DOCUMENT INFORMATION

This page provides a sequential record of changes for a multi-page drawing. Each "Revision Description" shall also include the appropriate page number(s). The change on the numbered page(s) shall be indicated with the new revision letter located in the right hand margin at the paragraph that has changed. (The term "Extensive Changes" may be entered if the loss of history is acceptable). All pages of this drawing shall carry the same revision letter as shown on this page.

Title:	795XB / 796XB CONTROLLER ERS
Written By:	MARC LeFEVRE
Model:	795XB / 796XB
Part Numbers:	
Supersedes:	A-07957-60010-4 (D7505XT A-5959-3912-1)
Doc. Users:	ER:48 D/H: C6, H5 09, 58, 22

REVISION HISTORY

Rev	Revision Description	Date	Approved by:(name)	MF
A	REPLACED A-07957-60010-4 PER C0483042	871208	MO/MARC LEFEVRE	
B	ADDED OFFLINE UTILITY INFORMATION PER C0483373	880712	MO/MARC LEFEVRE MU	

4
5
6
7
12
13

FALSTAFF III / WILE CONTROLLER ERS

PRODUCT NUMBERS

7957B 7958B 7959B

7961B 7962B 7963B 7963BD

TABLE OF CONTENTS PAGE

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This specification provides a description of the command set and utility/diagnostics which are being designed into the Falstaff III (ESDI to CS80) controller.

1.2 SCOPE

This document covers the command set of the Falstaff III disc controller. It does not contain the mechanical, electrical, and environmental characteristics of the disc mechanism.

2.0 APPLICABLE DOCUMENTS

2.1 The following documents are used as reference for the product specification:

HP #5955-3442: CS80 Instruction Set Programming Manual
795XB Autosparing Definition, by Bob Pentecost

3.0 PRODUCT FEATURES AND GENERAL DESCRIPTION

3.1 GENERAL DESCRIPTION

The Falstaff III controller interfaces the host computer to disc mechanisms which conform to the industry standard ESDI (Enhanced Small Device Interface) specification. The host communicates with the controller through a subset of CS80. CS80 compatibility is discussed in the command set section. (Tape storage is not supported by this controller.)

3.2 PRODUCT FEATURES

The Falstaff III controller consists of a single PCA which performs the following functions:

* HPIB Interface
* CS80 Command Processing
* Control signals for ESDI Standard Interface
* 16 KByte Data Buffer (1 track)
* DMA Hardware
* R/W Control
* Sector Formatting
* Target Sector Identification
* Serial/Parallel Data Conversion
* Error Detection and Correction
* Auto Configuration (based on ESDI request configuration)
* Self Test Firmware

3.3 DESCRIBE RESPONSE

The product number field of the describe response and the HPIB identify will be configured as follows:

PRODUCT	DESCRIBE FIELD	AMIGO IDENTIFY RESPONSE
7957B / 7961B [81Mb]	079571	022C hex
7958B / 7962B [152Mb]	079581	022D hex
7959B / 7963B [304Mb]	079591	022E hex

The controller will respond with these responses whether it is in a Falstaff III (795XB) or a WILE (796XB).

4.0 PERFORMANCE SPECIFICATIONS

4.1 ACCESS TIME (DISC STORAGE MODULE)

Access time is a function of the seek time and latency of the disc mechanism, and therefore cannot be specified in this document. Since 795XB and 796XB will use Coyote disc mechanisms, refer to the Coyote Disc Mechanism ERS document for more information on seek and latency times.

4.2 DATA CAPACITY

Data capacity is a function of the disc mechanism. It is anticipated that this controller will be used with mechanisms which provide 80 to 300+ megabytes of formatted capacity

4.3 DATA TRANSFER RATE

BETWEEN CONTROLLER AND HOST

	READS	WRITES
Maximum	1 Mbyte/sec	1 Mbyte/sec
Multi-track transfer (with Coyote mechanism)	750 Kbytes/sec	750 Kbytes/sec

BETWEEN CONTROLLER AND MECHANISM

READS	WRITES
10 Mbits/sec	10 Mbits/sec

4.4 CONTROLLER OVERHEAD:

For firmware versions of MR 2.0 and later, controller overhead is 0.8 msec.

4.0 PERFORMANCE SPECIFICATIONS (cont'd)

4.5 ERROR RATE

4.5.1 Error Recovery Procedure

Upon encountering a data error, the Falstaff III controller will attempt to retrieve error-free data for the host. If a data error occurs, the controller will begin to reread the sector where the error is detected. Read retries may continue for a maximum of 800 ms (37 retries). If the read retries fail to recover data, an error correction computation is attempted using ECC. Track offset is also used as part of the error recovery process.

NOTE: The CS80 command 'Set Retry Time' is accepted by this product, but it does not affect the number of loops of the recovery operation (it is a no op).

4.5.2 Error Definitions and Reporting

Data errors are classified into three primary categories by CS80: recoverable, marginal, and unrecoverable.

a) Recoverable: If the first read retry successfully retrieves the data, then the data is considered recoverable. Accurate data is returned to the host. Recoverable errors are not reported to the host during run time or logged in the run time log. (Recoverable errors are counted in error rate calculations and are reported when error rate utilities are executed.)

b) Marginal: If the data is successfully recovered, but recovery required more than one read retry or ECC was used, then the data error is classified as marginal. Marginal data implies that the data was recovered with difficulty, but the data returned to the host is accurate. The host is notified of marginal data by setting the marginal data bit in the request status error reporting field. Marginal data errors which occur during run time activities are recorded in the run time log.

Since aggressive seeks are enabled in Coyote disc mechanisms during channel operations, this reporting scheme hides one of the negative consequences of aggressive seeks. That is, an increased recoverable error rate on the first sector read after a seek.

c) Unrecoverable: If the recovery loop count is exhausted, and the data has not been successfully retrieved, then the data is classified as unrecoverable, and inaccurate data is returned to the host. The host is notified of the bad data by the unrecoverable data bit in the request status error reporting field. Unrecoverable data errors which occur during run time activities are logged in the run time log.

The controller does not verify data after a write operation. This means that, in normal use, an error during a write operation cannot be distinguished from a hard read error.

4.0 PERFORMANCE SPECIFICATIONS (cont'd)

4.5 ERROR RATE (cont'd)

4.5.3 Error Rate Specification

The error rates specified below apply after sparing has been performed.

Error rate is specified by a recoverable data error rate and an unrecoverable data error rate. Recoverable data errors include those previously described as recoverable and marginal. In other words, the recovery operation was successful and accurate data is returned to the host. The unrecoverable data error rate specifies the ratio of bits read to the number of unrecoverable data errors (retry count exhausted and inaccurate data returned).

```
**********************************************************
 RECOVERABLE ERROR RATE:  1 ERROR IN 1.0 E+10 BITS
 UNRECOVERABLE ERROR RATE:  1 ERROR IN 1.0 E+12 BITS
**********************************************************
```

4.5.4 Sparing

The controller supports an autosparing capability as well as the spare block command. Each track contains a spare sector. Each surface contains six spare tracks. If it becomes necessary to spare more than one sector on a track, the data will be moved to one of the spare tracks. There is no cross-head track sparing.

The autosparing function allows the drive to spare unrecoverable and marginal errors without host intervention. Data integrity is maintained during the sparing operation. The host can disable autosparing via the Set Options command. A Spare Block command to a sector that was previously autospared will pass the operation without doing unnecessary sparing.

4.5.5 Seek Error (Access Position Errors)

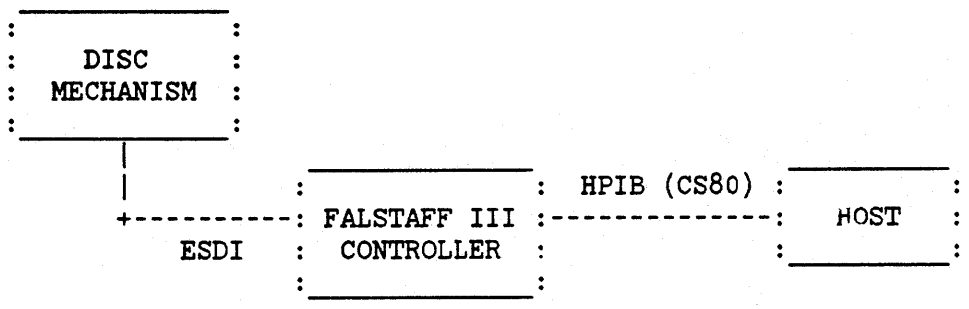
Seek errors are logged in the fault log, but do not cause the operation to fail.

A seek fault occurs when the mechanism is unable to reach the target track and all of the recovery processes have failed. This situation is reported as a hardware fault and the current operation returns with a QSTAT of 1.

5.0 INTERFACE REQUIREMENTS

5.1 SUBSYSTEM ARCHITECTURE

A schematic of the subsystem architecture helps to clarify interface requirements.



5.2 COMMAND SET

The Falstaff III controller implements a subset of Command Set '80. Refer to CS80 Instruction Set Programming Manual, HP #5955-3442.

yes = Implemented as defined by CS80
no = Will return illegal opcode if received
no op = Command ignored but parameters are checked. If the parameters are incorrect, then illegal parameter/bounds is returned.

COMMAND	IMPLEMENTED
Transparent commands	
Universal Device Clear	yes
Amigo Clear	yes
Channel Independent Clear	yes
Selected Device Clear	yes
Cancel	yes
Loopback	yes
HPIB Parity Checking	yes
Identify	yes
Real Time Commands	
Locate and Read	yes
Cold Load Read	yes
Locate and Write	yes
Write File Mark (tapes only)	no

5.2 COMMAND SET (cont'd)

Complementary Commands	
Set Unit (unit 0 and 15)	yes
Set Volume (volume zero only)	yes
Set Address (1 and 3 vector)	yes
Set Block Displacement	no
Set Length	yes
Set Burst	yes
Set RPS (Rotational Position Sensing)	no op
Set Retry Time	no op
Set Status Mask	yes
No Op	yes
Set Release	no op
Set Options	yes

Two bits of the option byte are supported:
- Bit 2 - enable autosparing on disc errors
  - 0-enable (power on state)
  - 1-disable
- Bit 3 - use aggressive seeks during utilities *
  - 1-enable
  - 0-disable (power on state)

Set Return Addressing Mode	yes

* Note that this affects seeks done in utilities only. Aggressive seeks are always used during real time commands.

General Purpose Commands	
Spare Block	yes
Describe	yes
Locate and Verify	yes
Release	no op
Release Denied	no op
Copy Data	no
Initialize Media	yes

The following options are supported under the Initialize Media command:
- 0 - The data fields of the sectors in the logical address space are written with zeroes. All spares are retained.
- 1 - Same as option zero except that field spares are NOT retained. Factory spares are retained.
- 2 - ID fields and data fields are rewritten, and all spares are retained. Data fields are written with AA hex.
- 3 - ID fields and data fields are rewritten, and no spares are retained. Data fields are written with AA hex.

5.3 REQUEST STATUS SUMMARY

yes = bit will be set by the controller in response to an error as described by the CS80 manual
no = under no condition will this bit be set

Reject Errors	
Channel Parity Error	yes
Illegal Opcode	yes
Module Addressing	yes
(we only support volume 0 and unit 1 or 15)	
Address Bounds	yes
Parameter bounds	yes
Illegal Parameter	yes
Message Sequence	yes
Message Length	yes

Fault Errors	
Cross-Unit (copy data not supported)	no
Controller Fault	yes
Unit Fault	yes
(set whenever a problem is detected in disc mechanism)	
(set when a failure occurs during a disc diagnostic)	
Diagnostic Result	yes
Operator Request	no
Diagnostic Request	no
Internal Maintenance	no
Power Fail	yes
Retransmit	no

5.2 COMMAND SET (cont'd)

Diagnostic Commands	
Request Status	yes
(see Section 5.3, Request Status Summary)	
Initiate Utility:	
No execution message	yes
Device will receive execution message	no
Device will send execution message	yes

See Section 5.4, Utility Command Summary. Also, see UTILITIES ERS, A-07957-60010-6, for a detailed description of the utility commands.

Initiate Diagnostic	yes
0 - self test	
1 - Random seeks	

5.0 INTERFACE REQUIREMENTS (cont'd)

5.3 REQUEST STATUS SUMMARY (cont'd)

Access Errors	
Illegal Parallel Operation (only support 1 unit)	no
Uninitialized Media (formatted at factory)	no
No Spares Available	yes
Not Ready	no
Write Protect	no
No Data Found	no
Unrecoverable Data Overflow	yes
Unrecoverable Data	yes
End of File (only for tapes)	no
End of Volume	yes
Information Errors	
Operator Request	no
Diagnostic Request (release not supported)	no
Internal Maintenance	no
Media Wear	yes
Latency Induced	no
Auto Sparing Invoked	yes
Recoverable Data Overflow	no
Marginal Data	yes
Recoverable Data	no
Maintenance Track Overflow	no

5.4 UTILITY COMMAND SUMMARY

```
No Execution Message
--------------------
Clear Logs  (run time/fault, error rate test)
Pattern Error Rate Test
Random Error Rate Test
Read Only Error Rate Test
Read Only Random Error Rate Test
Preset

Send Execution Message
----------------------
Read Fault Log
Read Run Time Log
Read Error Rate Test Log
Read Spare Table
Locate and Read Full Sector
Servo Test
Pattern Error Rate Test
Random Error Rate Test
Read Only Error Rate Test
Read Only Random Error Rate Test
Read ROM Revision Number
Read Defect List

Receive Execution Message
-------------------------
No commands are implemented for this option.
```

6.0 INDICATORS

6.1 CONTROLLER SELF TEST

The red and green LEDs, which comprise the front panel FAULT/ON LINE indicator, signal the operating status of the drive. When the drive is turned on, the Fault (red) and On Line (green) LEDs will both be on for about 2-3 seconds while the controller tests its own memory and the Medusa (HPIB Interface). If the controller self test fails, both LEDs will remain on. The drive will not attempt to come ON LINE.

If the controller self test passes, then the red LED is turned off, and the green LED is flashed, as self test establishes communication with the mechanism and attempts to do some seeks and read/write tests.

NOTE: If the mechanism is unable to spin up, there will be no index pulse to flash the green LED, so a misleading solid green will occur for approximately 1 minute until self test times out and fails.

6.2 MECHANISM SELF TEST

This second stage of self test (Fault LED is off and the On Line LED is flashing) normally requires 10-15 seconds to complete.

If mechanism self test passes, the Fault LED will remain off, and the On Line LED will be on. In general, the solid green LED indicates the drive is ready, and a flashing green LED indicates that the drive is active (i.e., processing a command).

If mechanism self test fails, the Fault LED will come on, and the On Line LED will go off. The drive will come ON LINE and the diagnostic result bit will be set. The green LED will flash when the drive responds to host commands, but will be off when the drive is idle (red remains on). It is very strongly recommended that the host not attempt to access data on the drive or issue commands to the drive if power-on self test has failed.

NOTE: Faults which occur during run time do not affect the Fault and On Line indicators.

When the diagnostic bit is set in status, P1-P6 are defined as follows:

P1 = most suspect FRA (1 = mechanism, 2 = controller)
P2 = next most suspect FRA (0 = none, 1 = mechanism, 2 = controller)
P3 = TERROR code (40H - 4FH)
P4-P6 = not used

7.0 OFFLINE UTILITIES

7.1 SCOPE:

The Falstaff III/Wile firmware set incorporates enhancements that allow field personnel to perform limited drive troubleshooting and maintenance without the need for an external host. These features are accessed with positions 8 and 9 on the drive's HPIB address switch. Initiation prompts and utility results are displayed on the drive's front panel LEDs. Refer to OFFLINE UTILITIES ERS, A-5959-3943-1 for details on accessing the utilities.

7.2 LOOPING SELF TEST:

This utility allows the user to place the drive in a mode where it executes the power-on selftest repetitively until cancelled or until a failure is detected. This is most useful for verifying intermittent failures on the controller PCA or in the disc mechanism.

7.3 OFFLINE MEDIA MAINTENANCE:

Offline media maintenance (or offline autosparing) is a utility that allows the user to perform write/read testing on the disc volume with automatic sparing of sectors that have media defects in them. Since this test destroys data on the disc, it is most useful for verification of drives at a site, before installation, after potentially rough shipment.

APPENDIX A

This appendix will attempt to describe the differences between the 795XA and 795XB/796XB controllers. The 795XB/796XB controller is the result of cost reduction efforts done on the 795XA controller, and consequently retains much of the same architecture.

A.1 DATA TRANSFER RATE

The multi-track transfer rate is reduced to 750 Kbytes per second, mainly due to the slower disc rotational speed and slower head switch times on Coyote.

A.2 CONTROLLER OVERHEAD

The controller overhead has been reduced by about 300 microseconds.

A.3 AUTOSPARING

Disc R/W error autosparing has been implemented.

A.4 SET OPTIONS COMPLEMENTARY

The Set options complementary is now supported. It allows the host to control the use of autosparing as well as whether or not Coyote's aggressive seeks are used during utilities. Note that aggressive seeks are always used during real time commands.

A.5 REQUEST STATUS

The Latency Induced bit is no longer used by the 795XB/796XB controller since the FIFO Data Lost error is considered fatal now.

The autosparing invoked bit is now active and is used to notify the host that autosparing took place.

A.6 HPIB IDENTIFY

The 795XB/796XB class of products will have a set of identify responses different from 795XA.