MOOG

July 12, 2013

Mr. George Haralampopoulo
National Transportation Safety Board
Via: E-mail ███████████████████████

Subject: Investigation of SCU 233700-109 S/N 0270 (HBC PN: 390-384011-0019)

Accident Description Provided:

On February 20, 2013, a Hawker Beechcraft model 390 Premier 1A business jet, registered N777VG, was destroyed in a landing accident at Thomson-McDuffie County Airport, GA, USA

This report describes the information download from the Spoiler Control Unit (SCU) 233700-109 S/N 0270 NV RAM memory IC chip component that was involved in the accident and delivered to Moog Aircraft on June 10, 2013.

Information and Instructions Provided to Moog:

- On 5/1/13 the NTSB sent Moog a picture of the burned SCU unit. Moog provided a response that the data recovery depended on the internal conditions.
- On 5/20/13 the NTSB contacted Moog and sent pictures of the internal cards removed from the unit. Moog did not know they were going to open the unit and remove the boards.
- On 5/20/13 Moog provided a pictorial description of the location of the NV RAM memory data chip U3 on BIT / Diagnostics board PN: 233498-001) and requested additional pictures to determine its condition.
- On 5/21/13 the NTSB notified Moog that the U3 memory chip was removed. Moog did not know the NTSB was going to remove the chip.
- On 5/22/13 the NTSB determined they would like Moog to mate the removed chip to an engineering asset board and attempt data download. The NTSB has been advised that while the chip is in good condition it could still be damaged and data recovery impossible.
- The NTSB planned to send Moog the chip on or about 5/31/13 and be on site at Moog to witness the mounting and download.

Following are pictures taken by NTSB:

SCU S/N: 0270
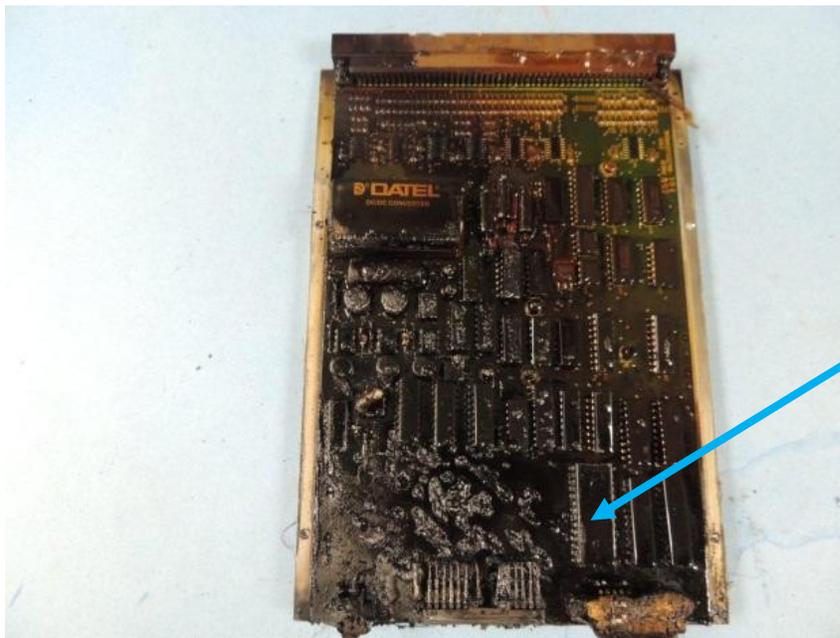
U3 – NV RAM
memory chip

BIT / Diagnostics Board PN: 233498-001 from SCU S/N: 0270

Actions Performed at Moog:

George Haralampopoulo arrived at Moog on 06/10/2013 with the U3 NV RAM memory chip. The BIT / Diagnostics Board PN: 233498-001 from SCU S/N: 0270 was not returned to Moog.

The chip was brought into Moog Aircraft Plant 6 production area (ESD controlled) and was installed onto an engineering asset circuit board (PN: 233498-001) for download of the NV RAM information.

The engineering asset BIT / Diagnostics board (PN: 233498-001) with the U3 chip from SCU S/N: 0270 were installed in an engineering asset Premier SCU and using the NVRAM downloader per the AVO 003843 Rev. 2 procedure, the NV RAM codes were viewed.

Below is the screen capture taken from the "Premier 1 Viewer" used to view the last 250 fault codes recorded.

> **Note:** The Premier 1 Viewer is an engineering test and development tool used as a troubleshooting and fault isolation aide and is not used during normal maintenance activity. This tool will display information not seen on the unit display.

S/N 0270 (last 20 codes are displayed)
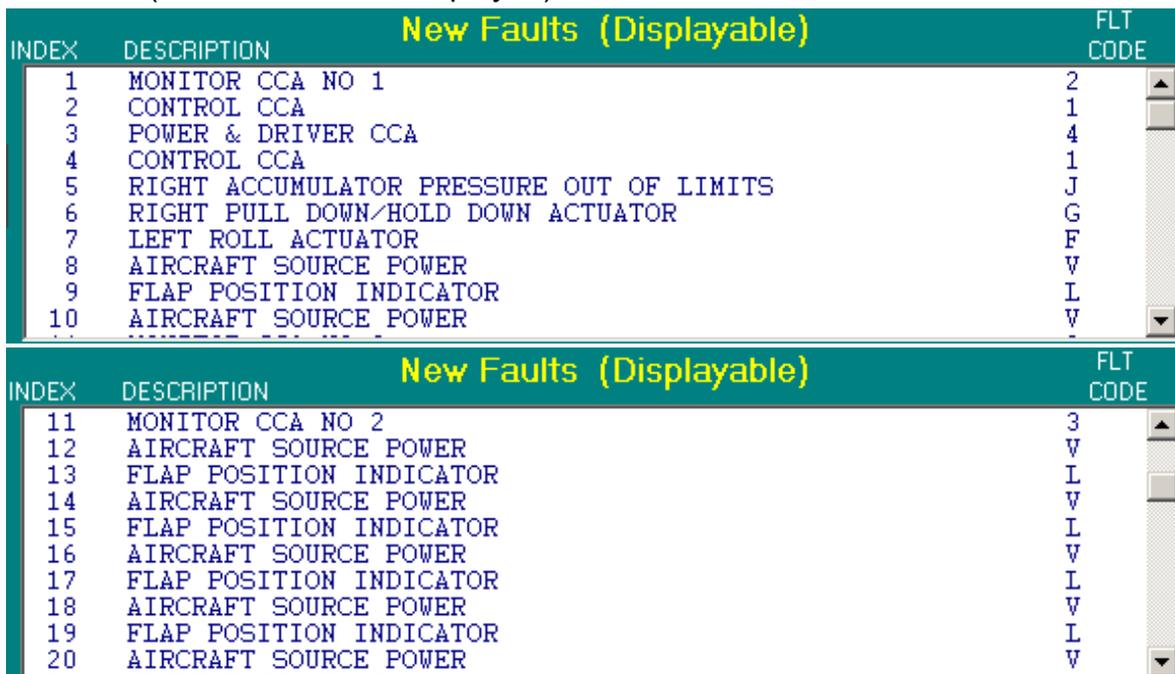
INDEX	DESCRIPTION	FLT CODE
	New Faults (Displayable)	
1	MONITOR CCA NO 1	2
2	CONTROL CCA	1
3	POWER & DRIVER CCA	4
4	CONTROL CCA	1
5	RIGHT ACCUMULATOR PRESSURE OUT OF LIMITS	J
6	RIGHT PULL DOWN/HOLD DOWN ACTUATOR	G
7	LEFT ROLL ACTUATOR	F
8	AIRCRAFT SOURCE POWER	V
9	FLAP POSITION INDICATOR	L
10	AIRCRAFT SOURCE POWER	V

INDEX	DESCRIPTION	FLT CODE
	New Faults (Displayable)	
11	MONITOR CCA NO 2	3
12	AIRCRAFT SOURCE POWER	V
13	FLAP POSITION INDICATOR	L
14	AIRCRAFT SOURCE POWER	V
15	FLAP POSITION INDICATOR	L
16	AIRCRAFT SOURCE POWER	V
17	FLAP POSITION INDICATOR	L
18	AIRCRAFT SOURCE POWER	V
19	FLAP POSITION INDICATOR	L
20	AIRCRAFT SOURCE POWER	V

The remaining 250 codes were repeats of L and V in the same pattern.

Fault codes are recorded in descending order. The most recent recorded fault is number 1. It is not clear when these events occurred. The SCU does not receive or supply time and date information, therefore it is uncertain if these events were logged before, during or after the accident.

Fault data are displayed as a single digit code that identifies the faulty LRU. The single digit code is identified in Table below. Diagnostics is capable of isolating a fault to any one of the components listed in Table below. If more than one fault exists, fault codes will be displayed as a series string of up to eight codes.

FAULT CODE	LRU
A	**Control Wheel RVDT B**. This means that the pilot's control wheel sensor, rigging or wiring may be faulty.
B	**Control Wheel RVDT A**. This means that the copilot's control wheel sensor or wiring may be faulty.
C	**Right Midboard Panel LVDT**. The right midboard panel wiring, LVDT (sensor) or rigging may be faulty.
D	**Left Midboard Panel LVDT**. The left midboard panel wiring, LVDT (sensor) or rigging may be faulty.
E	**Right Roll Actuator**. This fault indicates a problem with the actuator. It could be the LVDT (sensor) that is internal to the actuator or some other wiring problem.
F	**Left Roll Actuator**. This fault indicates a problem with the actuator. It could be the LVDT (sensor) that is internal to the actuator or some other wiring problem.
G	**Right Pull-down/Hold-down Actuator**. This fault indicates a possible fault in the down-and-lock switch, wiring, or the down-and-lock actuator itself.
H	**Left Pull-down/Hold-down Actuator**. This fault indicates a possible fault in the down-and-lock switch, wiring or the down-and-lock actuator itself.
I	**Hydraulic Control Unit**. This fault could be caused by many malfunctions but indicates something is wrong with the hydraulic control unit, a signal going into the unit, or a portion of the wiring is faulty or disconnected.
J	**Right Pneumatic Pressure Out-of-Limits**. This fault indicates over or under-charged pneumatic pressure in the blowdown actuator, a faulty pressure sensor, or faulty wiring. There may also be a leak in the actuator assembly if pneumatic pressure continues to bleed off.

FAULT CODE	LRU
K	**Left Pneumatic Pressure Out-of-Limits**. This fault indicates over or under-charged pneumatic pressure in the blowdown actuator, a faulty pressure sensor, or faulty wiring. There may also be a leak in the actuator assembly if pneumatic pressure continues to bleed off.
L	**Flap Position Indicator**. This is a signal from the flap control system and indicates flap position. Faulty wiring or potentially a fault in the flap control system is the likely causes of this fault.
M	**Right Weight on Wheels (WOW) Switch**. This fault can be caused by faulty rigging, wiring or a defective switch.
N	**Left WOW Switch**. Faulty rigging, wiring or a defective switch can cause this fault.
O	**Right Throttle at Idle Switch**. Faulty wiring or a defective switch can cause this fault.
P	**Left Throttle at Idle Switch**. Faulty wiring or a defective switch can cause this fault.
Q	**Right Throttle at Power Switch**. Faulty wiring or a defective switch can cause this fault.
R	**Left Throttle at Power Switch**. Faulty wiring or a defective switch can cause this fault.
S	**Speed Brake Switch**. Faulty wiring or a defective switch can cause this fault.
T	**Right Inboard Panel Stow Switch**. Faulty wiring, rigging or a defective switch can cause this fault.
U	**Left Inboard Panel Stow Switch**. Faulty wiring, rigging or a defective switch can cause this fault.
V	**Aircraft Power**. This fault indicates an aircraft low or high voltage situation. This can be caused by a low battery condition and may occur during engine starts. If a problem exists with aircraft's power system, this fault will likely occur.
1	**Control CCA**. This fault indicates a potentially faulty Control CCA in the SCU. All other potential faults should be ruled out before SCU replacement is attempted.
2	**Monitor CCA No. 1**. This fault indicates a potentially faulty Monitor 1 CCA in the SCU. All other potential faults should be ruled out before SCU replacement is attempted.

FAULT CODE	LRU
3	**Monitor CCA No. 2**. This fault indicates a potentially faulty Monitor 2 CCA in the SCU. All other potential faults should be ruled out before SCU replacement is attempted.
4	**Power and Driver CCA**. This fault indicates a potentially faulty power and driver CCA in the SCU. All other potential faults should be ruled out before SCU replacement is attempted.
5	**BIT and Diagnostics CCA**. This fault indicates a faulty condition in the BIT and diagnostics card. It is likely that if the cycling power on the SCU does not clear the problem, it is faulty.
9	**Unknown Monitor Fault**. No specific cause of the monitor fault could be isolated. If there are no system anomalies, this may be a spurious fault with no action needed.

Conclusions:

Based on the codes reported, it is difficult to determine sequence of events before and during the accident.

See Appendix A attached, for the AVO 003843 Rev. 2 procedure used.

The original New Build Record and previous maintenance history for SCU (S/N 0270 is available from Moog upon request.

John Pioli
Moog Sr. Quality Engineer

CC: Brian Webber, HBC

Appendix A
AVO 003843 Rev. 2

AVO #:AVO003843

DATE: <u>April 29, 2013</u>

Revision: 2

AVO

*Avoid
Verbal
Orders*

MOOG Inc.

FROM: **Michael Voigt**
TO: **Dept 143, Premier**
SUBJECT: **233700 NV RAM Download**
REFERENCE: **MRM12494 Software User's Manual**

PURPOSE: Procedure for NV RAM downloads

SCOPE: OEM and Aftermarket NV RAM download

1.0 Download requires a CA21072-001 test stand(See figure 1), Test Set Assembly, and Load Assembly (See figure 2). While in proximity to the test equipment, remove the front cover on the unit for NV RAM Download and connect the communications cable to the RS232 port in the SCU.

Figure 1 – Premier Test Stand CA21072-001	Figure 2 – Test Set Assembly (top right) CA27781-001 Test Set Load (bottom right) CA27787-001 Premier SCU 233700 unit under test (Left)

Communications Cable

2.0 On the Premier test stand. Open the Premier 1 Viewer program by selecting the icon shown in Figure 5. Once open select the fault listing tab on the bottom as shown in Figure 6. Prior to proceeding to step 4.0 assure that the "Freeze Data" button says "Freeze Data". If it does not toggle the status of the button to "Freeze Data".
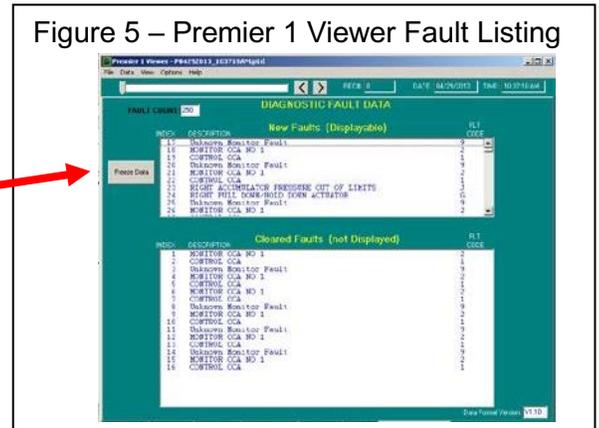
Figure 3

Freeze
Data
Button

Figure 5 – Premier 1 Viewer Fault Listing

3.0 On the Premier test stand. Open the Premier 1 test system.exe program by selecting the icon shown in Figure 3. There is no password and when in the sequence. Select and run the manual sequence.
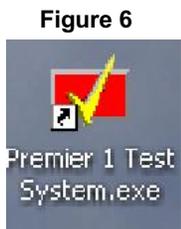
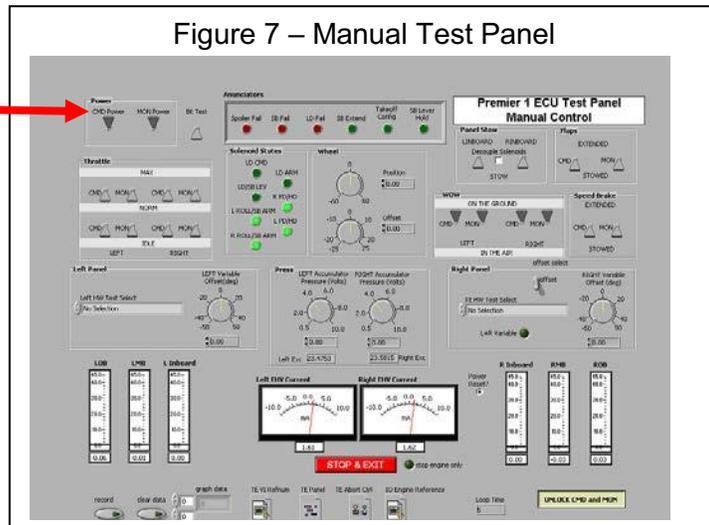**Figure 6**

CMD and Mon
power switches
(step 4)

Figure 7 – Manual Test Panel

4.0 On the manual test panel assert the CMD Power and Mon Power switches up as shown in Figure 7.

5.0 Press and hold the toggle switch on the SCU as shown in Figure 8 to dump the NV RAM data. Hold this button till the NV RAM records in the Premier fault viewer (Figure 5) meets or exceeds 250 records. This can take several minutes.

Figure 8 – NV RAM Download
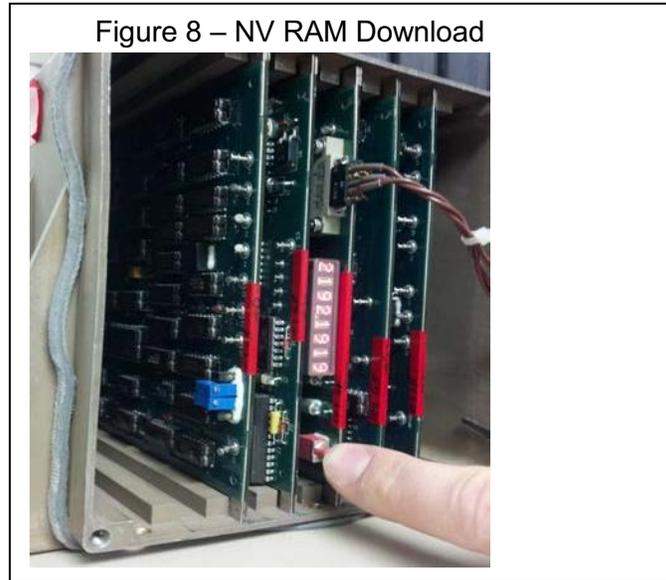
6.0 Once the NV RAM fails have completed downloading (250+ records). Record the data by selecting the data drop down and select "Record Data". Wait 10 seconds and select the data drop down again and select "End Recording".

Figure 9 - Record NV RAM Data
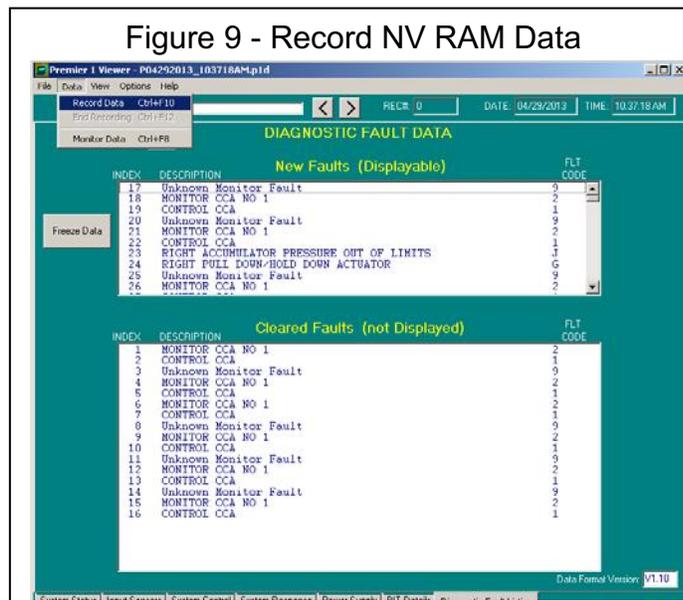
7.0 The NV Ram download can be loaded back into the Premier 1 Viewer by selecting the file drop down and selecting open log.