transportable to a
 different type of HEX-BUS-compatible computer.

3.2 MARKET

This HEX-BUS peripheral is intended to provide the consumer with an economical 5-1/4" floppy disk storage capacity of 170K bytes.

3.3 PRODUCTION GOAL

This unit should be available for a total cost, including material, labor, and overhead, of \$180 by 4Q83.

3.4 ELECTRICAL

Power shall be supplied by normal household electrical service. International compatibility shall be accommodated by replacement of an external component. This external component must be approved by appropriate government and safety agencies such as U.L., CSA, VDE, etc.

3.5 POWER REQUIREMENTS

	Min.	Max.	
Input Voltage	5.0	12	volts
Current	1.7	1.8	amps max

3.6 DISKETTE CONFIGURATIONS

The HEX-BUS disk controller hardware and device service routine (DSR) software will format, read, and write diskettes of the following configurations:

No. Trks.	No. Sides	Data Density	Sectors/Track	Sectors/Diskette	Data Bytes/Diskette
35	1	S	9	315	80640
35	1	D	16	560	143360
40	1	S	9	360	92160
40	1	D	16	640	163840
40	2	S	9	720	184320
40	2	D	16	1280	327680

All sectors are 256 data bytes long. Single data density follows IBM 3740 FM encoding format and double density is IBM 34 MFM format.

Data density is automatically determined by the low level DSR in the read or write mode.

3.7 DISK DRIVE REQUIREMENTS

2
K
R
A
M

```

>4000 *****
*
* FILE 1 518 *
*
*****
*
* FILE 2 518 *
*
*****
*
* FILE 3 518 *
*
*****
*
* STACK SPACE 217 *
*
*****
*
* ADDITIONAL INFORMATION 10 *
*
*****
*
* VOLUME INFORMATION BLOCK 256 *
*
*****
*
* FILE NAME OR VOLUME NAME 11 *
*
>47FF *****

*****
>F000 *
* WORK SPACE 1 ( => 83E0-83FF) *
>F01F *
*****
>F020 *
* WORK AREA FOR HIGH LEVEL DSR *
* (>834E => >8370) *
>F033 *
*****
>F034 *
* WORK AREA FOR LOW LEVEL DSR AND WORK *
* SPACE 2 *
>FOC3 *
*****
>FOC4 *
* AREA FOR INTERFACE WITH HEX-BUS *
*
>FOFB *
*****

```

4.2 ELECTRICAL CONNECTIONS

Signals to the 8-pin HEX-BUS connector are described in the HEX-BUS ca sketches.

Signals to the 34 pin disk drive connector are in accordance to ANSI Standard X3.80-1981 and are as follows:

PIN	SIGNAL	DIRECTION	
		Controller	Drive
2	Not Assigned		-
4	Not Assigned		-
6	Drive Select 3		>
8	Index		<
10	Drive Select 0		>
12	Drive Select 1		>
14	Drive Select 2		>
16	Motor ON		>
18	Direction Select		>
20	Step		>
22	Composite Write Data		>
24	Write Gate		>
26	Track 0		<
28	Write Protected		<
30	Composite Read Data		<
32	Side One Select		>
34	Not Assigned		-
1-33	Ground - all odd number pins		

5.0 SOFTWARE ORGANIZATION

5.1 OVERALL STRUCTURE

Overall software structure may be viewed as follows:

```

*****
*                                     *
*               OPERATING SYSTEM      *
* -contained in console ROM's and GROM's. *
* -provides user display, keyboard scan, etc. *
* -contains BASIC. *
* -hands off to DSR software. *
*                                     *
*****
*                                     *
*               DEVICE SERVICE ROUTINE *
* -contained in peripheral board ROM's. *
* -maybe augmented with command module sftwr. *
* -provides total interface to periph. device. *
* -returns control to operating system after *
* performing specified function. *
* -organized as follows for disk control: *
*                                     *
*-----*
*               Level 3 *
* -highest DSR level. *
* -interfaces to BASIC in accordance with *
* 99/4 file management requirements. *
* -blocks fixed or variable length logical *
* records into 256 byte physical records. *
*-----*
*               Level 2 *
* -accesses data by file name and physical *
* record location. *
* -creates and deletes files. *
* -maintains file directory and allocation *
* unit bitmap on diskette. *
* -passes logical sector number to Level 1 *
* for Read or Write of a sector. *
*-----*
*               Level 1 *
* -lowest DSR level. *
* -provides machine code interface to disk *
* controller hardware. *
* -defines basic disk functions of sector *
* read/write, initialization, head control, *
* track formatting, and drive selection. *
* -provides encode and decode to HEX-BUS *
* Interface *
*-----*
*****

```


5.2 ADDITIONAL SOFTWARE Additional disk-related software resides in the Disk Manager command module to provide the following utility functions:

- Single disk backup
- Disk to disk copy/backup
- Disk initialization/formatting
- Disk catalog
- Disk rename
- Disk test
- File copy
- File rename
- File protection status
- Selective file deletion

6.0 OPERATION

To eliminate the need for user prompts or option select switches routine disk read/write operations will depend on pre-formatted diskette information to tell the DSR how to select controller options. Options will be determined as follows:

1. Single or Double Data Density - The controller will attempt to read a specified sector address ID at the start of a Read or Write sector operation. The controller may be in single or double data density mode.
2. Single or Double Side - The low level DSR calculates track and physical sector number from the logical sector number passed from the high level DSR. If the calculated track number exceeds the max. tracks available for the drive on Side 0 the DSR extends the calculation to Side 1. The algorithm places the next excess sector on the inner track of Side 1 so that the head can sweep from outer (Track 00) to inner track of Side 0 then inner to outer track of Side 1. This technique coincides with the old controller DSR.
3. Variable Sector Length - The present high level DSR supports only 256 bytes/sector and this fixed length is carried over into the new DSR.

7.0 PHYSICAL CHARACTERISTICS

7.1 WEIGHT

The total weight of an operational HEX-BUS Floppy Disk System--drive controller with built-in drive--shall be less than 8 pounds.

7.2 SIZE

The HEX-BUS Floppy Disk System shall have these maximum overall

dimensions:

Width: 6.5 inches
Length: 13 inches
Height: 8.5 inches

7.3 STYLING

Product styling shall be consistent with the styling of the HEX-BUS peripherals as well as the CC-40, TI-99/2, TI-99/4A, and TI-99/8 product lines.

7.4 DESIGN

This product will support the cost goals and provide good human factors for assembly, test, and consumer.

7.5 CASE

The HEX-BUS Floppy Disk System shall be made of injection molded plastics or die cast aluminum. The material used must be of sufficient durability to survive the anticipated environmental specifications to GRAS 10237, any pertinent governmental regulatory requirements, and any other field-use environment characteristic of the end use of the product.

7.6 DEVICE CONDITIONING

Specifics of the burn-in or pre-conditioning shall be called out in the individual piece part specification or purchase agreement. This specification merely defines the requirements.

7.7 INTEGRATED CIRCUITS

The main logic devices, microprocessors, memory devices, etc. shall meet the requirements of their individual component specifications and of CPSP 6.6 MOS device specification. In addition, each IC must be qualified by either the vendor or CPG QRA in accordance with GRAS 10348.

7.8 EMI/RFI

This system shall meet certification or verification according to FCC rules, part 15, subpart J.

7.9 ENVIRONMENTAL REQUIREMENTS

The HEX-BUS Floppy Disk System shall meet all of the requirements of this specification after exposure to the environmental requirements of TI GRAS 10237.

7.10 QUALIFICATION

The HEX-BUS Floppy Disk System shall meet all of the requirements of this specification and of TI GRAS 10237 at the conclusion of all

testing requirements of TI QRAS 10237. This shall include, but not be limited to, the following categories:

- A) Mechanical stress testing (vibration, loose cargo), transportation tests, transportation handling, and customer handling.
- B) Operation under temperature/humidity rapidly changing conditions.
- C) Long term operation under anticipated worst case conditions of temperature/ humidity.
- D) Long term storage under worst case conditions of temperature/ humidity.
- E) Operating life tests to simulate field performance and predict return rate liability.
- F) Electrical characterization for conformance to this specification and any governmental regulatory or safety agencies such as U.L., CSA, FCC, VDE, etc.
- G) Resistance to static electricity.
- H) Compatibility with peripheral products intended for use in conjunction with this product.
- I) Any other category pertinent to this specific product.

7.11 QUALITY ASSURANCE PROVISIONS

All product production will be sampled per the applicable TI QRAS 10237 for conformance to the TI outgoing quality standards. Expected Mean Time Between Failures should exceed 8000 hours.

7.12 SUBCONTRACTED OR PURCHASED PRODUCT

All shipments of the HEX-BUS Floppy Disk System received from non-TI facilities will be sample tested for conformance to this specification per TI QRAS 10308.