

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

April 11, 2016

Onboard Image Recorder

Specialist's Factual Report
By Sean Payne

1. EVENT

Location:	Frisco, Colorado
Date:	July 3, 2015
Aircraft:	Airbus Helicopter AS 350 B3E, N390LG
Operator:	Air Methods Corporation
NTSB Number:	CEN15MA290

2. SUMMARY

On July 3, 2015, at 1339 mountain daylight time, an Airbus Helicopter Inc. (formerly American Eurocopter) AS 350 B3e helicopter, N390LG, impacted the upper west parking lot 360 feet southwest of the Summit Medical Center helipad (91CO), Frisco, Colorado. A post-impact fire ensued. Visual meteorological conditions prevailed at the time of the accident. The helicopter was registered to and operated by Air Methods Corp., and the flight was conducted under the provisions of 14 *Code of Federal Regulations* Part 135 on a company flight plan. The airline transport pilot was fatally injured and two flight nurses were seriously injured. The public relations flight was en route to Gypsum, Colorado.

3. DETAILS OF INVESTIGATION

On July 8, 2015, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following device:

Recorder Manufacturer/Model:	Appareo Vision 1000
Recorder Serial Number:	VIS-FF96

3.1. Recorder Description

The Appareo Vision 1000 device is a small self-contained image, audio, and data recorder. The unit is typically mounted in the overhead of aircraft's cockpit and records a cockpit image at a rate of four times per second. In addition to cockpit images, the device is also capable of recording two tracks of audio that is synchronized with the image data. The unit also contains a GPS receiver that receives GPS satellite based aircraft time, position, altitude and speed. In addition to the GPS position, the Appareo unit also has a self-contained real-time

inertial measuring unit that provides 3-axis accelerations as well as aircraft pitch, roll and yaw data.

The two recorded audio tracks can be wired to record the following inputs: an external audio source such as the aircraft's intercom or radios and audio picked up by a microphone mounted internal to the Vision 1000 unit. In this installation no external aircraft audio was connected to track one and the track two microphone only picked up very loud engine and or transmission sounds from the helicopter.

The Appareo unit records the image, audio and parametric data on a removable SD¹ memory card that is inserted into the unit. This removable memory retains approximately the last two hours of image and audio data and about the last 100 hours of parametric data. In addition to the removable memory the Vision 1000 is also equipped with a crash and fire resistant memory module that is mounted internal to the unit. This internal memory contains an exact duplicate of the data stored on the removable card.

The Appareo unit on this aircraft is connected to the aircraft's battery through the master battery switch. Anytime the battery switch is turned on the Appareo unit will start to record audio, images and data. The Vision 1000 unit creates a new file for every electrical power application.

3.2. Recorder Damage

Upon arrival at the NTSB Vehicle Recorder Division, it was evident that the Appareo Vision 1000 had sustained extensive heat damage (figure 1). The device was shipped attached to the installed mounting bracket. The front and rear of the device was identified. The unit's externally removable SD memory card was located and removed from the device (figure 2). The SD card's external packaging was dislocated from the silicon memory device. The silicon memory device was cracked and fractured throughout. Due to the fracture damage of the silicon memory device, data recovery was determined to be impossible.

The unit's internally protected non-volatile memory² (NVM) was then located and removed from the device. Figure 3 shows the front and rear of the internally protected NVM memory chip housing. The two NVM chips were then removed from the internal memory device chassis (figure 4). The two NVM chips were then cleaned and photographed under an optical microscope (figure 5). The first NVM chip (NVM chip #1) exhibited bubbling and a crack along the chip's plastic packaging surface (figure 6). The second chip (NVM chip #2) exhibited heavy bubbling in the chip's plastic packaging surface (figure 7).

Furthermore, both NVM chips were examined using x-ray microscopy methods. NVM chip #1 x-ray image revealed a region of broken bond wires in the upper left hand portion of the chip (Figure 8). NVM chip #2 was x-rayed and revealed no visible defects (Figure 9).

¹ SD – Secure Digital – A type of nonvolatile memory card used extensively in portable devices.

² Non-volatile Memory – NVM – Semi-conductor memory that does not need power to retain electronic data.



Figure 1. The arrival condition of the Appareo Vision 1000.

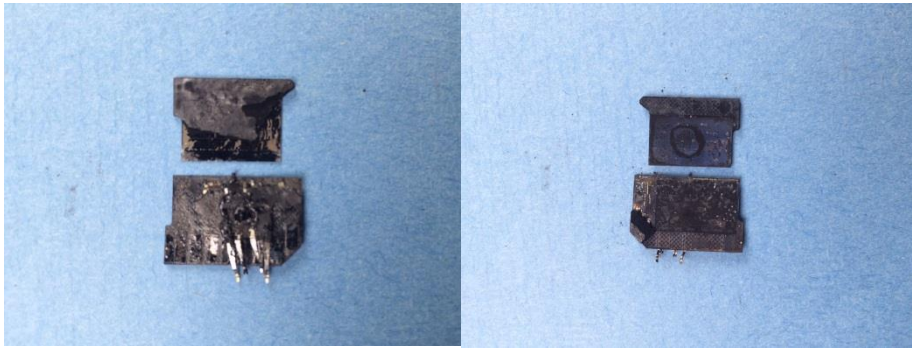


Figure 2. The remains of the SD card packaging and silicon memory device. The front (left) and back (right) of the SD card are pictured.



Figure 3. The front (left) and rear (right) of the internally mounted NVM chassis.

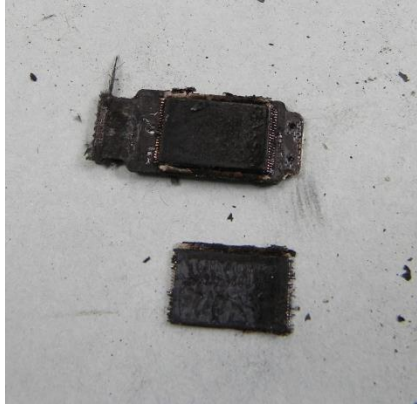


Figure 4. The two individual NVM chips separated from the chassis.



Figure 5. The two individual internal NVM chips after removal and cleaning.

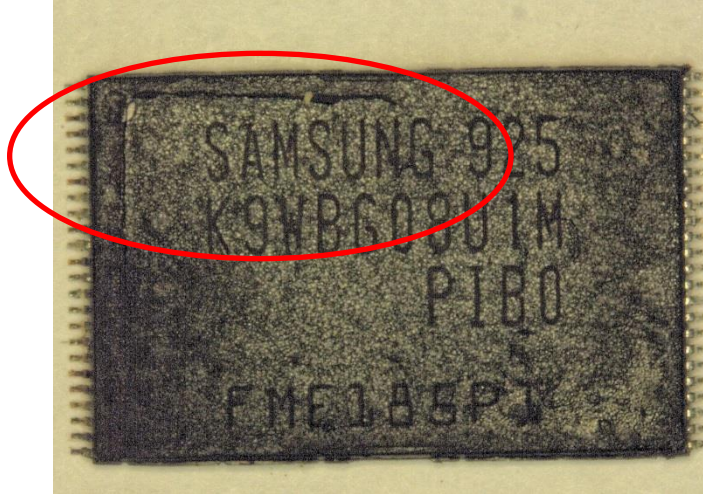


Figure 6. Bubbling and a crack along NVM chip 1's surface indicative of high temperature heat damage.



Figure 7. Bubbling along NVM chip 2's surface indicative of high temperature heat damage.

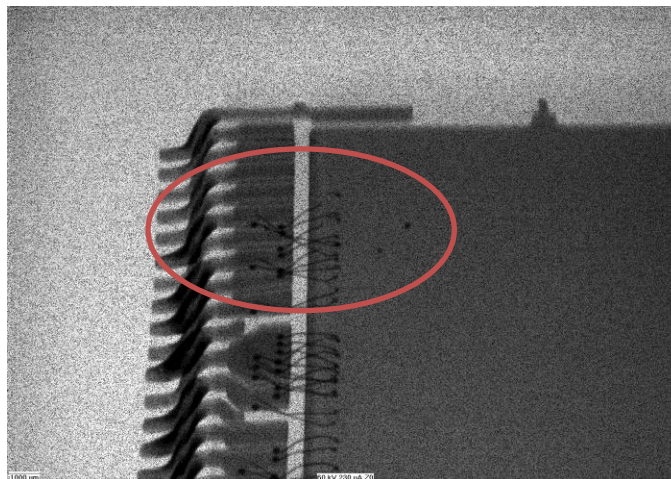


Figure 8. A top down x-ray of NVM chip 1 showing visible defects in the region of attachment of the chip's bond wires.

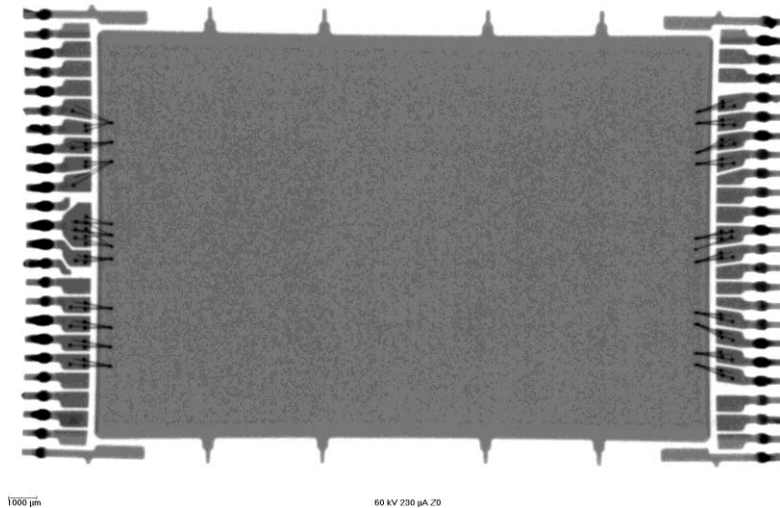


Figure 9. No visible bond wire damage was detected in this x-ray of NVM chip #2.

A binary readout attempt of internal NVM chip #2 from the device was performed in the laboratory using the appropriate type socket for this type of NVM chip. Upon readout, an error message displayed which is typically associated with failures due to unquantified internal damage to the chip. No further attempts were made to read either NVM chip #1 or #2.

All NVM chips discussed in this report were supplied to the Integrated Electronics Engineering Center (IEEC) at Binghamton University. A report was supplied that characterized the likelihood of recovery of each individual chip as poor. The report recommended NVM chip #2 (referred to in the IEEC report as “package 6-2”) was “worth an attempt at data recovery.” As noted in the results above, “package 6-2” (NVM chip #2) failed binary data recovery efforts. The IEEC report can be found in the public docket for this accident as Attachment 1 to the Onboard Image Recorder Factual Report.

Additionally, NVM chip #2, referred to as “package 2” in the IEEC report, was sent back to The Small Scale Systems Integration and Packaging Center at the IEEC lab at SUNY Binghamton. An additional report, Attachment 2, was prepared that covers the damage to this memory chip in detail. The report characterizes the nature of the damage as extensive, the most severe damage having likely been a result of the chip’s exposure to high temperature fire.

3.3. Video/Data Files

No electronic files were extracted from the device.