COS DCE BOOT FSW v1.13 Component Test Results
Requirement 5.1.1.5b Code in PROM

Date:	February 13, 2001
Document Number:	COS-03-0046
Revision:	Initial Release
Contract No.:	NAS5-98043
CDRL No.:	N/A

Prepared By: _____ _____
Tim Swanson, Software Test Engineer, Design_Net Eng. Date

Reviewed By: _____ _____
K. Brownsberger, COS Sr. Software Scientist, CU/CASA Date

Reviewed By: _____ _____
Grant Blue, COS Software & Operations Manager, BATC Date

Approved By: _____ _____
Barry Welsh, FUV Detector Program Manager. UCB Date

Approved By: _____ _____
John Andrews, COS Experiment Manager, CU/CASA Date

Center for Astrophysics & Space Astronomy
University of Colorado
Campus Box 593
Boulder, Colorado 80309

REVISIONS

Letter	ECO No.	Description	Check	Approved	Date
-		Initial Release			

Original Release Name	Date
Drawn: K. Brownsberger	2-13-01
Reviewed:	
Approved:	

THE UNIVERSITY OF COLORADO
At Boulder
The Center for Astrophysics and Space Astronomy

COS DCE BOOT FSW v1.13 Component Test Results
Requirement 5.1.1.5b Code in PROM

Size	Code Indent No.	Document No.	Rev
A		COS-03-0046	-
Scale: N/A			

Table of Contents

1. Introduction 2
1.1 Purpose 2
1.2 Scope 2
1.3 Limitations and Constraints 2
1.4 Procedure Overview 2
1.5 Theory of Test 3
1.6 Test Script Implementation 3
1.6.1 Test Script Arguments 3
2. Special Instructions 4
2.1 Quality Assurance 4
2.2 Safety 4
2.2.1 Personal Safety 4
2.2.2 Test Article and Equipment Safety 4
2.3 Contamination 4
3. Support Requirements 4
3.1 Personnel 4
3.2 Tools, Equipment, and Materials 5
3.3 Data/Software 5
3.4 Required Documentation 6
4. Procedure/Task Steps 6
4.1 Pre-Operation Activities 6
4.1.1 Make Sure that **hks** Tools Are Active 6
4.1.2 Make Sure that the Proper ROM Is Installed 6
4.1.3 Log In to the EGSE 6
4.1.4 Set Current Directory 6
4.1.5 Slogin as eagcos 7
4.1.6 Set Current Directory 7
4.1.7 Ensure that Proper Files are Present 7
4.2 Operation Execution 8
4.2.1 Establish Initial Test Conditions 8
4.2.2 Execute the Script 8
4.3 Post-Operation Activities 9
4.3.1 Copy Reports to PC Files and Print Them 9
4.3.2 Complete The Test Procedure Form 9

1. INTRODUCTION

1.1 PURPOSE

This document presents the Cosmic Origins Spectrograph (COS) Device Control Electronics (DCE) Flight Software (FSW) certification procedure. The purpose of this procedure is to verify that the FSW satisfies Software Requirements according to the method specified in the DCE FSW Test Plan (STP).

1.2 SCOPE

This test procedure comprises the steps necessary to verify that the FSW satisfies Software Requirements Document (SRD) paragraph 5.1.1.5 — Initialize to Boot State after Reset: verify that it processes interrupts.

1.3 LIMITATIONS AND CONSTRAINTS

This test cannot be run in parallel with any other commanding activity directed at the DCE FSW (such as, for example, the periodic transmission of NOOP commands). Test hardware shall be visually inspected, and its configuration noted, prior to conducting this test.

1.4 PROCEDURE OVERVIEW

The procedure requires the **hks** tools running on the Sun SparcStation Electronic Ground Support Equipment (EGSE) whose network IP address is one of

shorty.ssl.berkeley.edu
taiyo.ssl.berkeley.edu
ginger.ssl.berkeley.edu.

Test time shall be scheduled in advance. The Test Conductor must be logged into the Unix system as user **eagcos**, and be commanding from the appropriate directory. This directory contains both the test script file and the shell script file; these two files control test execution. The test is conducted by invoking the shell script. This shell script in turn invokes the Perl 5 program **UniScript.pl**, which resides in its own distinct directory. The test procedure steps have been pre-recorded in the test script file, and are executed interpretively by the **UniScript** program. The shell script and test script are attached to this document as appendices. As **UniScript** executes the test script it sends results to the operator console and to two report files, which are also placed in the current directory. After completion of the test script, the Test Conductor can certify successful test

execution by examining the contents of the report files and determining that required outputs are present in them. Printed copies of the report files are attached to the manually completed checklist (Paragraph 4 below) as documentation of the test.

1.5 THEORY OF TEST

It may be inferred from the fact that the Boot State FSW processes commands and returns HK data that the program processes interrupts, since these are interrupt-driven processes. Hence the test is essentially redundant if the above fact is taken into account. However, the test inspects the **EA** (enable all interrupts) bit in the Interrupt Enable (**IE**) Special Function 8051 Register (FSR). This bit should be set to 1, indicating that all interrupts are enabled; if it is, the test succeeds.

1.6 TEST SCRIPT IMPLEMENTATION

1.6.1 Test Script Arguments

The script is parameterized as shown in the following Table:

Table 1-1: Parameters/Arguments for stp5_1_1_1c.tst

Parameter	Meaning	Correct Argument for Version 1.13
#0	Absolute hex storage address of "scratch" buffer for special 8051 code	C000
#1	Absolute hex offset of **SLOT** byte from origin of scratch area	0013

These parameters must be encoded into the shell script **u** (see Appendix A).

The value of the **IE** 8051 SFR (address 0xA8 in 8051 "internal" memory) is not normally reported in HK; hence the test obtains this value by means of special 8051 machine code uploaded to a scratch area at location 0xC000. The **LFDGOTO** command is used to force execution of this special code. Once the code has executed (and returned control to FSW Boot State) the scratch area, into which the value of the **IE** register has been copied, is downloaded back to a **UniScript** buffer and inspected. Bit 7 (**EA**) of this byte should be 1. The special program is listed below:

```
C000 C0E0      PUSH ACC      ; save registers
C002 C083      PUSH DPH      ;  used in this
C004 C082      PUSH DPL      ;   code sequence
```

```
C006 90C013      MOV  DPTR,#SLOT ; set up location in scratch
C009 E5A8        MOV  A,0A8h     ; get contents of IE
C00B F0          MOVX @DPTR,A    ; move to scratch area
C00C D082        POP  DPL        ; restore
C00E D083        POP  DPH        ;   working
C010 D0E0        POP  ACC        ;     registers
C012 22          RET             ; return to DCE FSW
C013 00    SLOT: DB   0          ; slot for temporary storage of IE
```

2. SPECIAL INSTRUCTIONS

2.1 QUALITY ASSURANCE

QA support is required to verify the configuration and setup environment as well as monitoring test steps and verifying results.

2.2 SAFETY

2.2.1 Personal Safety

To ensure the safety of the test personnel during test execution the guidelines contained in Paragraph 3.4, Reference [1] will be adhered to.

2.2.2 Test Article and Equipment Safety

- If access within one (1) meter of COS bench electronics is necessary, wrist straps attached to technical ground shall be used by all personnel involved in handling of any COS test article. Overcurrent and overvoltage shall be set to remove power if nominal limits are exceeded.
- Emergency Power Shutdown — If, during the COS DCE FSW test, power is ON and a severe test equipment failure results in the power system exceeding specified limits, the Test Conductor shall direct or perform shutdown of power.

2.3 CONTAMINATION

All flight hardware shall be handled with clean latex gloves; it shall be covered with clean ESD material and/or stored in a clean flow-bench.

3. SUPPORT REQUIREMENTS

3.1 PERSONNEL

Execution of the COS DCE FSW certification procedure requires the following personnel (to be completed at the Test Readiness Review (TRR):

Test Director: _____

Test Conductor: _____

Test Technician: _____

QA: _____

3.2 TOOLS, EQUIPMENT, AND MATERIALS

The following is a list of tools, equipment, or materials required in this test. Record manufacturer and model, metrology, or property numbers of equipment used, where appropriate. Record calibration due dates where appropriate.

Boot Mode ROM: schematic **27C256**

Engineering Ground Support Equipment (see paragraph 1.4). Indicate specific configuration:

EGSE			DCE		
taiyo	**shorty**	**Ginger**	**ETU**	**DCE #1**	**DCE #2**
X				X	

3.3 DATA/SOFTWARE

The following files must be present:

Table 3-1: Required Program and Data Files

EGSE (shorty) Directory	File	Description
\disks\galex\users\galex\tcs\uniscript	**UniScript.pl**	**UniScript** interpreter
\disks\galex\users\galex\tcs\uniscript\stp5_1_1_5b	**u**	Shell script for this procedure
Ditto	**stp5_1_1_5b.tst**	Test script for this procedure (Appendix B)

In addition, the **hks** tools must be active. Directions for activating **hks** are given in UCB-COS-DOC-1118 (Paragraph 3.4, Reference [4]).

3.4 REQUIRED DOCUMENTATION

Reference	Document Number	Title
1	NHB 1700.1(V1-A)	*NASA Basic Safety Manual*
2	COS-03-0046	*DCE FSW Test Procedure 5.1.1.5b* (this document)
3	UCB-COS-008	*COS FUV Detector Software Test Plan*
4	UCB-COS-DOC-1118	*COS EGSE Startup Procedure*

4. PROCEDURE/TASK STEPS

4.1 PRE-OPERATION ACTIVITIES

4.1.1 Make Sure that **hks** Tools Are Active

Follow the procedure given in Paragraph 3.4, Reference [4].

4.1.2 Make Sure that the Proper ROM Is Installed

Visually verify that the ROM under test is installed: if EEPROM, in U18: if PROM, in U2 and U7.

4.1.3 Log In to the EGSE

Step	QA	Operator Entry/System Response	Description
1		C:\tcs\us> **telnet shorty.ssl.berkely.edu**	Establish connection to shorty via Telnet client program
2		Login: **xxx** Password: **-------**	Using telnet window, login as user **tcs**

4.1.4 Set Current Directory

Step	QA	Operator Entry/System Response	Description
3		tcs@shorty% **cd ~galex/tcs** tcs@shorty% **pwd** /disks/galex/users/galex/tcs	Change current directory as shown

4.1.5 Slogin as eagcos

Step	QA	Operator Entry/System Response	Description
4		tcs@shorty% **slogin –l eagcos shorty.ssl.berkeley.edu** eagcos@shorty.ssl.berkeley.edu's password: ***(get from SSL personnel)*** Last login: Sat Oct 7 10:41:05 2000 from auntem.ssl.berke Sun Microsystems Inc. SunOS 5.8 Generic February 2000 You have mail. COS EGSE software version: devel	slogin as **eagcos**; get password from SSL personnel

4.1.6 Set Current Directory

Step	QA	Operator Entry/System Response	Description
5		eagcos:shorty% **cd /disks/galex/users/galex/tcs/uniscript/stp5_1_1_1** eagcos:shorty% **pwd** /disks/galex/users/galex/tcs/uniscript/stp5_1_1_1	Change current directory as shown

4.1.7 Ensure that Proper Files are Present

Step	QA	Operator Entry/System Response	Description
6		eagcos@shorty% **ls –l** Total 12 -rw-r--r-- 1 tcs eag 1398 Oct 8 18:03 stp5_1_1_1b.tst -rw-r--r-- 1 tcs eag 62 Oct 9 17:44 u eagcos@shorty% **more < u** #!/bin/sh perl ../UniScript.pl stp5_1_1_1b "0,0,0,0,0,0,0,0"	List files; the **.tst** file and the shell script **u** should be present

4.2 OPERATION EXECUTION

4.2.1 Establish Initial Test Conditions

Step	QA	Operator Entry/System Response	Description
7		eagcos:shorty% **set path=($path ~dbb/scripts/bin)**	Set path as shown to enable access to hks tools

4.2.2 Execute the Script

Step	QA	Operator Entry/System Response	Description
8		**sh u** $pstring=C000,0013,0,0,0,0,0,0 Parameters are: Script File: stp5_1_1_5b #0: C000 #1: 0013 #2: 0 #3: 0 #4: 0 #5: 0 #6: 0 #7: 0 Report file >/disks/galex/users/galex/tcs/ver_1_13/stp5_1_1_5b/stp5_1_1_5b.rp1 successfully opened. Report file >/disks/galex/users/galex/tcs/ver_1_13/stp5_1_1_5b/stp5_1_1_5b.rp2 successfully opened. Script file /disks/galex/users/galex/tcs/ver_1_13/stp5_1_1_5b/stp5_1_1_5b.tst successfully opened at level 0.	Shell to **u**. You should see the accompanying output as **UniScript** executes

		"Uploading code to scratch area" LFDUPLOD SCRATCH,NBYTES,CRC1 "Sending LFDGOTO" LFDGOTO SCRATCH WAIT 0: HKV0=2; HKV1=42; wc=5 "Downloading scratch area" LFDDNLOD SCRATCH,NBYTES "Test 5.1.1.b completed successfully" eagcos:taiyo%	

4.3 POST-OPERATION ACTIVITIES

4.3.1 Copy Reports to PC Files and Print Them

Using an FTP client, copy the **u**, **stp5_1_1_1b.tst**, **stp5_1_1_1b.rp1**, and **stp5_1_1_1b.rp2** files to appropriate PC files. Include these files as Appendices A, B, C, and D with this completed form.

4.3.2 Complete The Test Procedure Form

Ensure that all blank fields in this report are completed correctly and submit the completed report to QA.

SUMMARY SHEET

OPERATION TITLE:_____ WOA#_____

TEST ARTICLES IDENTIFICATION (including serial and/or part numbers):

_____

TASKS/STEPS COMPLETED: _____

_____

LOCATION: _____

TEST STARTED: TEST TERMINATED

TIME: _____ Hr/Min TIME: _____ Hr/Min

DATE:_____ DATE:_____

LOGS USED: _____

ANOMALY REPORTS GENERATED: _____

_____

COMMENTS:_____

_____

_____

_____

_____

TEST CONDUCTOR: _____

Signature/Date

QA REPRESENTATIVE:_____

Signature/Date

Appendix A. Shell Script u

```
#!/bin/sh
pkill cosnoopy
perl ../UniScript.pl stp5_1_1_5b "C000,0013,0,0,0,0,0,0"
cosnoopy&
```

Appendix B. Test Script stp5_1_1_1b.tst

```
; ***************************************************
; * DCE FSW Requirement 5.1.1.5b -- Code in PROM     *
; * ----------------------------------------------- *
; * Verify that it services interrupts              *
; * ----------------------------------------------- *
; * Arguments: #0 = DCE "Scratch Area" = C000 in v1.07 *
; *            #1 = offset in Scratch Area of IE byte  *
; *               = 0x0013                          *
; ***************************************************
;
ECHO      2
;
SYM       SCRATCH=0x#0
SYM       NSEC   =5
SYM       OFFSET =0x#1
SYM       SLOT   =SCRATCH+OFFSET
SYM       NBYTES =OFFSET+1
;
; ************************************************************************
; * Acquire the value of the 8051 IE (Interrupt Enable) SFR.             *
; * -------------------------------------------------------------------- *
; * C000 C0E0         PUSH ACC        ; save registers                   *
; * C002 C083         PUSH DPH        ;   used in this                   *
; * C004 C082         PUSH DPL        ;     code sequence                *
; * C006 90C013       MOV  DPTR,#SLOT ; set up location in scratch       *
; * C009 E5A8         MOV  A,0A8h     ; get contents of IE               *
; * C00B F0           MOVX @DPTR,A    ; move to scratch area             *
; * C00C D082         POP  DPL        ; restore                          *
; * C00E D083         POP  DPH        ;   working                        *
; * C010 D0E0         POP  ACC        ;     registers                    *
; * C012 22           RET             ; return to DCE FSW                *
; * C013 00     SLOT: DB   0          ; slot for temporary storage of IE *
; ************************************************************************
;
DATA      1, 0,0,EMPTY
DATA      1, 0,7,CONST=0xC0E0_C083_C082_90
DATA      1, 7,2,CONST=SLOT
DATA      1, 9,2,CONST=0xE5A8
DATA      1,11,9,CONST=0xF0_D082_D083_D0E0_22_00
;
LOG       1,1
;
; *****************************************
; * Upload IE-extraction code to scratch area *
; *****************************************
;
DTG       3,"(0) Uploading code to scratch area"
WTO       "Uploading code to scratch area"
;
XMIT      1,NBYTES
LFDUPLOD  SCRATCH,NBYTES,CRC1
WAIT      1
;
; ****************
; * Execute code *
; ****************
;
DTG       3,"(1) Sending LFDGOTO"
WTO       "Sending LFDGOTO"
;
LFDGOTO   SCRATCH
WAIT      NSEC,HK
;
; ***********************************
; * Download code area with IE value *
; ***********************************
;
```

```
DTG       3,"(2) Downloading scratch area"
WTO       "Downloading scratch area"
;
LFDDNLOD  SCRATCH,NBYTES
RECV      2,0,NBYTES
LOG       1,2
;
; ***************
; * Test EA bit *
; ***************
;
CHECK     1,(($ie = hex(substr($B2,2*hex('#1'),2))) & hex("80")) != 0)
DTG       3,"(3) Test 5.1.1.b completed successfully"
WTO       "Test 5.1.1.b completed successfully"
```

Appendix C. Test Report stp5_1_1_1b.rp1

```
                                    55555          1           1          55555
                                    5             11          11          5
                     ssss  ttttt  pppp   555            1           1          555
bbbb
                    s        t    p   p     5           1           1             5
b   b
                    sssss    t    pppp       5          1           1              5
bbbb
                        s    t    p      5   5          1           1          5   5
b   b
                    ssss     t    p       555   _____   111   _____   111   _____   555
bbbb

Len  CRC  Buffer         Data
---- ---- ------         ----
0014 8ECC 1              C0 E0 C0 83 C0 82 90 C0 13 E5 A8 F0 D0 82 D0 83 D0 E0 22 00

Ver 01.13  Tue Jan 16 14:33:51 2001    "(0) Uploading code to scratch area"

LFDUPLOD  SCRATCH,NBYTES,CRC1

Ver 01.13  Tue Jan 16 14:33:53 2001    "(1) Sending LFDGOTO"

LFDGOTO   SCRATCH

Ver 01.13  Tue Jan 16 14:33:53 2001    "(2) Downloading scratch area"

LFDDNLOD  SCRATCH,NBYTES

Len  CRC  Buffer         Data
---- ---- ------         ----
0014 6FA3 2              C0 E0 C0 83 C0 82 90 C0 13 E5 A8 F0 D0 82 D0 83 D0 E0 22 87

CHECK:   (($ie = hex(substr($B2,2*hex('0013'),2))) & hex("80")) != 0)
eval:    (((0000 = hex(substr(C0E0...,2*hex('0013'),2))) & hex("80")) != 0)

S U C C E S S

Ver 01.13  Tue Jan 16 14:33:53 2001    "(3) Test 5.1.1.b completed successfully"
```

Appendix D. Test Report stp5_1_1_1b.rp2

```
                                    55555          1            1           55555
                                    5             11           11           5
                     ssss  ttttt  pppp   555            1            1           555
bbbb
                    s        t    p   p     5           1            1              5
b   b
                    sssss    t    pppp       5          1            1               5
bbbb
                        s    t    p      5   5          1            1           5   5
b   b
                    ssss     t    p       555   _____   111   _____   111   _____   555
bbbb

Ver 01.13  Tue Jan 16 14:33:51 2001    "(0) Uploading code to scratch area"

------------------------------------------------------------------------
                      U P L O A D   P A C K E T
------------------------------------------------------------------------
0040E0C0 004283C0 004482C0 0046C090 0048E513 004AF0A8 004C82D0 004E83D0
0050E0D0 00520022
------------------------------------------------------------------------

------------------------------------------------------------------------------------------
                               C O M M A N D   P A C K E T
------------------------------------------------------------------------------------------
            PARM4             PARM3             PARM2             PARM1             PARM0
045AFFFF 04580000 0456FFFF 04540000 04527133 04508ECC 044EFFEB 044C0014 044A3FFF 0448C000
------------------------------------------------------------------------------------------
               SN            OPCODE
0446FFFE 04440001 04425252 0440ADAD
------------------------------------------------------------------------------------------


Ver 01.13  Tue Jan 16 14:33:53 2001    "(1) Sending LFDGOTO"

------------------------------------------------------------------------------------------
                               C O M M A N D   P A C K E T
------------------------------------------------------------------------------------------
            PARM4             PARM3             PARM2             PARM1             PARM0
045AFFFF 04580000 0456FFFF 04540000 0452FFFF 04500000 044EFFFF 044C0000 044A3FFF 0448C000
------------------------------------------------------------------------------------------
               SN            OPCODE
0446FFFD 04440002 04421515 0440EAEA
------------------------------------------------------------------------------------------


Ver 01.13  Tue Jan 16 14:33:53 2001    "(2) Downloading scratch area"

------------------------------------------------------------------------------------------
                               C O M M A N D   P A C K E T
------------------------------------------------------------------------------------------
            PARM4             PARM3             PARM2             PARM1             PARM0
045AFFFF 04580000 0456FFFF 04540000 0452FFFF 04500000 044EFFEB 044C0014 044A3FFF 0448C000
------------------------------------------------------------------------------------------
               SN            OPCODE
0446FFFC 04440003 04425151 0440AEAE
------------------------------------------------------------------------------------------


Ver 01.13  Tue Jan 16 14:33:53 2001    "(3) Test 5.1.1.b completed successfully"
```