

# Technical document

## VEMD and DECU examination

concerning the accident on  
**5 January, 2006 at Maui (Hawai)**  
to the helicopter EC130B4  
registered N11QD



# Foreword

*This document contains technical information that is the property of the manufacturer of the equipment. Technical information and photographs in this document are intended only to explain the various phases of the examination and should not be used in any way other than for the purposes of this technical investigation.*

***Note: The onboard computer equipment mentioned in this report functions as a maintenance database and not as a flight recorder.***

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# Glossary

**Aluminium wire :** The wire used to make a physical connection from the device to the leadframe.

**Application software:** this software drives the fuel flow through the input/output and regulation laws.

**DECU :** Digital Engine Control Unit.

**Die :** An individual rectangular pattern on a wafer that contains circuitry to perform a specific function. The internal circuitry is made of thousands of tiny electronic parts. 'Die' refers to a semiconductor component or part that has not yet been packaged.

**Die pad :** Square metallic pads on the die where the ball bond is attached. The bond pad is used to find acceptable eye points.

**Floating gate :** In Silicon Gate MOS technology: a gate that is insulated from the rest of the circuit by a dielectric. Used in Flash memories.


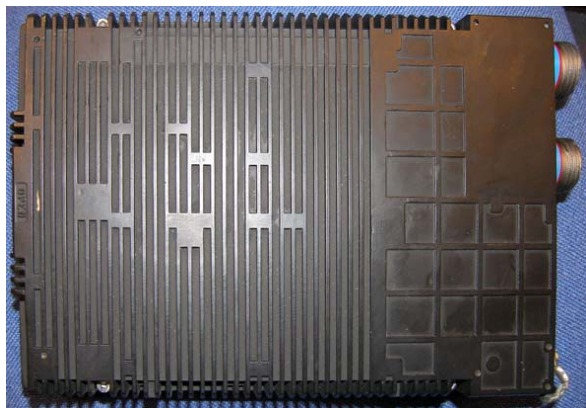
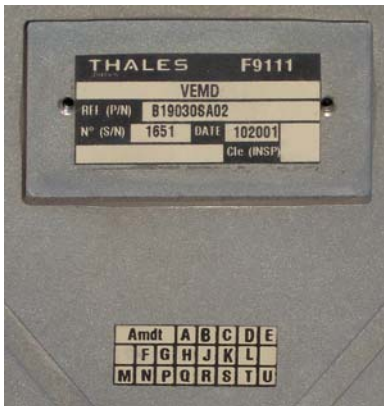

**Leadframe :** A metal structure that is part of the device. The die is attached to the leadframe.

**Metallization :** Refers to the metal layers that electrically interconnect the various device structures fabricated on the silicon substrate.

**Operating software:** this software functions as an operating system. It manages DECU general functioning. It controls input/output and monitors the application software.

**VEMD :** Vehicle and Engine Management Display.

# Equipment

VEMD	DECU
	
	
THALES	SEXTANT AVIONICS
B19030SA02	70BMF01000
1651	1075
Av1	Av2
C19184QD05	C19184RD05
2800	2813
EEPROM 32Kbyte AT28HC256-12JI 0042	EEPROM 32Kbyte AT28HC256-12JI 0014
Opening, memory unsoldering and reading	Opening, memory unsoldering x-ray inspection, decapsulation and optical examination
2 x 32 Kbyte raw data	None

## **1 - SUMMARY**

### **1.1 Circumstances**

On January 5, 2006, about 0945 Hawaiian standard time, a Eurocopter EC130B4 (ECO-star), registered N11QD, experienced a loss of main rotor RPM and made a hard forced landing in Honokohau Valley, near Lahaina, Hawaiï.

### **1.2 Purpose of the examination**

A DECU (Digital Engine Control Unit) and a VEMD (Vehicle and Engine Management Display) were removed from the helicopter registered N11QD.

The VEMD was brought to the BEA electronics laboratory to study the possibility of recovering the data that might still be stored on it. The examination was performed the 24 January, 2006.

The DECU was brought to Turbomeca in Bordes facilities to download the data. The examination was performed on 16 February, 2006 with the BEA accredited representative and with Mr Marquié from Turbomeca.

### **1.3 Synthesis**

Flight duration recorded by the VEMD was 13 minutes 18.5 seconds.

Powering on duration recorded by the DECU was 14 minutes 21 seconds.

Neither failures nor over-limits were recorded by the VEMD.

A single failure block was recorded by the DECU.

3 electrical failures were recorded in this block.

“NG cycles” (Generator) and “NF cycles” (Free Turbine) were not recorded for this flight by the VEMD because the recording process was interrupted before the end of the flight.

Power discret input selector failures were recorded 10 times in the whole DECU record. The previous selector failure was recorded in the DECU, counter number 6582, identified as the VEMD flight number 2804. The recorded duration of this flight was 87 seconds.

The VEMD and DECU data analysis seems to indicate that the failures recorded by the DECU occurred simultaneously with the VEMD power supply loss.

It should be interesting to know:

- whether the power supply was shutdown before or just before the impact,
- what was the maintenance action after the VEMD flight number 2804.

A CD-Rom containing the following data accompanies this document:

Both raw VEMD data files in binary format:

- ✓ N11QD\_EEPROM\_AV2\_0014.bin
- ✓ N11QD\_EEPROM\_AV2\_0042.bin

Decoded data in HTML format:

- ✓ "header.htm"
- ✓ "failure\_report.htm"
- ✓ "flight\_report.htm"
- ✓ "check\_engine.htm"

DECU decoded data in text format:

- ✓ Prm1075a.dmp
- ✓ Prm1075b.dmp

Readout report in pdf format.

- ✓ N11QD\_VEMD\_DECU\_Report.pdf

## 2 – VEMD EXAMINATION DETAILS

### 2.1 Technical information

The VEMD is installed on the instrument panel and designed to manage essential and non-essential vehicle and engine data. It manages:

- the display of vehicle parameters,
- the display of engine parameters,
- the computation and display of engine first limitation,
- the fail management procedures,
- the computation and display of weight related to performance data,
- the computation and display of the number of engine cycles.

It has four independent modes:

- INIT
- OPERATIONAL
- CONFIGURATION
- MAINTENANCE

**Note:** the last two modes are auxiliary modes, enabled only when the helicopter is on the ground.

### 2.2 External inspection and opening process

The VEMD was in good external condition.

The VEMD was opened to remove the two electronic boards containing both EEPROM memories.

A mechanical opening was performed to remove the two electronic boards containing both EEPROM memories.

Then an unsoldering process with temperature monitoring was performed to remove the memories.

### 2.2 Readout process

Readout was performed to download the memory raw data contained in the two EEPROM memories using a dedicated memory reader. Two binary files were extracted for the decoding process: N11QD\_EEPROM\_AV2\_0014.bin and N11QD\_EEPROM\_AV2\_0042.bin.

### 2.3 Data decoding process

**The VEMD is designed to store maintenance data. The interpretation of retrieved data for accident investigation requires precise knowledge of the failure code designed by the manufacturer.**

The decoding process was performed with the decoding grids produced by the manufacturer and using dedicated software developed at the BEA.

The areas relating to the presumed event flight were extracted and provided in appendix.



## Memory mapping :

The VEMD contains two modules: AV-1 Module and AV-2 Module. Each module contains a 32 Kbyte EEPROM (non volatile memory) reserved for DATA and FAILURE storage. Four blocks are defined in each memory:

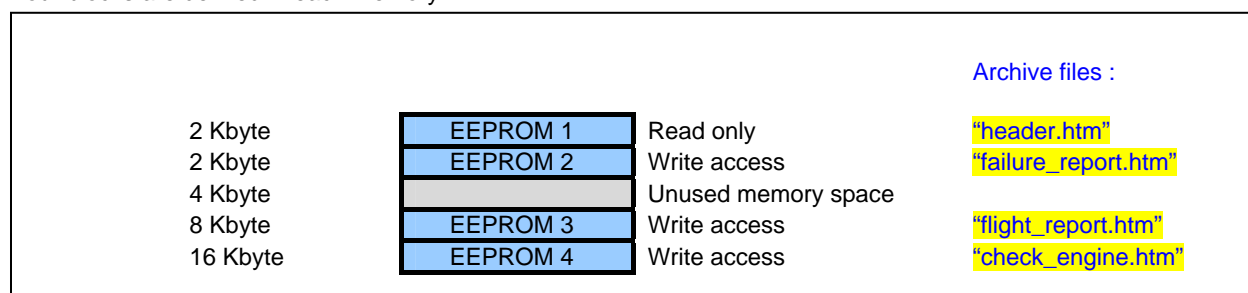


Figure 1: EEPROM mapping

- **EEPROM 1** is configured once and for all before equipment or module delivery and cannot be modified (Read Only). It is used to store:
  - ✓ module reference voltages,
  - ✓ other module reference voltages,
  - ✓ module VEMD part number, module part number and serial number.
- **EEPROM 2** is checked to be consistent at INIT with the data of the other module. If not, operational use is forbidden. It is used to store:
  - ✓ *other\_module* reference voltages,
  - ✓ *other\_module* VEMD part numbers,
  - ✓ torque calibration parameters,
  - ✓ configuration parameters,
  - ✓ compensation sensor data.
- **EEPROM 3** is used to store the 256 blocks of failure records.
- **EEPROM 4** is used to store:
  - ✓ 32 *flight records*,
  - ✓ 8 *check engine records* (only in memory of AV-1 module).

**Note:** in EEPROM 3 and EEPROM 4 new data continuously replaces the oldest data in the allocated memory space.

## 2.4 Results

### VEMD memory chip examination process

	VEMD EEPROM memories
Unsoldering and cleaning	X
Electrical characterisation	X
Memory reading out	X

All data recorded in the two VEMD memories was retrieved and decoded.  
The two last flight reports, including the accident flight, are given below (module AV1).

Flight number	2823 (0B07h)	2824 (0B08h)
Flight time	3 h 20 mn 35,00 s	13 mn 18,50 s
Module operating time	4550 h 10 mn 9,70 s	4550 h 52 mn 49,70 s
Engine operating time	4260 h 56 mn 54,70 s	4261 h 10 mn 13,15 s
NG cycles	0,32 cycle	0,00 cycle
NF cycles	0,07 cycle	0,00 cycle
Total NG cycles	624,40 cycle	626,45 cycles
Total NF cycles	232,55 cycle	233,00 cycles
Failure flag	0 (00h)	0 (00h)
Overlimit flag	0 (00h)	0 (00h)
NG - T1 over limitation value	4 mn 10.00 s	

- Flight number 2824 recorded in each module of the VEMD was identified as the accident flight.
- Flight duration recorded was 13 minutes 18.5 seconds.
- “Module operating time”<sup>1</sup> and “Engine operating time” were incremented respectively by 42 minutes 40 seconds and 13 minutes 18.45 seconds.
- “NG cycles” (Generator) and “NF cycles” (Free Turbine) were not recorded for this flight.
- Total NG cycles and Total NF cycles were incremented respectively by 2.05 and 0.45 cycles.
- Neither failures nor over-limits are recorded.

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<sup>1</sup> In normal operation, the “Module operating time”, “Engine operating time”, “Total NG cycle”, “Total NF cycle” parameters are refreshed in real time. At the end of flight, the DECU sends the “NG cycles” and “NF cycles” values to the VEMD. In this particular case, the recording process was interrupted before the end of the flight so the “NG cycles” and “NF cycles” parameters were not recorded.

## 3 – DECU EXAMINATION DETAILS

### 3.1 Technical information

DECU is an electronic onboard device performing fuel regulation, engine parameter management and failure recording. An internal EEPROM stores failure blocks dated in seconds from power up.

### 3.2 Readout process

Readout was performed to download the data contained in the DECU. Two text files were extracted: Prm1075a.dmp and Prm1075b.dmp.

**The DECU is designed to store maintenance data. The interpretation of retrieved data for accident investigation requires precise knowledge of the failure code designed by the manufacturer.**

### 3.3 Results

#### DECU examination process

The calculator was powered up in a dedicated test bench and the data were downloaded. All data recorded in the DECU were retrieved and decoded.

#### DECU failure commentary

Below, an analysis of the block of the event flight (block number 15) is presented:

Total DECU operation duration		Flight of the event duration after powering up
MST(Power on counter)	6605	6602
Date	1787.4 heures	14 mn 21 s

To define that the block 15 concerns the flight of the event we compared:

1. The number of powering up of the block 15 and the total of DECU powering up<sup>2</sup>.
2. The flight duration between VEMD and DECU records<sup>3</sup>.

The recorded failures in block 15 are explained below:

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<sup>2</sup> After the event, the DECU was powered up three times during the readout process.

<sup>3</sup> The difference between the flight duration recorded in the DECU and in the VEMD is probably due to:

- Different time references
- The fact that the DECU is designed to function with an emergency power supply.

**PANNE\_COHERENCE\_NG\_ALTERNATEUR\_OUI:** this failure concerns the DECU alternator.

**PANNE\_28V\_NON :** failure detected by the Operating system. It indicates a failure in the aircraft electrical system.

These two failures confirm an electrical failure on the aircraft electrical system.

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**PANNE\_ARINC\_HELICO :** indicates a communication problem from DECU and VEMD via the ARINC BUS.

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**PANNE\_ARR\_OUI :** Stop discrete input

**PANNE\_RAL\_OUI :** Idle discrete input

**PANNE\_VOL\_OUI :** Flight discrete input

- These three failures indicate a failure concerning the three positions selector (related to the engine start) or a communication problem between this selector and the DECU input.
- 

<b>PANNE_CONVERSION_VOIE_A_NON</b>	}	Failures detected by the Operating System. When a failure happens, these labels are triggered by the operating system.
<b>PANNE_CONVERSION_VOIE_B_NON</b>		

**Note:** « \_OUI » or « \_NON » at the end of failure labels indicates whether the failure was validated or not by the application software.

## **APPENDIX**

### **Appendix 1**

VEMD header (AV1)

### **Appendix 2**

VEMD flight report (AV1) extract

### **Appendix 3**

DECU extract (channel A)

## Appendix 1

### VEMD header (AV1)

	Identifiant	Valeur	Commentaire	Adresse	Taille
1	VREFCHAN10mV	0.010 V	VREF module - 10mV	00000h	2
2	VREFCHAN41mV	0.041 V	VREF module - 41 mV	00002h	2
3	VREFCHAN2V	1999.1000 mV	VREF module - 2V	00004h	2
4	VREFCHAN6V	6002.9000 mV	VREF module - 6V	00006h	2
5	CSM	00001772h (Csm invalide)	Checksum	00008h	4
6	VREFCHANOTH10mV	0.010 V	VREF other module 10 mV	0000Ch	2
7	VREFCHANOTH41mV	0.041 V	VREF other module 41 mV	0000Eh	2
8	VREFCHANOTH2V	1999.2000 mV	VREF other module 2 V	00010h	2
9	VREFCHANOTH6V	5993.7000 mV	VREF other module 6 V	00012h	2
10	PARTNUMCHAN	B19030SA	Module Vemd Part Number	00014h	8
11	MPARTNUMCHAN	C19184QD	Module Part Number	0001Ch	8
12	SERNUM	1651 (0673h)	VEMD Serial Number	00024h	2
13	CSM	00000673h (Csm invalide)	Checksum	00026h	4
14	SPARE	Spare ok	Spare	0002Ah	54
15	VREFOTHCHAN10mV	0.010 V	VREF other module 10mV	00800h	2
16	VREFOTHCHAN41mV	0.041 V	VREF other module 41mV	00802h	2
17	VREFOTHCHAN2V	2003.2000 mV	VREF other module 2V	00804h	2
18	VREFOTHCHAN6V	6008.5000 mV	VREF other module 6V	00806h	2
19	PARTNUMOTH	B19030SA	other module VEMD Part Number	00808h	8
20	MPARTNUMOTH	C19184RD	other module PartNumber	00810h	8
21	SERNUMOTH	1651 (0673h)	other module VEMD Serial Number	00818h	2
22	CSM	00000673h (Csm invalide)	Cheksum	0081Ah	4
23	OTHER	0	Calibrations & compensations data	0081Eh	2018

## Appendix 2

### VEMD flight report (AV1) extract

	Identifiant	Valeur	Commentaire	Adresse	Taille
2508	NUVOLM	2822 (0B06h)	Flight number	043C0h	2
2509	FLIGHTIMEM	2 h 19 mn 14.00 s	Flight time	043C2h	2
2510	CHANOPTIMEM	4546 h 42 mn 27.35 s	Moduler operating time (min et mx en heures)	043C4h	4
2511	ENGOPTIMEM	4257 h 36 mn 19.55 s	Engine operating time (min et mx en heures)	043C8h	4
2512	CCNGM	0.27 cycle	NG cycles	043CCCh	2
2513	CCNTLM	0.08 cycle	NF cycles	043CEh	2
2514	CCNGCM	622.70 cycle	Total NG cycles	043D0h	2
2515	CCNTLCM	232.05 cycle	Total NF cycles	043D2h	2
2516	BFAILM	0 (00h)	Failure flag	043D4h	1
2517	BOVLDETECM	0 (00h)	Overlimit flag	043D5h	1
2518	NRMAX1DEP	0.0 rpm	NR max 1	043D6h	1
2519	NRMAX2DEP	0.0 rpm	NR max 2	043D7h	1
2520	NRMAX3DEP	0.0 rpm	NR max 3	043D8h	1
2521	NRMAX4DEP	0.0 rpm	NR max 4	043D9h	1
2522	NRMAX5DEP	0.0 rpm	NR max 5	043DAh	1
2523	TRQMAXDEP	0.0 %	TRQ max	043DBh	1
2524	TRQT1DEP	0.0 s	TRQ - T1	043DCh	2
2525	TRQT2DEP	0.0 s	TRQ - T2	043DEh	2
2526	TRQT3DEP	0.0 s	TRQ - T3	043E0h	2
2527	TRQHT1DEPH	0.0 s	TRQ - H - T1	043E2h	2
2528	TRQHT2DEPH	0.0 s	TRQ - H - T2	043E4h	2
2529	TRQHT3DEPH	0.0 s	TRQ - H - T3	043E6h	2
2530	TRQHMAXDEPH	0.0 %	TRQ - H - Max	043E8h	1
2531	NFMAXDEP	0 rpm	NFMAX	043E9h	1
2532	NFT1DEP	0.0 s	NF - T1	043EAh	2
2533	NFT2DEP	0.0 s	NF - T2	043ECh	2
2534	T4LOWDEP	0.0 s	T4 LOW over limitation value	043EEh	2
2535	T4MEDDEP	0.0 s	T4 MED over limitation value	043F0h	2
2536	T4LHIDEP	0.0 s	T4 HI over limitation value	043F2h	2
2537	T4MAXDDEP	0.0 °C	T4 MAX D over limitation value	043F4h	2
2538	T4MAXVDEP	0.0 °C	T4 MAX V over limitation value	043F6h	2
2539	NGT1DEP	2 mn 51.50 s	NG - T1 over limitation value	043F8h	2
2540	NGT2DEP	0.0 s	NG - T2 over limitation value	043FAh	2
2541	NGT3DEP	0.0 s	NG - T3 over limitation value	043FCh	2
2542	NGMAXDEP	0.00 %	NG MAX over limitation value	043FEh	2
2543	SPARE	Spare ok	SPR	04400h	128
2544	NUVOLM	2823 (0B07h)	Flight number	04480h	2
2545	FLIGHTIMEM	3 h 20 mn 35.00 s	Flight time	04482h	2
2546	CHANOPTIMEM	4550 h 10 mn 9.70 s	Moduler operating time (min et mx en heures)	04484h	4
2547	ENGOPTIMEM	4260 h 56 mn 54.70 s	Engine operating time (min et mx en heures)	04488h	4
2548	CCNGM	0.32 cycle	NG cycles	0448Ch	2

2549	CCNTLM	0.07 cycle	NF cycles	0448Eh	2
2550	CCNGCM	624.40 cycle	Total NG cycles	04490h	2
2551	CCNTLCM	232.55 cycle	Total NF cycles	04492h	2
2552	BFILM	0 (00h)	Failure flag	04494h	1
2553	BOVLDETECM	0 (00h)	Overlimit flag	04495h	1
2554	NRMAX1DEP	0.0 rpm	NR max 1	04496h	1
2555	NRMAX2DEP	0.0 rpm	NR max 2	04497h	1
2556	NRMAX3DEP	0.0 rpm	NR max 3	04498h	1
2557	NRMAX4DEP	0.0 rpm	NR max 4	04499h	1
2558	NRMAX5DEP	0.0 rpm	NR max 5	0449Ah	1
2559	TRQMAXDEP	0.0 %	TRQ max	0449Bh	1
2560	TRQT1DEP	0.0 s	TRQ - T1	0449Ch	2
2561	TRQT2DEP	0.0 s	TRQ - T2	0449Eh	2
2562	TRQT3DEP	0.0 s	TRQ - T3	044A0h	2
2563	TRQHT1DEPH	0.0 s	TRQ - H - T1	044A2h	2
2564	TRQHT2DEPH	0.0 s	TRQ - H - T2	044A4h	2
2565	TRQHT3DEPH	0.0 s	TRQ - H - T3	044A6h	2
2566	TRQHMAXDEPH	0.0 %	TRQ - H - Max	044A8h	1
2567	NFMAXDEP	0 rpm	NFMAX	044A9h	1
2568	NFT1DEP	0.0 s	NF - T1	044AAh	2
2569	NFT2DEP	0.0 s	NF - T2	044ACh	2
2570	T4LOWDEP	0.0 s	T4 LOW over limitation value	044AEh	2
2571	T4MEDDEP	0.0 s	T4 MED over limitation value	044B0h	2
2572	T4LHIDEP	0.0 s	T4 HI over limitation value	044B2h	2
2573	T4MAXDDEP	0.0 °C	T4 MAX D over limitation value	044B4h	2
2574	T4MAXVDEP	0.0 °C	T4 MAX V over limitation value	044B6h	2
2575	NGT1DEP	4 mn 10.00 s	NG - T1 over limitation value	044B8h	2
2576	NGT2DEP	0.0 s	NG - T2 over limitation value	044BAh	2
2577	NGT3DEP	0.0 s	NG - T3 over limitation value	044BCCh	2
2578	NGMAXDEP	0.00 %	NG MAX over limitation value	044BEh	2
2579	SPARE	Spare ok	SPR	044C0h	128
2580	NUVOLM	2824 (0B08h)	Flight number	04540h	2
2581	FLIGHTIMEM	13 mn 18.50 s	Flight time	04542h	2
2582	CHANOPTIMEM	4550 h 52 mn 49.70 s	Moduler operating time (min et mx en heures)	04544h	4
2583	ENGOPTIMEM	4261 h 10 mn 13.15 s	Engine operating time (min et mx en heures)	04548h	4
2584	CCNGM	0.00 cycle	NG cycles	0454Ch	2
2585	CCNTLM	0.00 cycle	NF cycles	0454Eh	2
2586	CCNGCM	626.45 cycle	Total NG cycles	04550h	2
2587	CCNTLCM	233.00 cycle	Total NF cycles	04552h	2
2588	BFILM	0 (00h)	Failure flag	04554h	1
2589	BOVLDETECM	0 (00h)	Overlimit flag	04555h	1
2590	NRMAX1DEP	0.0 rpm	NR max 1	04556h	1
2591	NRMAX2DEP	0.0 rpm	NR max 2	04557h	1
2592	NRMAX3DEP	0.0 rpm	NR max 3	04558h	1
2593	NRMAX4DEP	0.0 rpm	NR max 4	04559h	1
2594	NRMAX5DEP	0.0 rpm	NR max 5	0455Ah	1
2595	TRQMAXDEP	0.0 %	TRQ max	0455Bh	1
2596	TRQT1DEP	0.0 s	TRQ - T1	0455Ch	2
2597	TRQT2DEP	0.0 s	TRQ - T2	0455Eh	2
2598	TRQT3DEP	0.0 s	TRQ - T3	04560h	2



2599	TRQHT1DEPH	0.0 s	TRQ - H - T1	04562h	2
2600	TRQHT2DEPH	0.0 s	TRQ - H - T2	04564h	2
2601	TRQHT3DEPH	0.0 s	TRQ - H - T3	04566h	2
2602	TRQHMAXDEPH	0.0 %	TRQ - H - Max	04568h	1
2603	NFMAXDEP	0 rpm	NFMAX	04569h	1
2604	NFT1DEP	0.0 s	NF - T1	0456Ah	2
2605	NFT2DEP	0.0 s	NF - T2	0456Ch	2
2606	T4LOWDEP	0.0 s	T4 LOW over limitation value	0456Eh	2
2607	T4MEDDEP	0.0 s	T4 MED over limitation value	04570h	2
2608	T4LHIDEP	0.0 s	T4 HI over limitation value	04572h	2
2609	T4MAXDDEP	0.0 °C	T4 MAX D over limitation value	04574h	2
2610	T4MAXVDEP	0.0 °C	T4 MAX V over limitation value	04576h	2
2611	NGT1DEP	0.0 s	NG - T1 over limitation value	04578h	2
2612	NGT2DEP	0.0 s	NG - T2 over limitation value	0457Ah	2
2613	NGT3DEP	0.0 s	NG - T3 over limitation value	0457Ch	2
2614	NGMAXDEP	0.00 %	NG MAX over limitation value	0457Eh	2
2615	SPARE	Spare ok	SPR	04580h	128

## Appendix 3

### DECU flight of the event extract (channel A)

Extract of DECU data

CR: outil "PRO.EXE" vers:3.9

Date : 16.02.06

FADEC S/N : 1075A

Nombre MST : 6605

Temps Util : 1787.40 h

Usure EEPROM: 0

Cycles NTL : 291.75

Cycles NG : 783.71

OEI 2mn Nb : 0.00

OEI 2mn Cum : 0.00

OEI 30s Nb : 0.00

OEI 30s Cum : 0.00

Reg Moteur : 0.01

Date Diag de +8pan : 4470

Moteur : Arriel 2B1 Double-canal

Materiel : C12380KA01XX

Amorce : G1377AEA04

Autom.FProm : G1377ACB02

Autom.Eprom : G1377ACB02

Applicatif : L622C00404

CRC : 3CF9

CSM : A606

Voie : A

Version : CLIENT

Recette : 000000

Genre fadec : DC=01

Option Volet: Absente=01

Option Surv : Absente=00

Tableau resume des pannes

Nombre	Description de panne
13	PANNE_CONVERSION_VOIE_A_NON
13	PANNE_CONVERSION_VOIE_B_NON
1	PANNE_28V_NON
3	PANNE_ARINC_HELICO_OUI
1	PANNE_P3_OUI
10	PANNE_ARR_OUI
10	PANNE_RAL_OUI
10	PANNE_VOL_OUI
1	PANNE_COHERENCE_NG_ALTERNATEUR_OUI

=====

Bloc : 15

Mst : 000019CA

Date : 0000035D

Csum : B5 Csum Ok

Panne:1

0006 => PANNE\_CONVERSION\_VOIE\_A\_NON

0001 => INTERNE

Panne:2

0007 => PANNE\_CONVERSION\_VOIE\_B\_NON

0001 => INTERNE

Panne:3

000D => PANNE\_28V\_NON

0001 => INTERNE

Panne:4

0012 => PANNE\_ARINC\_HELICO\_OUI

0001 => INTERNE

Panne:5

0045 => PANNE\_ARR\_OUI

0001 => INTERNE

Panne:6

0047 => PANNE\_RAL\_OUI

0001 => INTERNE

Panne:7

0049 => PANNE\_VOL\_OUI

0001 => INTERNE

Panne:8

0069 => PANNE\_COHERENCE\_NG\_ALTERNATEUR\_OUI

0001 => INTERNE

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