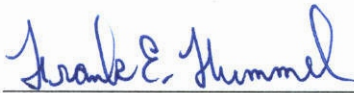


RAPORT
z odzyskania danych FMS

**FMS DATA EXTRACTION
FOR
NTSB IDENTIFICATION: ENG10SA025**

ORIGINAL

APPROVALS:



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1 INTRODUCTION

This document summarizes the activities performed by Universal Avionics Systems Corporation (UASC) engineering to extract data from two Flight Management Systems (FMSs) and convert the data to human-readable form. This was done at the request of the National Transportation Safety Board (NTSB) in its investigation of an accident identified as ENG10SA025.

Thor Skaug, FMS software engineer, and Brian Eckmann, FMS software manager, performed the data-extraction procedures in a specially prepared lab at UASC's Redmond, Washington, facility. Brian Eckmann analyzed the data and prepared this report. Thor Skaug checked the accuracy of the data analysis.

At the request of the accident investigators, a preliminary version of this report was released on May 25, 2010. This is the final report.

2 REFERENCES

Table 2-1 Acronyms and Abbreviations

Acronym/Abbreviation	Description
A/D	analog to digital
ADC	air data computer
ARINC	Aeronautical Radio, Incorporated
ASCB	avionics standard communication bus
AUX	auxiliary
CDU	control display unit
cm	centimeters
CPU	central processing unit
DME	distance measuring equipment
DR	dead reckoning
FMS	Flight Management System (UASC)
FPL	flight plan
ft	feet
GMT	Greenwich Mean Time
GPS	global positioning system
IAS	indicated air speed
kts	knots
min	minutes
MSG	message
NA	not applicable
NCU	navigation computer unit
NM	nautical miles
NTSB	National Transportation Safety Board
PC	personal computer
PN	part number
PVOR	Pseudo-VOR
RAM	random access memory
ROM	read-only memory
RRS	radio reference sensor
SCN	software control number
SID	standard instrument departure
SN	serial number
STAR	standard terminal arrival route

Acronym/Abbreviation	Description
TACAN	tactical air navigation
TAS	true air speed
UASC	Universal Avionics Systems Corporation
UNS	Universal Navigation System (UASC)
UTC	coordinated universal time
V	volts
VNAV	vertical navigation
VOR	VHF omnidirectional range

3 SUMMARY OF ACTIVITIES

Components from two UASC UNS-1D FMSs were recovered from the aircraft. The UNS-1D consists of a Control Display Unit (CDU) mounted in the cockpit and a Navigation Computer Unit (NCU), which is normally mounted in the avionics bay. The NCU contains several computer boards. Its main central processing unit (CPU) board runs the FMS application software. The information requested by the NTSB resides on this board.

All random access memory (RAM) on the CPU board is battery-backed, which allows the FMS to hibernate during power interruptions. The entire state of CPU board memory is frozen at the instant that external power to the FMS is removed. The battery will last several years before it is exhausted. Unless there was physical or electrical damage to the CPU board, all FMS parameters should be recoverable from the units that were on board the aircraft. The other boards inside the CDU and NCU do not retain any information after power is removed.

3.1 Preparation

Using information regarding the model and software version of the FMS supplied by the incident investigators, Brian Eckmann and Thor Skaug set up the rig and used a checklist to perform a dry run of the FMS data-extraction procedure. The rig includes a Microsoft Windows personal computer (PC), a known-good FMS NCU, a CDU, a +28V power supply, and a wiring harness. A serial cable connects the Windows PC to the NCU.

The CPU board is moved from the (possibly damaged) NCU to the known-good NCU. Placing the CPU board in a different host system does not disturb or alter the contents of CPU board memory in any way, but it reduces the possibility for data to be lost or corrupted.

A jumper on the CPU board must be installed before powering up the FMS. This causes the boot program to activate its maintenance mode at power up. The maintenance mode prevents the FMS application software from running because if it were to run, it would erase parameters that pertain to the previous flight. The maintenance program makes one alteration to the RAM contents. It copies the stack area used by the application program to an area of spare memory. It must do this because the maintenance program needs the program stack area for it to operate.

While the maintenance program is running, a utility program running on the PC directs the maintenance program to transmit the CPU board RAM contents. The PC captures the information and stores it in an electronic file.

3.2 Data-Extraction Procedures

The two NCUs, part number 1192-00-111101, serial numbers 281 and 1577, arrived at the UASC Redmond facility on Tuesday, May 4, 2010. Both NCUs had obviously suffered significant damage. The normal data-extraction procedures were specially modified as explained in the following sections.

3.2.1 NCU Serial Number 281

3.2.1.1 Physical and Electrical Examination

The unit was heavily damaged. The top of the enclosure was absent. The front bulkhead and front piece had separated from the rest of the enclosure. The remaining parts of the enclosure were dented and scraped. The CPU board was visible because of the missing pieces. The sheet metal of the left side of the enclosure was bent such that it touched the CPU board.

Because the top of the enclosure was missing, the condition of its quality seal could not be determined. Half of the other quality seal was attached to the enclosure. The other half was attached to the front piece.

When the left side of the enclosure was removed, the CPU board was still connected to the motherboard. The CPU board was held only by the middle bulkhead and motherboard connector because the lid and the front bulkhead were missing.

The CPU board, part number 010107010F, serial number 93981-010, was removed and examined. The CPU board had visual damage. It was cracked near the forward end of the card edge connector. The plastic shell of the card edge connector had suffered a small chip.

Greg McKay, FMS hardware engineer, performed a voltage test on the battery terminals and the power pins of the eight battery-backed RAM devices. All voltages were between +3.63V and +3.64V, which is nominal. The presence of battery voltage on the RAM devices indicated that some data may be recoverable.

See Table 3-1 for details of the NCU hardware and software identification. See Figure 3-1, Figure 3-2, and Figure 3-3 for photos of the exterior of the NCU. See Figure 3-4 and Figure 3-5 for photos of the CPU board.

Table 3-1 NCU Serial Number 281 Identification

Model	UNS-1D
Part Number	1192-00-111101
Serial Number	281
Mod Level	4
FMS Software	604.5
GPS Software	10.3
Auxiliary Software	1.6
Analog Software	2.0
Bootstrap Software	2.3
ARINC Software	2.1
ASCB Software	NA
Advanced Performance Database	Not installed
Condition	Significant damage to the enclosure. Missing top. Missing front and front bulkhead. CPU board not missing any components. The CPU printed circuit board has a visible crack next to the card edge connector. The plastic shroud around the card edge connector is chipped. Battery voltage measured at the battery is nominal. Battery voltage measured at the eight RAM devices is nominal.



Figure 3-1 Right Side of NCU Serial Number 281



Figure 3-2 Left Side of NCU Serial Number 281

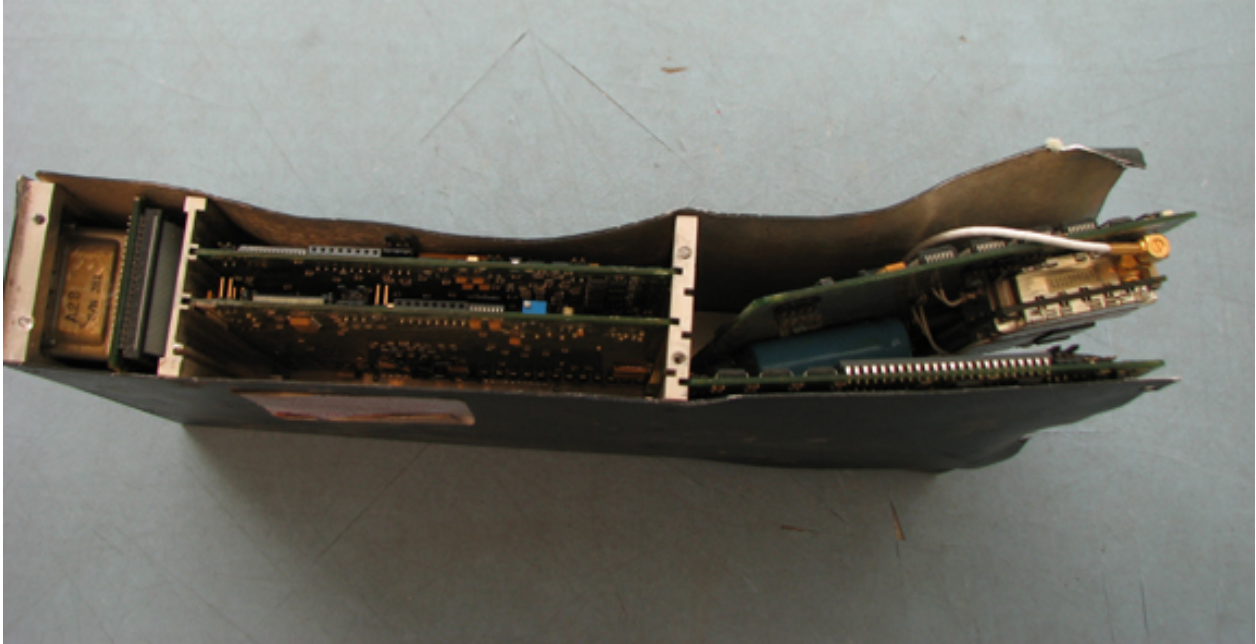


Figure 3-3 Top of NCU Serial Number 281

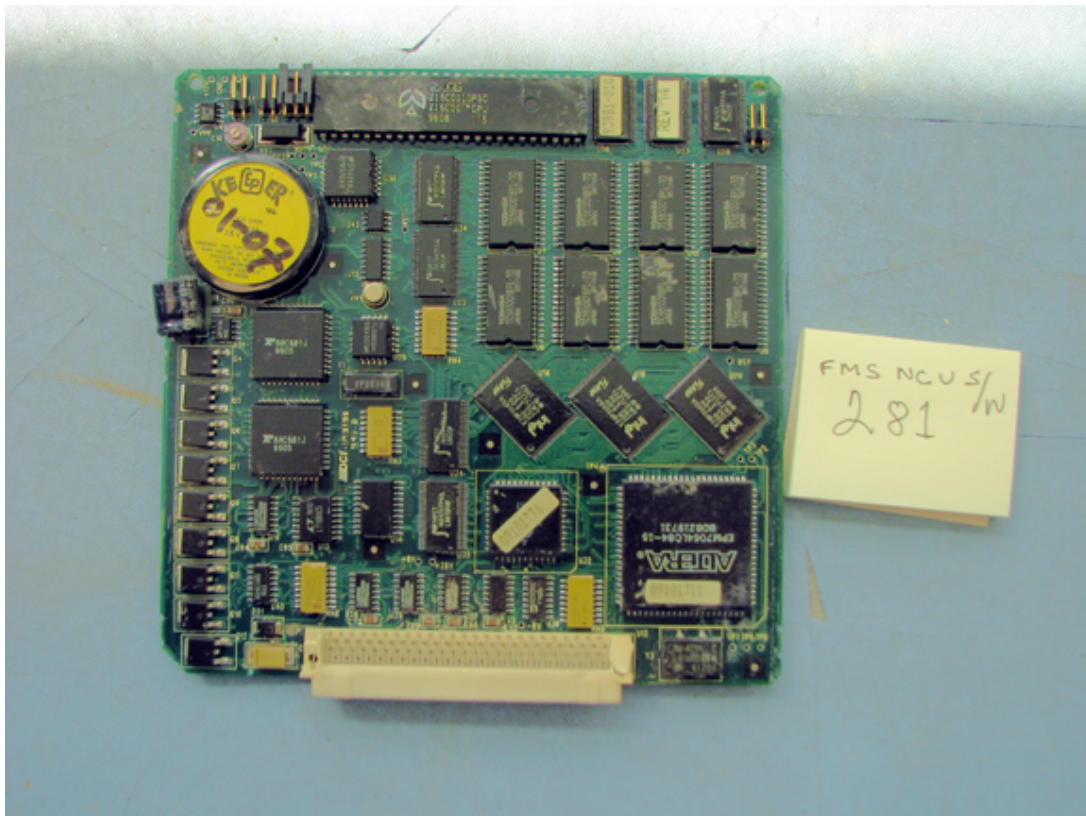


Figure 3-4 Top of CPU Board Serial Number 93981-010

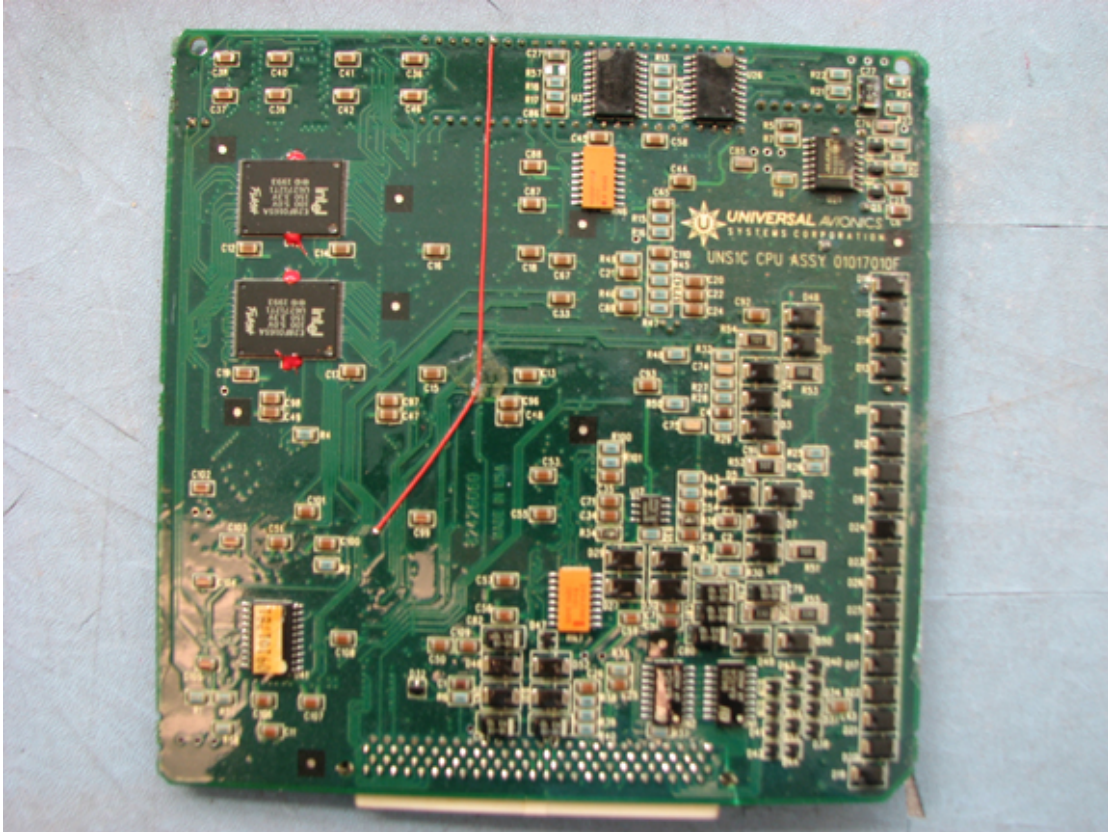


Figure 3-5 Bottom of CPU Board Serial Number 93981-010

3.2.1.2 Data Extraction

An electrical examination of the CPU board revealed that a crack in the printed circuit board severed one of the signal paths needed to perform the data extraction. The CPU board was reworked to bypass the damaged circuit. The rework is shown in Figure 3-6.

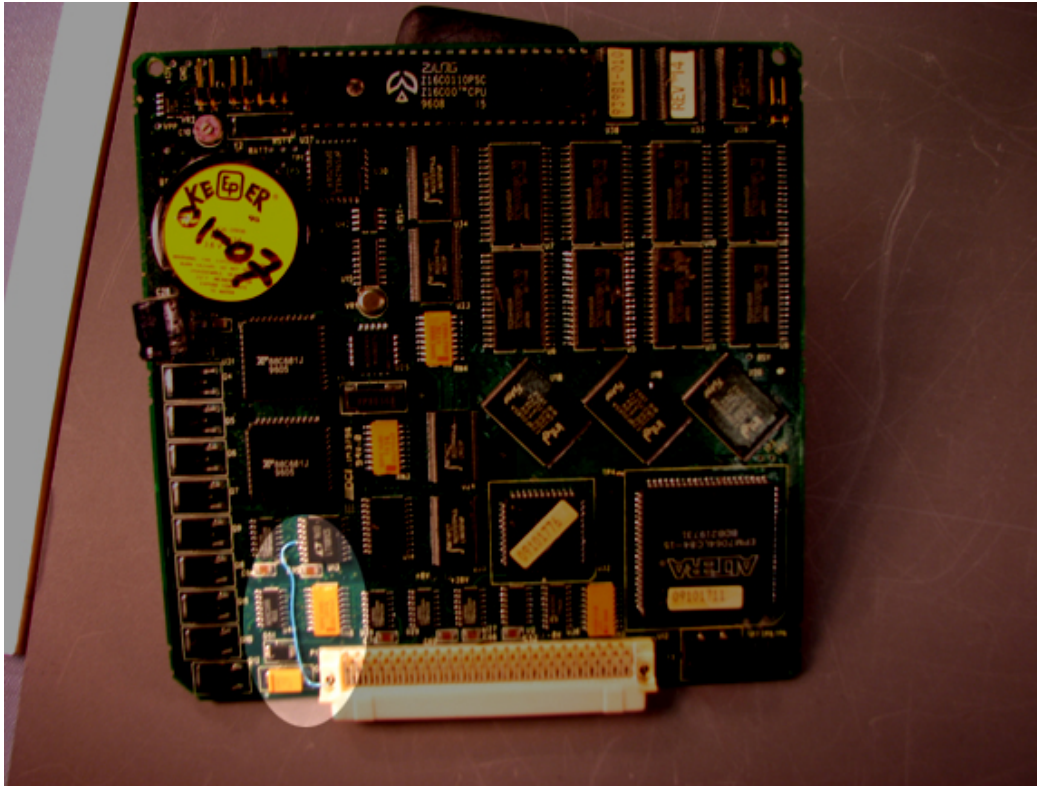


Figure 3-6 CPU Board Serial Number 93981-010 with Rework

On May 5, 2010, the reworked CPU board was moved to the rig that was set up to perform the data extraction. See APPENDIX A for the checklist that was used to perform the procedure.

No anomalies occurred during the startup and running of the procedure. When the data extraction was complete, the engineers decoded part of the raw data into human-readable form and verified that it appeared to be reasonable. A second data extraction was performed, and the result was successfully compared to the first.

3.2.2 NCU Serial Number 1577

3.2.2.1 Physical and Electrical Examination

The NCU was very heavily damaged. The top of the enclosure was missing. The front of the enclosure was partially detached. The left side of the enclosure forward of the central bulkhead was badly dented, which moved the CPU board several centimeters (cm) to the right of its normal position. The right side of the enclosure was also dented, especially the section to the rear of the center bulkhead. Approximately 2 cm of the CPU board was protruding from the top of the enclosure. The CPU board was cracked, scuffed, and bent. The microprocessor and part of its socket were completely missing.

The condition of the unit's quality seal could not be determined because the top of the enclosure was missing. The other quality seal was damaged.

The CPU board, part number 010107010J, serial number 9908179, was removed and examined for damage. The CPU board had very heavy damage. A very large horizontal crack ran about 3 cm below the top of the board. The board was bowed. It had several smaller cracks and many abrasions.

Greg McKay, FMS hardware engineer, performed a voltage test on the battery terminals and the power pins of the eight battery-backed RAM devices. All voltages were between +3.63V and +3.64V, which is nominal. The presence of battery voltage on the RAM devices indicated that some data may be recoverable.

See Table 3-2 for details of the hardware and software identification. See Figure 3-7, Figure 3-8, and Figure 3-9 for photos of the exterior of the NCU. See Figure 3-10 and Figure 3-11 for photos of the CPU board.

Table 3-2 NCU Serial Number 1577 Identification

Model	UNS-1D
Part Number	1192-00-111101
Serial Number	1577
Mod Level	4
FMS Software	604.5
GPS Software	10.3
Auxiliary Software	1.6
Analog Software	2.0
Bootstrap Software	2.3
ARINC Software	2.1
ASCB Software	NA
Advanced Performance Database	Not installed
Condition	Very heavy damage to both the enclosure and the CPU board. Structural and electrical parts missing. Battery intact with nominal voltage. RAM devices intact with nominal battery voltage.



Figure 3-7 Right Side of NCU Serial Number 1157

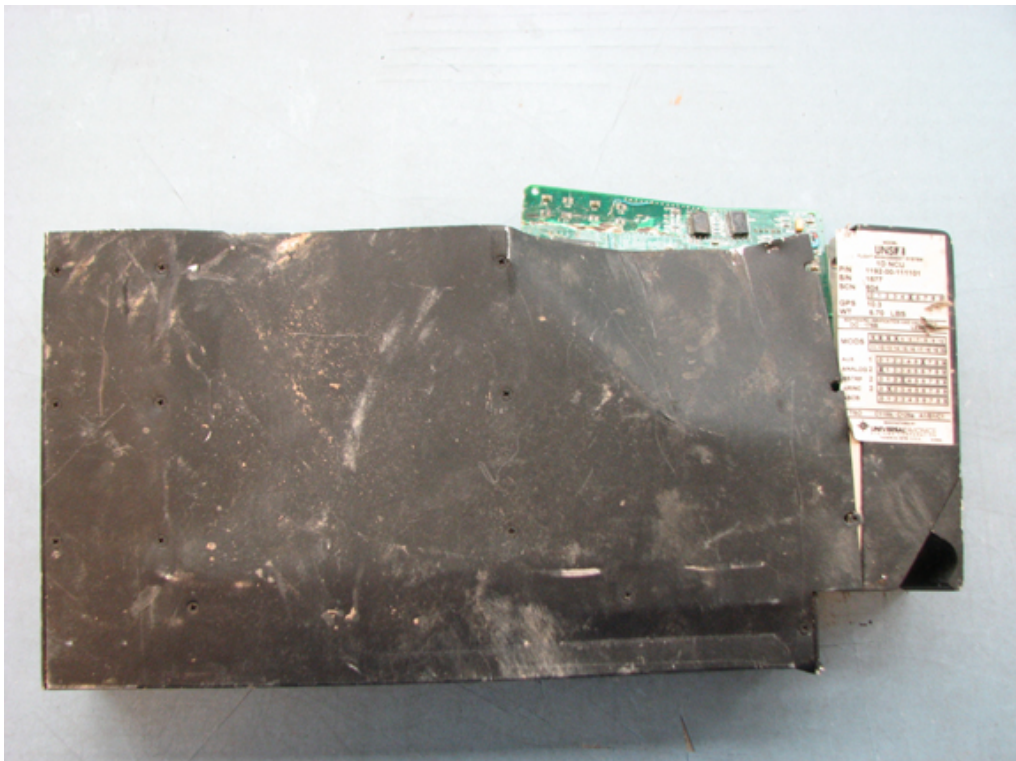


Figure 3-8 Left Side of NCU Serial Number 1577



Figure 3-9 Top of NCU Serial Number 1577

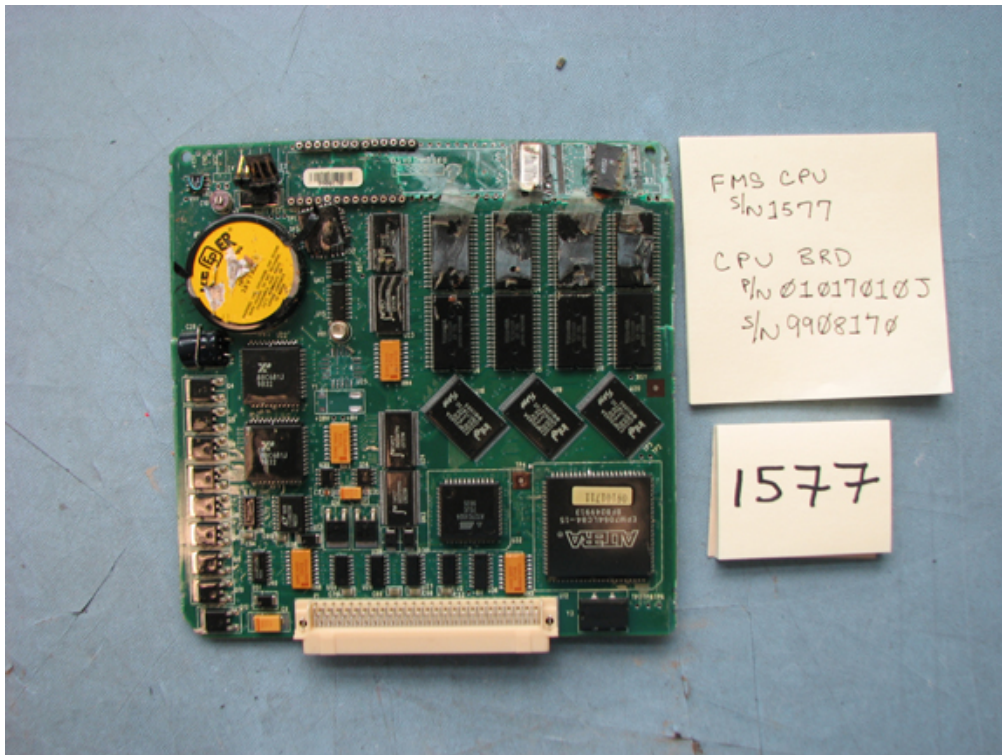


Figure 3-10 Top of CPU Board Serial Number 9908170

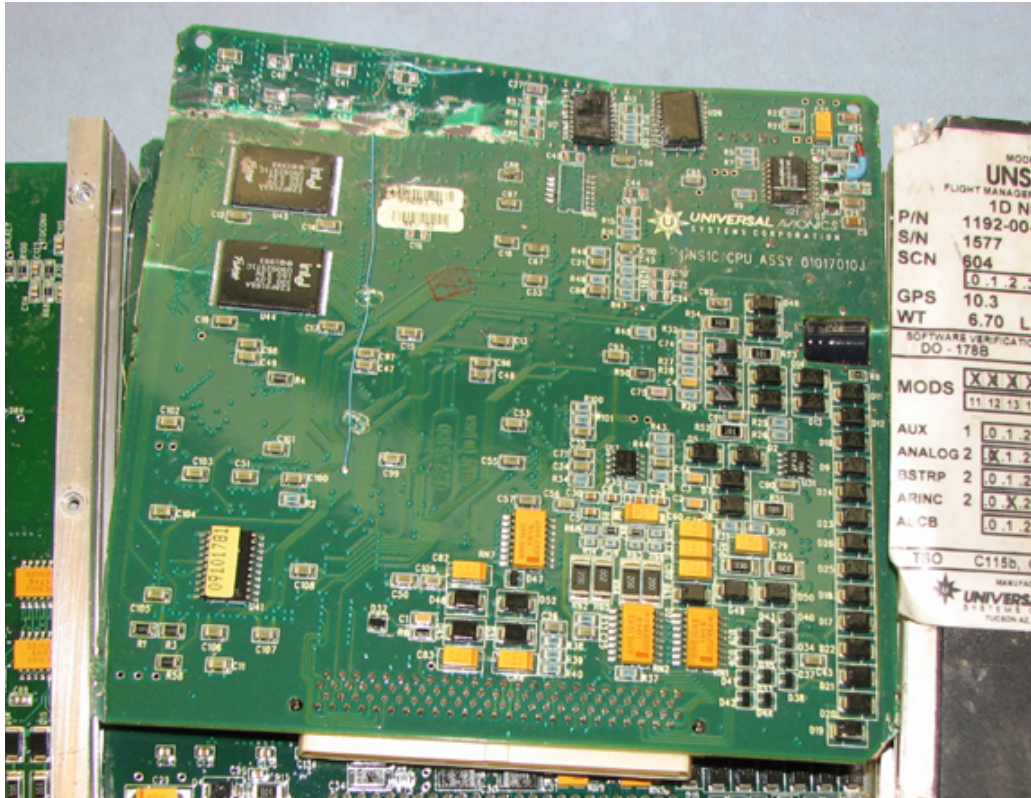


Figure 3-11 Bottom of CPU Board Serial Number 9908170

3.2.2.2 Data Extraction

The damage to the CPU board made it impossible to attempt a RAM download using the normal method. However, the presence of battery voltage on the RAM devices indicated that some data may be recoverable. UASC engineers and technicians are attempting to develop a method to move the individual RAM devices from the damaged CPU board to a functioning host without loss or corruption of data.

3.3 Analysis of Memory Contents

The RAM on the CPU board contains the state of FMS memory at the moment power was removed. All of the parameters detailed in the following sections represent the instantaneous values that were preserved at power down.

The variables are stored in a machine-readable format. Decoding the variables into human-readable form is tedious and requires expert knowledge. Analyzing all of the variables is possible, but not practical. UASC has coordinated with the accident investigators to select the subset of parameters included in this report.

3.3.1 Analysis of NCU Serial Number 281

3.3.1.1 Serial Number 281 Configuration Settings

The aircraft-specific FMS configuration settings are stored in a Configuration Module attached to the NCU mounting tray. This is so the FMS can be replaced by another unit without the need to reconfigure the replacement. At power up, the FMS reads the Configuration Module and stores a copy of its image. The configuration parameters in Table 3-3 were obtained from the RAM image.

The FMS position is set by configuration strapping on the NCU mounting tray. Serial number 281 was installed in the number 2 position.

Table 3-3 Serial Number 281 Configuration Settings

CDU Page	Field Name	Setting
A561 XMIT 1/1	561 BUS	LRN DATA
A561 XMIT 1/1	DTG FORMAT	ARINC 561
AIR DATA 1/1	A/S DISPLAY	TAS AND IAS
AIR DATA 1/1	A/S FORMAT	DIGITAL
AIR DATA 1/1	ALT DISPLAY	BOTH
AIR DATA 1/1	BARO ALT FMT	DIGITAL
AIR DATA 1/1	MACH FORMAT	DIGITAL
AIR DATA 1/1	MINIMUM TAS (m/s)	30.8594
AIR DATA 1/1	PRESS ALT FMT	DIGITAL
AIR DATA 1/1	SAT FORMAT	DIGITAL
ANALOG OPT 1/1	(DESIRED TRK)RELATIVE TO	NORTH
ANALOG OPT 1/1	(WPT BRG)RELATIVE TO	NOSE
ANALOG OPT 1/1	ANALOG ATT	HDG ONLY
ANALOG OPT 1/1	DESIRED TRK	RESOLVER
ANALOG OPT 1/1	PITCH CMD	NONE
ANALOG OPT 1/1	WPT BRG FMT	NONE
ANALOG OPT 1/1	WPT BRG OFFSET	+180 DEGREES
ANALOG OPT 1/1	WPT BRG SIG	WAYPOINT BEARING
APPR OPT 1/1	APPR MODE	ENABLED
APPR OPT 1/1	FPA LIMIT	9
APPR OPT 1/1	REMOTE ARM	DISABLED
APPR OPT 1/1	REMOTE TUNE	ENABLED
APPR OPT 1/1	ROLL GAINS	1
APPR TYPES 1/2	BC	ENABLED
APPR TYPES 1/2	GPS	ENABLED

CDU Page	Field Name	Setting
APPR TYPES 1/2	ILS	ADVISORY
APPR TYPES 1/2	LOC	ENABLED
APPR TYPES 1/2	NDB	ENABLED
APPR TYPES 1/2	RNV	ENABLED
APPR TYPES 1/2	VFR	ENABLED
APPR TYPES 1/2	VOR	ENABLED
APPR TYPES 2/2	GLS	ADVISORY
APPR TYPES 2/2	TAC	ENABLED
APU OPT 1/1	APU SOURCE	NONE
APU OPT 1/1	FUEL FLOW1	0
APU OPT 1/1	FUEL FLOW2	0
APU OPT 1/1	FUEL FLOW3	0
APU OPT 1/1	FUEL FLOW4	0
ARINC RCV 1/2	PORT 0	LS GPS 2 B1
ARINC RCV 1/2	PORT 1	LS GPS 1 B1
ARINC RCV 1/2	PORT 2	LS GPS 3 B1
ARINC RCV 1/2	PORT 3	RRS
ARINC RCV 1/2	PORT 4	LS 429 ADC
ARINC RCV 1/2	PORT 5	TAWS A739
ARINC RCV 1/2	PORT 6	NO SENSOR
ARINC RCV 1/2	PORT 7	CROSSFILL 1
ARINC XMIT 1/1	PORT 0	429 HS
ARINC XMIT 1/1	PORT 1	UNS HS429-1
ARINC XMIT 1/1	PORT 2	429 LS
ARINC XMIT 1/1	PORT 3	429 XFILL
CABIN DISP 1/1	CABIN DISP	DISABLED
CONFIG 2/2	AIRCRAFT IDENTIFICATION	TUPOLEV 154M N101
CONFIG 2/2	CONFIG MODULE UPDATES DATE #1	10/20/2008
CONFIG 2/2	CONFIG MODULE UPDATES DATE #2	10/20/2008
CONFIG 2/2	CONFIG MODULE UPDATES DATE #3	10/20/2008
CONFIG 2/2	CONFIG MODULE UPDATES DATE #4	10/20/2008
CONFIG 2/2	CONFIG MODULE UPDATES UTC #1	7:11:53
CONFIG 2/2	CONFIG MODULE UPDATES UTC #2	7:09:45
CONFIG 2/2	CONFIG MODULE UPDATES UTC #3	7:07:25
CONFIG 2/2	CONFIG MODULE UPDATES UTC #4	7:04:50
CONFIG 2/2	SCN	604.X

CDU Page	Field Name	Setting
CSDB OPT 1/1	RCVR 0	NONE
CSDB OPT 1/1	RCVR 1	NONE
CSDB OPT 1/1	RCVR 2	NONE
CSDB OPT 1/1	RCVR 3	NONE
CSDB OPT 1/1	XMITTER 0	NONE
CSDB OPT 1/1	XMITTER 1	NONE
DISC IN 1/2	DISC IN 1	NONE
DISC IN 1/2	DISC IN 2	NONE
DISC IN 1/2	DISC IN 3	NONE
DISC IN 1/2	DISC IN 4	TEST
DISC IN 1/2	DISC IN 5	MAG/TRUE SW
DISC IN 1/2	DISC IN 6	STRUT
DISC IN 1/2	DISC IN 7	FREQ MNGT
DISC IN 1/2	DISC IN 8	NONE
DISC IN 2/2	DISC IN 10 28V	NONE
DISC IN 2/2	DISC IN 11	NONE
DISC IN 2/2	DISC IN 9	NONE
DISC OUT 1/2	DISC OUT 1	NONE
DISC OUT 1/2	DISC OUT 2	WPT ANN
DISC OUT 1/2	DISC OUT 3	SXTK ANN
DISC OUT 1/2	DISC OUT 4	GPS INTEG
DISC OUT 1/2	DISC OUT 5	HDG ANN
DISC OUT 1/2	DISC OUT 6	NONE
DISC OUT 1/2	DISC OUT 7	NONE
DISC OUT 1/2	DISC OUT 8	NONE
DISC OUT 2/2	DISC OUT 9 28V	FMS VAL
DISPLAY CONFIG	COLORS	STANDARD
EFIS OPT 1/1	TYPE	429 GAMA
FMS CONFIG 1/3	FMS OPTIONS	ANALOG
FMS CONFIG 3/3	FLIGHT LOG	DISABLED
FMS CONFIG 3/3	MAX STBY TIME	2 HOURS
FMS CONFIG 3/3	PLT DB @ PWRUP	RETAINED
FMS CONFIG 3/3	POS EST DISP	Q
FMS CONFIG 3/3	STRUT SW	ANALOG
FUEL OPT 1/1	# OF ENGINES	2
FUEL OPT 1/1	EMPTY WEIGHT	-----

CDU Page	Field Name	Setting
FUEL OPT 1/1	DISPLAY UNITS	lbs
FUEL OPT 1/1	FUEL FLOW TYPE	NO SENSOR
FUEL OPT 1/1	FUEL MODE	DISABLED
INTERNAL	CONFIG DATA CHECKSUM	19212
INTERNAL	CONFIG DATA REVISION	5
INTERNAL	CONFIG DATA VERSION	106
NAV OPT 1/1	A/C ROLL STR	ENABLED
NAV OPT 1/1	A/C TYPE	FIXED WING
NAV OPT 1/1	AT OR ABOVE ALT	22000
NAV OPT 1/1	AT OR ABOVE BANK LIMIT	16
NAV OPT 1/1	AT OR BELOW ALT	20000
NAV OPT 1/1	AT OR BELOW BANK LIMIT	22
NAV OPT 1/1	HDG SEL	ENRT+APPR
PERF DISP OPTS	PERF EFIS DISP	DISABLED
PERF OPT 1/1	ADVANCED	DISABLED
PERF OPT 1/1	ASCB	DISABLED
PERF OPT 1/1	BASIC	DISABLED
PERF OPT 1/1	CLIMB GRAD	500
PERF OPT 1/1	EFIS	DISABLED
PERF OPT 1/1	MANUAL	DISABLED
PL4-OPT 1/1	ADF DIAG	N/A
PL4-OPT 1/1	CHP	N/A
PL4-OPT 1/1	FUEL MAX	N/A
PL4-OPT 1/1	MLS	N/A
PL4-OPT 1/1	PL-4 REF	N/A
PL4-OPT 1/1	RAD ALT	N/A
PL4-OPT 1/1	RADAR TYPE	N/A
PL4-OPT 1/1	TCAS	N/A
TAWS CONFIG 1/1	MODE/RANGE SEL	A739
TAWS CONFIG 1/1	PAGE DISPLAY	A739
TUNE OPT 1/1	# ADFS	0
TUNE OPT 1/1	# ATC	0
TUNE OPT 1/1	# COMS	0
TUNE OPT 1/1	# NAVS	1
TUNE OPT 1/1	COMM RADIO	25 KHz
VNAV OPT 1/2	FPA LIMIT	9

CDU Page	Field Name	Setting
VNAV OPT 1/2	TEMP COMP	DISABLED
VNAV OPT 1/2	VDEV SCALE	NORMAL
VNAV OPT 1/2	VDEV STOW	DISABLED
VNAV OPT 1/2	VNAV MODE	ENABLED
VNAV OPT 2/2	429/571/ASCB PITCH	ENRT+APPR
VNAV OPT 2/2	429/571/ASCB VDEV	ENRT+APPR
VNAV OPT 2/2	429/571/ASCB VERT SPD	ENRT+APPR
VNAV OPT 2/2	ANALOG PITCH	ENRT+APPR
VNAV OPT 2/2	ANALOG VDEV	ENRT+APPR
XFILL OPT 1/1	FPL	ENABLED
XFILL OPT 1/1	FUEL	ENABLED
XFILL OPT 1/1	INITIAL	ENABLED
XFILL OPT 1/1	MASTER	ENABLED
XFILL OPT 1/1	TUNE PRESETS	ENABLED
XFILL OPT 1/1	XFILL MODE	PUSH

3.3.1.2 Serial Number 281 System Status

Table 3-4 Serial Number 281 System Status

Parameter	Value	Raw Data
Date	10 April 2010	_DAY 0000C22C 00 63 _YEAR 0000C22E 0A
GMT	06:41:02	_GMT 0000C228 00 00 5D FE
System Position	N 54:49.483 E 032:03.161	SYSLAT 0000D03A 26 FC 89 47 SYSLON 0000D03E 16 CB 03 2D
Altitude	47 ft	_ALTINFEET 0000C59C 00 00 00 2F
Altitude 1 second ago	120 ft	PREVALTINFEET 0000C5A8 00 00 00 78
Derived Vertical Speed (computed by FMS based on altitude change)	-2374 ft/min	DERIVEDVS 0000EF14 F6 B9 2E 95
Filtered Derived Vertical Speed (Derived Vertical Speed with 4 second lag filter)	+603 ft/min	FDERIVEDVS 0000EF18 02 5B 34 8C
True Air Speed	73.281 m/s (142.45 kts)	TAS 0000C58E 12 52
Indicated Air Speed	145 kts	IAS 0000C594 05 AA
Ground Speed	71.609 m/s (139.20 kts)	_GS 0000C9E2 11 E7
System Velocity	S 22.2391 m/s W 69.2235 m/s	_SYSVEL 0000D08E FF E9 C2 CA SYSVELE 0000D092 FF BA C6 C8
True Track Angle	252.2°	TRK 0000C9E6 B3 58
Magnetic Heading	Not Valid. Last known heading value was 267.1°	HDGSRG 0000C58C 00 00 _HDG 0000C584 BD ED
Magnetic Variation	E 7.61°	_MAGVAR 0000C9E0 05 6A
Wind	Not Valid. (Note: This is expected because there is loss of heading, which is necessary for computation of winds.)	_WMAG 0000C9E8 81 D6 WANG 0000C9EA 12 10
Static Air Temperature	0° C	SAT 0000C590 00 00
Active From Waypoint	Flight Plan Leg number 19 DRL N 54:49.7 E 032:08.6 (DRL is a user-defined waypoint.)	26 FD 32 00 16 DB 84 00

Parameter	Value	Raw Data
Active To Waypoint	Flight Plan Leg number 20 XUBS N 54:49.5 E 032:01.6 (XUBS is a user-defined waypoint.)	26 FC 96 00 16 C6 47 00
Desired Track	267.1°	DSRTK 0000F1EC BD F4
Cross Track Distance	Left 114 m (0.062 NM)	XTK 0000F7A6 FF FF FF 8E
Along Track Distance	1664 m (0.9 NM)	DISPALONGTRACKDIST 0000F1D4 00 00 06 80
Bearing to Terminator	271.0°	C0 BC
Distance to Terminator	1673 m (0.9 NM)	DISPDISTTOTERM 0000F1E8 00 00 06 89
Heading Error	Not Valid (heading input is not available)	LGSDATAFLAGS 0000F47C 03 CE _HEADINGERROR 0000F476 E3 25
System Flags	Initial GMT, Date, and Position Verified Airborne Magnetic Variation Valid Mag/True Mode = Magnetic Flight Plan Defined Test mode = off PVOR mode = off VNAV mode = off Go-Around mode = off Selected Cross Track = off	SY\$FLAGS 0000C224 64 25 MORE\$FLAGS 0000C226 C1 00 SXTK 0000D36E 00 00 00 00
Fuel and Weight Data	Not Used	_DEPFUEL 0000C172 80 00 00 00
Power Down Data	Abnormal power-down February 28 06:42:37 N 50:54.500 E 004:29.936	PWRFLG 0000C000 00 01 PWRCLK 0000C004 00 00 5E 5D 00 3A PWRLAT 0000C00E 24 33 94 61 03 33 01 A5
Nav aids and Airports for the background map display	Nav aids: VTB MGL WKL GOL MNS GLB DGP LBN VNO KNA SAU RUD SUW MRA Airports: UMII UMOO UMGG UMMS UMMM ULOO EYVI EYKA UMMG EYSA EVRA EYPA EPSY UMKK	_MFDBUF 00 1C B0 31 49 59 00 C0 C7 B4 B0 31 40 71 01 08 7D C6 B0 31 49 D1 01 43 9D 2E B0 31 34 05 01 B2 80 55 B0 31 40 CB 01 CC C3 F5 B0 31 33 BA 01 D4 A9 D9 B0 31 31 E9 02 5C 94 58 B0 31 3F 45 02 BB 00 55 B0 31 49 2C 02 CA C9 C1 B0 31 3E 0A 03 4B FF A1 B0 31 45 5D 03 A3 32 2D B0 31 45 03 03 B8 B3 F5 B0 31 46 E3 03 CE 27 B4 B0 31 40 E9 04 8D 1E 49 B1 32 17 27 00 C0 C7 B4 B1 32 17 68 01 07 77 D1 B1 32 17 1A 01 B1 62 C6 B1 32 17 5B 01 CB C0 94 B1 32 17 4E 01 FD 87 10 B1 32 16 F3 02 98 43 5E B1 32 10 A7 02 CB CF 56 B1 32 10 80 03 49 F2 81 B1 32 17 41 03 68 F4 94 B1 32 10 9A 03 A6 61 79 B1 32 10 66 03 A6 87 75 B1 32 10 8D 04 94 A8 18 B1 32 10 18 04 AC 71 89 B1 32 17 34 04 B7 58 CD

Parameter	Value	Raw Data
Non-directional Beacons for the background map display	UU WS CO UF GH G VX NE GK KI	_NDB_LIST 53 0A B1 33 D7 E5 00 B9 C4 E9 B1 33 DA E5 00 C6 CC 79 B1 33 B2 C5 01 07 95 7D B1 33 D6 AD 01 08 59 6E B1 33 B8 B9 01 C9 DF 18 B1 33 B7 C9 01 CA CF 7D B1 33 D9 1D 01 CF A4 D8 B1 33 C6 B1 01 F9 8C 86 B1 33 B8 D1 02 02 82 F6 B1 33 BE C5 02 4C AE 06
Enroute Waypoints for the background map display	OLEMO RALOT MOSON ASKIL BUMIN BASRO OGUTA RATIN RUMIK BABOK	_ENR_LIST 53 0A B3 34 B6 E1 00 0F 04 75 B3 34 C7 E9 00 32 28 41 B3 34 A1 A1 00 73 3D 35 B3 34 3C ED 00 79 68 A5 B3 34 52 91 00 7C 4C 96 B3 34 46 89 00 83 E0 34 B3 34 B3 CB 00 89 95 2D B3 34 C9 8D 00 9A D2 D6 B3 34 D5 BD 00 B0 B4 51 B3 34 3F D1 00 CC DD 36
LIST Page Contents	The LIST pages were used to display the SIDs for EPWA. BAMS1A BAMS1D BAMS1G BAMS1K EVIN1A EVIN1B EVIN1D EVIN1E EVIN1G EVIN1H EVIN1K EVIN1L LOLS1A LOLS1D LOLS1G LOLS1K OLIL1A OLIL1B OLIL1D OLIL1E OLIL1G OLIL1H OLIL1K OLIL1L SOXE1A SOXE1D SOXE1G SOXE1K XIMB1A XIMB1B XIMB1D XIMB1E XIMB1G XIMB1H XIMB1K XIMB1L	LL3

Parameter	Value	Raw Data
NAV Leg Editing Buffer	Crew performed a Direct-TO (DTO) BERIS when position was approximately N 53:57.959 E 028:22.868 Result was the following navigation legs: FROM (PPOS) TO BERIS NEXT SODK NEXT+1 ASKIL NEXT+2 DRL1 NEXT+3 10XUB	TACTICALLEGSET

3.3.1.3 Serial Number 281 Lateral Flight Plan

Table 3-5 Serial Number 281 Lateral Flight Plan

Leg No.	Path	Terminator	Comment
1	Initial Fix	EPWA	Warsaw Frederic Chopin Airport
2	Course 291°	D289C	RW29.BAMS1G Departure
3	Course 291°	1000 ft Altitude	RW29.BAMS1G Departure
4	Heading 339°	Intercept next leg	RW29.BAMS1G Departure
5	Course 309°	Overfly WA706	RW29.BAMS1G Departure
6	Direct	WA798	RW29.BAMS1G Departure
7	Track	WA572	RW29.BAMS1G Departure
8	Track	BAMSO	RW29.BAMS1G Departure
9	Track	ASLUX	
10	Track	TOXAR	
11	Track	RUDKA	
12	Track	GOVIK	
13	Track	MNS	Minsk-2 VOR/DME
14	Track	BERIS	
15	Track	SODKO	
16	Track	ASKIL	
17	Track	DRL1	User-defined N 54:49.30 E 031:57.00
18	Track	10XUB	User-defined N 54:50.07 E 032:18.86
19	Track	DRL	User-defined N 54:49.70 E 032:08.60
20	Track	XUBS	User-defined N 54:49.50 E 032:01.60

3.3.1.4 Serial Number 281 Vertical Flight Plan

VNAV mode was inactive, and no vertical plan was defined.

3.3.1.5 Serial Number 281 Digital Outputs

The digital outputs are shown in the following table. The references in parentheses are the ARINC labels that correspond to the decoded parameter.

Table 3-6 Serial Number 281 Digital Outputs

Parameter	Value	Raw Data
TACAN Tuning Code (L032)	No Computed Data	B429L_RTAC 0000C3D0 20 00 00 D8
VOR Tuning Code (L034)	112.7	B429L_RVOR 0000C3D4 04 9C 02 38
DME Tuning Code (L035)	114.1	B429L_RDME 0000C3C0 05 04 0C B8
Selected Heading (L101)	No Computed Data	B429L_101 0000C3DC 20 00 00 82
ILS Course (L105)	No Computed Data	B429L_ILSCOURSE 0000C3E8 20 00 00 A2
Pseudo ILS Course (L110)	No Computed Data	B429L_PSEUDOILSCOURSE 0000C3EC 20 00 00 12
True Desired Track (L114)	268.5°	B429L_114 0000C39C F7 BF 00 32
True Waypoint Bearing (L115)	271.1°	B429L_115 0000C3A0 F8 18 00 B2
Cross Track Distance (L116)	L 0.067 NM	B429L_116 0000C3A4 7F FD DC 72
Vertical Deviation (L117)	No Computed Data	B429L_117 0000C3AC 20 00 00 F2
Horizontal Command (L121)	No Computed Data	B429L_121 0000C3A8 20 00 00 8A
Vertical Command (L122)	No Computed Data	B429L_122 0000C3B0 20 00 00 4A
Greenwich Mean Time (L125)	06:41.0	B429L_125 0000C378 01 90 40 AA
Magnetic Variation (L147)	E 7.73°	B429L_147 0000C398 E0 B0 00 E6
Greenwich Mean Time (L150)	06:41:02	B429L_150 0000C3D8 63 52 10 16
Wind on Nose (L163)	3 kts	B429L_163 0000C340 60 30 00 CE
Pseudo Localizer Deviation (L173)	No Computed Data	B429L_173 0000C3E0 20 00 00 DE
Pseudo Glideslope Deviation (L174)	No Computed Data	B429L_174 0000C3E4 20 00 00 3E
Pressure Altitude (L203)	604 ft	B429L_203 0000C3F0 60 12 E0 C1
Baro-Corrected Altitude (L204)	45 ft	B429L_204 0000C394 E0 01 68 21
True Air Speed (L210)	142.4375 kts	B429L_210 0000C388 61 1C E0 11
Static Air Temperature (L213)	0° C	B429L 0000C33C E0 00 00 D1
Distance to Go (L251)	0.875 NM	B429L_251 0000C380 60 00 E0 95
Time to Go (L252)	0.375 minutes	B429L_252 0000C384 E0 03 00 55
Date (L260)	Day = 10 Month = 4 Year = 10	B429L_260 0000C37C 08 10 40 0D
GPS Discrete Word (L261)	Approach not active. Terminal Mode.	B429H_GPS_WD1 0000D380 01 00 02 8D
FMS Navigation Mode (L266)	NAV mode = GPS Not Position Uncertain	B429L_266 0000C3F4 80 00 C2 6D
Status (L270)	NAV Valid MSG Present Selected Crosstrack = off No Waypoint Alert No Vertical Waypoint Alert Mag/True Mode = Mag Not FROM TO Not Approach Not Dead Reckoning Not Position Uncertain Estimated Position Uncertainty = 0.1 NM	B429L_270 0000C3B8 18 20 04 1D

Parameter	Value	Raw Data
Status (L275)	HSI Valid Magnetic Mode MSG Alert TO/FROM = TO Not Heading Mode Not Approach Mode Not Dead Reckoning Mode No Waypoint Alert	B429L_275 0000C3C8 74 40 00 BD
Present Position Latitude (L310)	N 54:49.471	B429L_310 0000C344 64 DF 90 13
Present Position Longitude (L311)	E 032:03.126	B429L_311 0000C348 62 D9 5D 93
Ground Speed (L312)	139.25 kts	B429L_312 0000C364 60 8B 40 53
True Track Angle (L313)	252°	B429L_313 0000C368 76 6B 00 D3
True Heading (L314)	No Computed Data	B429L_314 0000C36C 20 00 00 33
Filtered Wind Speed (L315)	No Computed Data	B429L_315 0000C370 20 00 00 B3
Filtered Wind Angle (L316)	No Computed Data	B429L_316 0000C374 20 00 00 73
Drift Angle (L321)	No Computed Data	B429L_321 0000C3BC 20 00 00 8B
Lateral Full Scale Display Deviation (L326)	1.0 NM	B429H_XTKLFS 0000D378 60 20 02 6B
Vertical Full Scale Display Deviation (L327)	500 ft	B429H_XTKVFS 0000D37C 63 E8 02 EB
N/S Velocity (L366)	S 42.625 kts	B429L_366 0000C35C FF D5 60 6F
E/W Velocity (L367)	W 132.5 kts	B429L_367 0000C360 7F 7B 80 EF
Distance to Destination (L351)	1 NM	B429L_351 0000C38C E0 00 20 97
Estimated Time to Destination (L352)	0 minutes	B429L_352 0000C390 60 00 00 57
Local Time Offset (L353)	No Computed Data	B429_353 0000C84C 20 00 00 D7
Equipment Ident (L371)	UASC	B429L_371 0000C3CC 62 4C 08 9F

3.3.1.6 Serial Number 281 Sensor Data

Configured sensors included analog heading, one ARINC 429 air data computer (ADC), triple ARINC 743 GPS, and one radio reference sensor (RRS). The RRS contains one DME, one VOR, and one TACAN. The cross-fill bus input from the offside FMS was also configured.

3.3.1.6.1 Serial Number 281 Analog Heading Inputs

The FMS was configured to receive heading from an analog heading source. The FMS was reporting that the heading input was not available. The last known heading was 259.5°. It is not known how long it had been since the heading input was lost.

Table 3-7 Serial Number 281 Analog Heading Inputs

Parameter	Value	Raw Data
Heading Status	Analog heading input not available	ANALOGHDGFLAGS 0000C5EE 00
Last Known Heading Value (magnetic referenced)	259.5°	ANALOGHDG 0000C5EC B8 83

3.3.1.6.2 Serial Number 281 ARINC 429 Air Data Inputs

ADC inputs are shown in Table 3-8. The references in parentheses are the ARINC labels that correspond to the decoded parameter.

Table 3-8 Serial Number 281 Air Data Inputs

Parameter	Value	Raw Data
Selected Altitude (L102)	0 ft	A_SELALTITUDE 0000C5B6 00 00 00 00 TAWS_102 00139F08 60 00 00 FF
Pressure Altitude (L203)	577.0 ft	ARINCPRESSALT 0000C5CA 00 90 40 00 TAWS_203 00139F1C 60 12 08 FF
Baro Corrected Altitude (L204)	20 ft	ARINCBAROALT 0000C5C6 00 05 00 00 TAWS_204 00135C5A 60 00 A0 FF
MACH (L205)	0.221	MACH 0000C592 00 DD
IAS (L206)	145 kts	ARINCIAS 0000C5BA 12 20 00 00
TAS (L210)	145 kts	ARINCTAS 0000C5BE 09 15 00 00 TAWS_210 0013B598 61 22 A0 FF
Vertical Rate (L212)	-432 ft/min	TAWS_212 00135C5E 7F CA 00 FF
Static Air Temperature (L213)	0.25° C	ARINCSAT 0000C5C2 00 10 00 00 TAWS_213 00134CF8 60 02 00 FE

3.3.1.6.3 Serial Number 281 ARINC 743 GPS Inputs

GPS1, GPS2, and GPS3 inputs are shown in Table 3-9. The references in parentheses are the ARINC labels that correspond to the decoded parameter.

Table 3-9 Serial Number 281 GPS Inputs

Parameter	GPS1	GPS2	GPS3	Raw GPS1	Raw GPS2	Raw GPS3
Latitude	N 54:49.4698	N 54:49.46788	N 54:49.46994	26 FC 7F BA	26 FC 7D 3D	26 FC 7E D7
Longitude	E 32:03.12166	E 32:03.1227	E 32:03.1221	16 CA E4 C1	16 CA E5 90	16 CA E5 15
HFOM	57.63 m	57.63 m	57.66 m	07 34	07 34	07 35
GPS Mode	NAV	NAV	NAV	03	03	03
Number of Satellites Tracked	11	11	11	0B	0B	0B
Number of Satellites Visible	13	13	13	0D	0D	0D
MSL Altitude (L076)	1018.25 ft	1018.25 ft	1018.25 ft	60 1F D2 AC	60 1F D2 AC	60 1F D2 AD
Ground Speed (L112)	141.875 kts	141.875 kts	141.750 kts	60 8D E0 AD	60 8D E0 AD	60 8D C0 AE

3.3.1.6.4 Serial Number 281 DME/VOR/TACAN Inputs

An RRS was configured on ARINC input port 3. The RRS contains DME, VOR, and TACAN receivers. The DME, VOR, and TACAN receivers were operational, but no stations were in range.

Table 3-10 FMS Serial Number 281 DME/VOR/TACAN Inputs

Parameter	Value	Raw Data
VOR Station Identifier	VTB	VORID 0000CA26 36 D2 20 00
VOR Station Position	N 55:07.534 E 30:21.080	VORPOS 0000CA2A 27 33 4E 00 15 95 4B 00
VOR Bearing	277.7°	VORBRG 0000CA44 C5 80
VOR Status	Station tuned, but no bearing received	VORCON 0000C94A F3 63 VORFLG 0000CA46 82 2B
Computed distance to VOR station	114169 m (61.65 NM)	VORDIST 0000CA4C 00 01 BD F9
VOR Frequency	112.70	VORFREQ 0000CA50 2C 06
VOR Station Declination	E 8.1°	VORDECL 0000CA52 05 C0

Parameter	Value	Raw Data
TACAN Identifier	SQQ	VTID 0000CA8E 33 C7 10 00
TACAN Position	N 55:53.427 E 23:24.143	VTPOS 0000CA92 27 BE 8C 00 10 A4 46 00
TACAN Bearing	119.4°	VTBRG 0000CAAC 54 F0
TACAN Status	TACAN tuned, but no bearing/distance received	TACANCON 0000C94E F3 63 VTFLG 0000CAAE 83 08
Computed distance to TACAN station	325575 m (175.8 NM)	VTDIST 0000CAB4 00 04 F7 C7
TACAN Frequency	116.30	VTREQ 0000CAB8 2D 6E
TACAN Declination	E 4.9°	VTDECL 0000CABA 03 80
DME Status	Scanning DME functioning, but not used for navigation, no DME stations tracked	DMEFLG 0000D2E0 61 49 DMECON 0000C936 F3 63
DME Stations for short-range navigation	BRP LBN MR VTB	DMESTK 80 02 B0312FFA 0439 F2BE 0034 80 04 B0313F45 E0AC F80B 00EA 80 03 B03140DA F44B F065 0058 01 11 B0314959 E0AF F826 00E5

3.3.1.6.5 Serial Number 281 Cross-Side FMS Inputs

Table 3-11 lists the parameters received from the cross-side FMS via the cross-fill bus.

Table 3-11 Serial Number 281 Cross-Side FMS Inputs

Parameter	Value	Raw Data
GMT	06:41.0	DUGMT 0000C6D4 01 90 40 FC
Date	Day = 10 Month = 4 Year = 10	DUDATE 0000C6DC 08 10 40 FD
FMS1 Status	Airborne Mode. Flight plan available for cross fill. Approach Mode not active.	FMS275 0000C6E8 0D 80 00 FD
FMS1 Position	N 54:49.492 E 032:03.157	FMS 0000DABA 26 FC 90 00 16 CB 00 00
Heading	No Computed Data Last known heading value was 264.8°	DUFLG 0000C6D0 00 13 DUHDG 0000C6E4 BC 4D 00 00
Selected Heading	No Computed Data	XIN_SEL_HDG 00132AD0 20 00 00 FF
Facility Frequency	No Computed Data	XFILL_FAC_FREQ 00108148 00 00
True Air Speed	127 kts	XFILL\$TAS 0000C768 60 FE 20 FE
Pressure Altitude	573 ft	XFILL\$ALT203 0000C770 60 11 E8 FE
Baro-Corrected Altitude	573 ft	XFILL\$ALT204 0000C778 60 11 E8 FE
Static Air Temperature	0.5° C	XFILL\$SAT 0000C780 60 04 00 FE

3.3.1.7 Serial Number 281 Timeline

There are a limited number of events that the FMS records with a timestamp. The following table shows the timeline leading up to the moment power was removed. The times are expressed in UTC on April 10, 2010.

Table 3-12 Serial Number 281 Timeline

Time (UTC)	Event	Notes
05:27:14	Takeoff time	TAKEOFF 0000D35C 00 00 4C B2
06:41:02	Greenwich Mean Time	GMT 0000C228 00 00 5D FE
No Data	Landing time	LANDINGGMT 0000E2BC 00 00 00 00

3.3.1.8 Serial Number 281 Maintenance Log Archive

This version of FMS does not have a maintenance log.

3.3.1.9 Serial Number 281 Faults and Messages

The results of power-on-self-test and contents of the MSG page are shown in Table 3-13. The MSG annunciator was flashing, which indicates that at least one message was unread.

Table 3-13 Serial Number 281 Faults and Messages

Parameter	Value	Raw Data
Self-Test Pass/Fail Status	Program Checksum Pass Non-volatile RAM Pass Clock/Calendar Pass Battery Pass Power Supply Pass Configuration Module Pass AUX Board Pass Analog Board Pass ARINC Board Pass Database RAM Pass Navigation Database Pass User-defined Database Pass	TFLAGS 0000C212 00 00 00 00 TFLAGS_DBSTAT 0000C222 01 00
MSG Page	MSG light blinking, but MSG page not read. Messages (newest to oldest): "NO HEADING" (Appears when airborne and there are no heading inputs available.) "A/D HEADING FAIL" (Appears when airborne and A/D heading input has been invalid for at least one second.) "NO VOR RECEIVED" (Appears when VOR is tuned, but no bearing received.) "NO DME RECEIVED" (Appears when no DME are received.)	MSGLIGHT 0000EE2C 00 03 MSG_STACK 001316E2 22 00 A8 4A 00 01 00 00 22 00 A9 68 F0 01 00 00 001316F2 22 00 AF 80 00 01 00 00 22 00 AF B4 00 00 00 00

3.3.1.10 Serial Number 281 Navigation Database

The FMS can store two complete Navigation Databases. Only one of the databases can be selected at a time. There were two different Navigation Databases installed. Both databases were current. The database in Bank 1 was active. The database in Bank 2 was deselected.

Table 3-14 Serial Number 281 Navigation Database

Parameter	Value	Raw Data
Bank 1 Status	Selected, not failed, expires on May 6, 2010.	DBACTIVE 0000C10B 01 DBSTATUS_TABLE1 BANK1EXDATE 0000C242 00 7D 0A FF
Bank 1 Contents	World Database with runways 5000 ft or longer, omitting Latin America, South America, and United States.	HEADERFILENAV1 WORLD W/O LAM SAM USA
Bank 2 Status	Deselected, not failed, expires on May 6, 2010.	DBACTIVE 0000C10B 01 DBSTATUS_TABLE2 BANK2EXDATE 0000C246 00 7D 0A FF
Bank 2 Contents	Database with runways 5000 ft or longer for Canada, Eastern Europe, Latin America, Pacific, South America, and United States.	HEADERFILENAV2 CAN EEU LAM PAC SAM USA

3.3.1.11 Serial Number 281 User-Defined Databases

The user-defined waypoint database contained 173 waypoint records. The user-defined route database contained 200 routes. The user-defined airport, SID, STAR, tactical waypoint, RADAR waypoint, alignment point, and company route databases were empty.

3.3.1.12 Serial Number 281 Waypoint Database

The user-defined waypoints are shown in Table 3-15.

Table 3-15 Serial Number 281 Waypoint Database

Identifier	Latitude	Longitude
1025	N 50 58.88	E 004 44.03
1029	N 52 19.54	E 018 08.19
1029L	N 52 25.35	E 017 36.97
10ABW	N 38 03.77	E 058 12.24
10ACC	N 51 01.84	E 017 07.44
10AST	N 51 09.01	E 071 40.32
10BAB	N 52 11.97	E 016 04.76
10BYD	N 53 07.71	E 018 19.58
10CCC	N 51 10.46	E 016 38.82
10CIA	N 41 56.17	E 012 29.90
10DE	N 51 38.33	E 021 39.89
10DEE	N 51 27.78	E 022 07.10
10DIR	S 07 58.96	W 034 58.29
10DRE	S 07 58.18	W 034 56.53
10EMB	N 54 03.39	E 019 24.82
10EMM	N 52 11.53	E 021 55.60
10EOK	N 54 41.99	E 018 19.14
10EPB	N 53 07.33	E 018 15.06
10EPD	N 51 27.78	E 022 07.10
10EPG	N 54 26.42	E 018 12.13
10EPM	N 52 11.90	E 021 23.11
10EPO	N 54 42.34	E 018 19.79
10EPW	N 52 19.35	E 018 07.95
10G11	N 54 18.57	E 018 44.87
10G12	N 54 19.14	E 018 42.56
10G3	N 54 26.73	E 018 10.93
10GCT	N 27 59.16	W 016 44.93

Identifier	Latitude	Longitude
10GDA	N 54 18.50	E 018 44.90
10HB	N 36 41.78	E 003 00.37
10IBR	N 50 58.90	E 004 44.02
10IBX	N 50 43.72	E 004 25.80
10IFL	N 12 00.52	E 014 54.39
10IGD	N 54 19.15	E 018 42.57
10IKF	N 63 59.12	W 022 57.72
10INA	N 41 33.39	E 045 05.32
10IOB	N 55 38.72	E 037 30.70
10IZA	N 45 37.18	E 015 52.13
10KRA	N 50 02.47	E 019 32.23
10KRW	N 50 07.92	E 020 09.93
10KS	N 52 15.27	E 017 12.41
10KSP	N 52 24.54	E 016 43.54
10KTC	N 50 28.64	E 019 21.00
10LLZ	N 50 02.47	E 019 31.95
10LPR	N 50 11.13	E 014 30.20
10M	N 52 11.54	E 021 55.60
10MBA	N 54 03.56	E 019 24.77
10MIN	N 52 11.53	E 021 55.60
10MM	N 52 11.54	E 021 55.60
10MMG	N 52 11.53	E 021 55.60
10MMP	N 52 11.90	E 021 23.11
10MS	N 46 50.85	E 017 05.85
10OK	N 54 27.20	E 018 42.20
10OKN	N 31 23.07	E 065 40.36
10OKS	N 54 27.54	E 018 42.85

Identifier	Latitude	Longitude
10OSV	N 49 35.30	E 017 56.56
10PBY	N 53 04.25	E 017 42.28
10PGD	N 54 17.46	E 018 42.56
10PKS	N 52 15.26	E 017 12.40
10POW	N 52 19.81	E 018 06.72
10PR	N 50 12.83	E 014 36.16
10PW	N 52 22.27	E 017 52.36
10R	N 37 16.81	E 127 05.12
10RD	N 51 25.76	E 021 28.19
10RK	N 37 27.14	E 127 19.33
10RKS	N 37 16.72	E 127 06.88
10SBH	N 26 51.72	E 014 36.73
10SEB	N 27 05.88	E 014 20.87
10SM	N 46 31.51	E 017 13.21
10SMO	N 54 49.65	E 033 17.30
10TFS	N 27 59.19	W 016 44.98
10UBS	N 54 48.89	E 031 44.35
10WR	N 51 01.61	E 017 07.87
10WRO	N 51 01.62	E 017 07.88
10XUB	N 54 50.07	E 032 18.86
10ZG	N 52 12.46	E 016 02.69
111TB	N 41 30.93	E 045 08.58
113UD	N 47 56.08	E 106 28.32
11EPW	N 52 01.15	E 021 05.69
11GD	N 54 26.73	E 018 10.93
11GDA	N 54 18.46	E 018 45.34
11ORE	N 48 38.74	E 002 06.69
11OSV	N 49 49.91	E 018 19.79
11TBS	N 41 28.13	E 045 02.27
11UDA	N 48 00.43	E 106 32.73
12AST	N 51 09.20	E 071 39.90
12PAP	N 18 33.82	W 072 31.06
13NA	N 41 27.15	E 045 02.51
14AST	N 51 09.54	E 071 44.07
14PNW	N 49 02.97	E 002 54.59
15AST	N 51 13.30	E 071 39.00

Identifier	Latitude	Longitude
15R	N 33 16.07	E 044 13.00
168TB	N 41 51.28	E 044 43.08
16POZ	N 52 20.11	E 017 16.07
16TBS	N 41 48.50	E 044 40.11
1EPW	N 52 18.74	E 020 50.31
20CZE	N 52 14.17	E 017 15.81
22PAP	N 18 39.52	W 072 40.83
23SA	N 53 03.85	E 050 09.24
23SAM	N 53 12.16	E 050 18.44
26KS	N 52 18.71	E 017 01.75
33L	N 33 14.34	E 044 14.04
33R	N 33 15.09	E 044 15.09
39SBH	N 26 56.04	E 014 31.90
4M33R	N 33 11.63	E 044 17.50
4WAS	N 52 08.60	E 021 03.02
63KTC	N 50 28.61	E 019 15.21
63POZ	N 52 25.44	E 017 00.56
7LAW	N 52 29.24	E 016 40.31
7MM	N 52 11.60	E 021 50.73
80VB	N 17 22.75	E 078 07.29
88POZ	N 52 22.51	E 017 03.96
89AG	N 36 47.96	E 003 23.80
8LOD	N 51 46.12	E 019 36.33
8SL	N 53 04.62	E 017 46.80
92SCZ	N 53 28.78	E 015 06.48
98SME	N 46 49.74	E 017 09.82
9SZC	N 53 28.77	E 015 06.47
ABEAM	N 46 06.47	E 014 40.68
AHD8	N 37 55.27	E 058 31.31
AL1	N 53 41.00	E 041 41.00
AP1	N 48 50.15	E 024 57.23
ASH76	N 37 56.13	E 058 29.95
AST1	N 51 09.60	E 071 44.20
AST2	N 51 08.90	E 071 40.40
BAG21	N 35 07.21	E 069 23.15
BURAK	N 53 00.00	W 012 00.00

Identifier	Latitude	Longitude
CYXO	N 53 54.00	E 051 11.00
D107	N 50 29.66	E 030 55.07
D108	N 50 57.50	E 004 47.22
D109	N 50 59.28	E 004 45.31
D10RE	S 07 58.47	W 034 55.87
D13	N 50 58.53	E 004 51.85
D139	N 50 58.53	E 004 51.85
D14	N 52 23.05	E 020 48.67
D162	N 51 08.09	E 017 26.60
D191	N 54 15.58	E 018 44.80
D63	N 52 23.28	E 017 00.08
D80	S 11 54.94	W 077 13.26
D81	N 53 29.55	E 015 04.95
D88	N 43 15.11	E 027 36.84
D89	N 36 51.48	E 003 15.96
DD191	N 54 20.24	E 017 40.10
DD76	N 54 19.42	E 018 41.12
DRL	N 54 49.70	E 032 08.60
DRL1	N 54 49.30	E 031 57.00
DUPA	N 52 11.53	E 021 55.60
FLL10	N 50 58.91	E 004 55.81
FLO10	N 50 46.27	E 005 20.27
FLO81	N 50 57.71	E 004 58.14
FLOS1	N 64 03.30	W 027 10.70

Identifier	Latitude	Longitude
GDV1	N 28 04.60	W 015 25.70
GOLT	N 51 38.00	E 056 36.00
GTOH	N 52 00.00	E 050 37.00
IBL13	N 50 58.53	E 004 51.85
KNN	N 54 32.55	E 018 34.01
KRW10	N 50 06.84	E 020 02.25
KRYT	N 53 08.00	E 053 13.00
LAW88	N 52 22.87	E 017 01.77
OTRN1	N 64 11.20	W 022 36.30
P12	N 51 55.00	E 053 12.00
PW11L	N 52 23.16	E 017 49.73
PW11R	N 52 23.03	E 017 19.67
PW29L	N 52 22.46	E 017 52.60
PW29R	N 52 22.72	E 017 52.01
SAL1	N 16 44.50	W 022 57.00
SB75	N 37 56.05	E 058 29.76
UM26	N 54 49.45	E 033 00.01
UOLH	N 52 34.00	E 049 59.00
UUBS	N 54 49.48	E 002 01.75
UUSM	N 54 49.40	E 032 01.40
UWWG	N 53 13.07	E 050 19.46
VIDR1	N 26 53.70	W 017 02.40
XUBS	N 54 49.50	E 032 01.60

3.3.1.13 Serial Number 281 Route Database

The user-defined routes are shown in Table 3-16.

The route identifier has the form "ORIGIN DESTINATION" when the route identifier was assigned automatically by the FMS. It has the form "NAME" when the route identifier was manually entered by the crew.

Many of the routes contain one or more "*GAP*". A *GAP* indicates that the route was originally defined with a waypoint, procedure, or airway from the navigation database, and that item is not included in a subsequent database cycle. The FMS automatically substitutes a *GAP* for missing items when it updates the route database for a newly activated navigation database cycle.

Table 3-16 Serial Number 281 Route Database

Route Identifier	Route Contents
GAP *GAP*	*GAP* *GAP* *GAP* 6235N 6140N *GAP* 5750N 5555N SCROD VALIE YYR PN *GAP* *GAP* *GAP*
GAP BIKF	*GAP* *GAP* *GAP* TAFFY J564 LOACH 5850N 6140N 6330N EMBLA BIKF *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* J575 J577
GAP CYQX	CYQX
GAP EPGD	*GAP* *GAP* *GAP* *GAP* N873 UN873 UP729 UP730 UL983 UZ491 N195 Y100 L730 EPGD
GAP EPWA	*GAP* *GAP* *GAP* UL156 UM985 UM141 UM985 UM866 EPWA
GAP EPWA	*GAP* *GAP* *GAP* UN736 UM985 UM866 EPWA
GAP EPWA	*GAP* *GAP* *GAP* UN736 UM985 UM866 EPWA
GAP EPWA	*GAP* *GAP* *GAP* *GAP* *GAP* *GAP* UN983 UY100 UL730 UN133 L621 EPWA
GAP EPWA	*GAP* *GAP* *GAP* *GAP* *GAP* *GAP* UN983 UY100 UL730 UN133 L621 EPWA
GAP EPWA	*GAP* *GAP* *GAP* *GAP* M985 M866 EPWA
GAP FTTJ	*GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP*
GAP FTTJ	*GAP* *GAP* FTTJ
GAP GRU	*GAP* *GAP* *GAP* UZ907 UZ717 UT705 UL730 EPGD GRU
GAP KBGR	*GAP* *GAP* W11 A319 ELMUC MACOR L455 J174 J55 J581 KBGR
GAP MDLR	*GAP* *GAP* W26 W29 PETRI MDLR
GAP MTPP	*GAP* *GAP* *GAP* *GAP* *GAP* B520 G633 MTPP
GAP MTPP	*GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* *GAP* G444 G444W MTPP
GAP TJSJ	*GAP* *GAP* *GAP* W6 W12 TJSJ
09020010	EPWA BAMSO Z182 UZ460 UM977 UT727 UP851 EPWA
BRU1002	EPWA LOLSI UZ71 UL980 T851 UZ717 UM170 UZ158 EBBR
BRU11021	EPWA LOLSI UZ71 UL980 UM170 UZ717 T855 EBBR
BRUWAW11	*GAP* *GAP* *GAP* Z905 UZ907 UZ717 UL980 UP150 EPWA
CYQX EPWA	CYQX COLOR RONPO 4750N 4940N *GAP* *GAP* *GAP* BURAK *GAP* *GAP* *GAP* *GAP* UP147 UL980 P150 EPWA
EPGD EGLL	EPGD KRT L730 UL730 T705 UZ717 UM864 UL980 UL480 UL980 L980 EGLL
EPGD EPBY	EPGD KRT N133 Z96 EPBY
EPGD EPKS	EPGD KRT N133 Z71 L980 EPKS
EPGD EPPO	EPGD KRT N133 N858 GINOK LAW LAW88 EPPO
EPGD EPWA	EPGD KRT N133 L621 EPWA
EPGD EPWA	EPGD KRT N133 L621 EPWA
EPGD EPWA	EPGD KRT N133 L621 EPWA
EPGD LKMT	EPGD KRT UN133 UQ10 UL984 LKMT
EPGD OKBK	EPGD KRT N133 UL621 UL981 UM860 UT33 UT34 UR21 R784 UP975 OKBK
EPGD UBBS	EPGD KRT N133 UL621 UN191 UA42 UM854 UM860 UL851 UR317 UM11 UBBS
EPGD UKBB	EPGD KRT N133 L621 B490 R22 A87 UKBB
EPKK EPWA	EPKK VAVEL M985 EPWA
EPKK EPWA	EPKK JED M866 EPWA
EPKK UGTB	EPKK KRW ADOKI L984 UL984 UA42 UM854 UM860 UL851 UG261 UN61 UGTB
EPKS EPBY	EPKS DEKUT Z96 EPBY
EPKS EPKS	EPKS
EPKS EPWA	EPKS DEKUT Z96 EPBY SL Z96 L621 EPWA
EPKS EPWR	EPKS CZE L617 EPWR
EPKT EPWA	EPKT MOKOS T709 M866 EPWA
EPLL LOWW	EPLL DEDOL N744 UM984 UT43 LOWW
EPMM EPWA	EPMM SIE EPMM SIE EPWA
EPPO *GAP*	EPPO CZE *GAP* *GAP* *GAP* *GAP*
EPPO EPWA	EPPO CZE P150 EPWA
EPPO EPWA	EPPO CZE L980 EPWA
EPSC EPWA	EPSC TOMKO L23 L621 EPWA
EPWA *GAP*	EPWA TITAK *GAP* *GAP* *GAP* *GAP*
EPWA BIKF	EPWA OLILA UN191 UL621 G3 KEILA BIKF
EPWA DAAG	EPWA EVINA UN744 UM984 UN850 UM989 UA24 DAAG
EPWA DAAG	EPWA DEDOL UM985 UM984 UM725 UL141 UM859 UM167 UL12 UQ710 UZ924 M603 UM986 UG26 DAAG
EPWA EBBR	EPWA TITAK UZ71 UL980 UZ717 Z717 T855 EBBR
EPWA EBBR	EPWA TITAK UZ71 UL980 UZ717 Z717 T855 EBBR
EPWA EBBR	EPWA TITAK UZ71 UL980 UZ717 Z717 T855 EBBR
EPWA EBBR	EPWA TITAK UZ71 UL980 UZ717 Z717 T855 EBBR
EPWA EFHK	EPWA SIE UM857 M857 EFHK
EPWA EHAM	EPWA TITAK UZ71 UL980 T281 EHAM

Route Identifier	Route Contents
EPWA EPBY	EPWA IDAKO N191 Z96 10BYD NEREK SL EPBY
EPWA EPBY	EPWA IDAKO N191 Z96 EPBY
EPWA EPBY	EPWA IDAKO N191 Z96 SL 10BYD EPBY
EPWA EPBY	EPWA IDAKO N191 Z96 SL EPBY
EPWA EPGD	EPWA IDAKO GRU KRT *GAP* EPGD
EPWA EPGD	EPWA IDAKO N191 EPGD
EPWA EPGD	EPWA IDAKO N191 N133 GDA 10GDA 10G11 EPGD
EPWA EPGD	EPWA IDAKO N191 N133 EPGD
EPWA EPGD	EPWA IDAKO N191 N133 KRT D191 DD76 GDA S EPGD
EPWA EPKK	EPWA EVINA M985 EPKK
EPWA EPKK	EPWA *GAP* DEDOL M985 KRW10 EPKK
EPWA EPKK	EPWA DEDOL M985 KRW10 EPKK
EPWA EPKS	EPWA IBARA T711 L980 EPKS
EPWA EPLL	EPWA IBARA EPLL
EPWA EPMM	EPWA *GAP* SIE 10MM EPMM
EPWA EPMM	EPWA KOVOL SIE EPMM
EPWA EPMM	EPWA SIE 10MMP EPMM
EPWA EPMM	EPWA SIE 10MM EPMM
EPWA EPPO	EPWA TITAK Z71 L980 20CZE 16POZ D63 EPPO
EPWA EPPO	EPWA *GAP* IBARA T711 L980 20CZE 16POZ EPPO
EPWA EPSC	EPWA IBARA T711 L980 L619 L996 EPSC
EPWA EPWA	EPWA EVINA M985 M866 EPWA
EPWA EPWA	EPWA BAMSO Z182 UZ460 UM977 UT727 UL23 UL730 UL996 UL619 UL981 M866 EPWA
EPWA EPWA	EPWA BAMSO Z182 UZ460 M977 L29 L23 L730 L996 L619 L981 M985 KRW JED M866 EPWA
EPWA EPWA	EPWA BAMSO Z182 UZ460 UM977 UT727 UL23 L621 EPWA
EPWA EPWA	EPWA BAMSO TOXAR UZ460 UM977 UT727 UL619 UL980 UN133 UM866 EPWA
EPWA EPWA	EPWA SIE EPWA
EPWA EPWA	EPWA SIE EPWA
EPWA EPWA	EPWA SIE EPMM URAGI IDAKO N191 Z96 EPBY SL NEREK Z96 L621 EPWA
EPWA EPWA	EPWA SULOX *GAP* AY EPWA
EPWA EPWA	EPWA LIN EPWA
EPWA EPWA	EPWA SIE UM857 UM857 EPMM SIE EPWA
EPWA EPWA	EPWA *GAP* *GAP* EPWA
EPWA EPWA	EPWA SIE 10MMP EPMM SIE EPWA
EPWA EPWA	EPWA IBARA T711 L980 10KSP EPKS CZE L980 EPWA
EPWA EPWA	EPWA SIE EPWA
EPWA EPWA	EPWA SIE 10MM EPMM SIE EPWA
EPWA EPWA	EPWA SIE *GAP* *GAP* *GAP* EPWA
EPWA EPWA	EPWA MARIA 10RD EPRA MARIA 10MM EPMM LIN *GAP* *GAP* *GAP* EPWA
EPWA EPWA	EPWA SIE 10M EPMM LIN L621 Z96 SL EPBY NEREK Z96 L621 EPWA
EPWA EPWA	EPWA LIN *GAP* *GAP* EPWA
EPWA EPWR	EPWA SOXER N869 EPWR
EPWA EPWR	EPWA *GAP* IBARA T711 WRW EPWR
EPWA EPZG	EPWA IBARA T711 L980 10BAB EPZG
EPWA EYVI	EPWA SIE UM857 N858 EYVI
EPWA GCTS	EPWA IBARA UT711 UN869 UN747 UN857 GCTS
EPWA HLLS	EPWA DEDOL UM66 UZ201 UZ200 UM986 UY552 L196 UM725 UM742 UP623 UM727 T295 M726 G659 A403 HLLS
EPWA LBWN	EPWA MARIA L621 UN616 G1 B27 LBWN
EPWA LDZA	EPWA EVINA UN744 UM984 UM725 LDZA
EPWA LDZA	EPWA DEDOL N744 UM984 UM725 LDZA
EPWA LFPO	EPWA IBARA UT711 UN869 UL984 UN857 LFPO
EPWA LFST	EPWA IBARA UT711 UN869 T710 T711 LFST
EPWA LGAV	EPWA DEDOL UM985 UN133 UL619 UN127 UG33 LGAV
EPWA LHBP	EPWA EVINA UM985 UM866 UZ201 LHBP
EPWA LIRA	EPWA DEDOL UN744 UM984 UM725 UL141 UN737 LIRA
EPWA LILJ	EPWA DEDOL UM985 UM984 UM725 L141 LILJ
EPWA LILJ	EPWA DEDOL UN744 UM984 UM725 L141 LILJ
EPWA LKPR	EPWA EVINA N744 M984 T47 M748 LKPR
EPWA LKPR	EPWA EVINA N744 M984 T47 M748 LKPR
EPWA LLBG	EPWA MARIA UL621 UN616 UL620 UA16 UG18 UH2 LLBG
EPWA LPPT	EPWA IBARA UT711 UN869 UN995 UN976 UN872 LPPT
EPWA LRBS	EPWA DEDOL UM985 UN133 UL619 UL620 T74 LRBS

Route Identifier	Route Contents
EPWA LROP	EPWA DEDOL UM985 UN133 UL619 UL620 T74 LROP
EPWA LROP	EPWA DEDOL UM985 UN133 UL619 UN127 UL867 UL605 L605 W2 LROP
EPWA OAIX	EPWA MARIA UL621 UL984 B493 B946 G246 A87 B363 B198 A107 A466 OAIX
EPWA OAKB	EPWA MARIA UL621 UL980 A87 B363 B198 A107 A466 A454 OAKB
EPWA OEJN	EPWA DEDOL UM985 UP746 UN616 UL601 R785 UR785 B544 B412 JDW OEJN
EPWA ORBI	EPWA MARIA UL621 UL981 UM860 UT33 UT34 UR21 R784 L417 NUNSE ORBI
EPWA UACC	EPWA SIE UP851 UP140 B365 G549 G234 B935 G111 UACC
EPWA UBBB	EPWA MARIA UL621 UL980 UN191 UA42 UM854 UM860 UL851 UR317 UM11 UBBB
EPWA UBBB	EPWA MARIA UL621 UL980 UN191 A277 UN77 UM747 UM11 UBBB
EPWA UGSB	EPWA XIMBA L621 UL980 UN191 A277 UT910 UGSB
EPWA UGTB	EPWA MARIA UL621 UL980 UN191 UA42 UM854 UM860 UL851 UG261 UN61 UGTB
EPWA UKBB	EPWA MARIA UL621 UL980 UA87 UKBB
EPWA UKHH	EPWA MARIA UL621 UL980 UA87 UB144 UA137 UKHH
EPWA UL601	EPWA DEDOL UM985 UP746 UN616 UL601
EPWA UN191	EPWA OLILA UN191
EPWA UN191	EPWA OLILA UN191
EPWA UTAA	EPWA IBARA T711 L980 UL980 A226 B493 A87 UTAA
EPWA UUWW	EPWA SIE UN869 UM863 B102 R11 DR UUWW
EPWA UWWW	EPWA ASLUX UZ182 UP851 UP140 B365 UWWW
EPWA XUBS	EPWA BAMSO Z182 Z460 N869 UM863 B102 DRL 10XUB XUBS
EPWR EPKK	EPWR WRW *GAP* R232 EPKK
EPWR EPWA	EPWR TRZ VAGSA N871 EPWA
EPZG EPWA	EPZG OBOLA L980 EPWA
EPZG EPWA	EPZG KELOD L980 EPWA
EYVI EPWA	EYVI *GAP* L29 UM857 EPWA
GDANSK	EPWA IDAKO N191 N133 KRT D191 DD76 GDA S EPGD
ICPI	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
KTC2502	UKBB KR *GAP* UT709 L981 T709 KTC EPKT
LBWN EPWA	LBWN *GAP* *GAP* UL743 UL621 EPWA
LHBP EPWA	LHBP LITKU UL853 UM985 UM866 EPWA
LKMT EPWA	LKMT SOPAV T709 M866 EPWA
LKPR EPWA	LKPR ARTUP N871 Q277 EPWA
LRBS EPWA	LRBS NILOV UL622 UN133 UM866 EPWA
LROP EPWA	LROP NILOV UL622 UN133 UM866 EPWA
LROP EPWA	LROP NILOV UL622 UN133 UM866 EPWA
OBLOT	EPWA ASLUX Z460 UM977 UN871 UN133 UM866 EPWA
OBLOT	EPWA SIE M857 N871 N133 M866 EPWA
OBLOT1	EPWA SIE M857 N871 EPWA
RJTT RKSM	RJTT SEKID Y20 Y18 G585 RKSM
RKSM ZMUB	RKSM SEL G597 A326 B339 ZMUB
SCROD *GAP*	SCROD VALIE YZR PN *GAP* *GAP* *GAP*
UACC EPWA	UACC DIDAL G111 B935 G234 SL B365 UP140 UP851 EPWA
UACC ZMUB	UACC EDANO G111 A241 R366 G22 G2 ZMUB
UBBB EPGD	UBBB SAGIL UM11 UR317 UL851 UM860 UM854 UA42 UN191 N133 EPGD
UBBB EPWA	UBBB SAGIL UM11 UR317 UL851 UM860 UM854 UA42 UN191 N191 Q130 EPWA
UBBB VOHY	UBBB DILON A911 B449 B447 G792 P628 W20S W19 VOHY
UGSB EPWA	UGSB SOSED UT910 A277 UN191 N191 EPWA
UGTB EPWA	UGTB LEGVI B140 B705 B232 UM11 UR317 UL851 UM860 UM854 UA42 UL984 UL621 EPWA
UGTB EPWA	UGTB LAGAS UN61 UG261 UL851 UM860 UM854 UA42 UN191 UL980 UL621 EPWA
UGTB UGTB	UGTB
UKBB EPGD	UKBB KR *GAP* UA87 UL980 UN191 EPGD
UKBB EPWA	UKBB KR *GAP* UA87 UL980 N191 Q130 EPWA
UKBB2425	EPWA XIMBA UL621 UL980 UA87 UKBB
UKCC EPWA	UKCC GELBO W644 UA83 UL980 UN191 EPWA
UKHH EPWA	UKHH KW UA137 UA87 UL980 N191 Q130 EPWA
UTAA EPKK	UTAA MAMED B450 UN50 B450 B494 UM991 UL984 UL981 M985 EPKK
UTAA EPWA	UTAA MAMED B450 B494 UM991 UN191 UL980 UL621 EPWA
UTAA OAKB	UTAA BUROT A118 B442 T1 B441 A466 A454 OAKB
UTAA OAKB	UTAA KEMOR T1 B441 A466 OAKB
UUBS EPWA	UUBS *GAP* *GAP* UL999 UP851 EPWA
UUSM EPWA	UUSM *GAP* *GAP* UL999 UP851 EPWA
UUWW EPWA	UUWW *GAP* UM BG R805 G723 UN858 UN869 N869 EPWA
UUWW UUWW	UUWW WZ IP IN DR UUWW
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG

Route Identifier	Route Contents
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWG UWWG	UWWG UOLH GTOH GOLT KRYT CYXO UWWG
UWWW UWWW	UWWW UOLH GTOH GOLT KRYT CYXO UWWW
UWWW EPWA	UWWW RL B922 B365 B364 G3 AL1 NEMRI B365 UP140 UP851 P851 EPWA
UWWW UWWW	UWWW UWLW UWKD UWWW
VALIE SCROD	VALIE YXR *GAP* SCROD
WROCLAW	EPWA SOXER N869 TRZ D162 SUPUT WRW EPWR
XUBS EPWA	XUBS ASKIL UM863 M863 EPWA
ZMUB RJBB	ZMUB UDA B339 W12 A326 G597 TRE SAEKI HAKBI OKC ALISA EDDIE RJBB
ZMUB RJTT	ZMUB UDA B339 A326 G597 V17 RJTT
ZMUB UACC	ZMUB BULAG G14 G2 G22 R366 A241 G111 UACC

3.3.1.14 Serial Number 281 Advanced Performance Database

The FMS did not have an Advanced Performance Database installed.

3.3.1.15 Serial Number 281 CDU Page

The CDU was displaying the NAV 1/2 page. The information displayed on the CDU is shown in Figure 3-12.

```

+-----+
|                 N A V           1 / 2           M S G                 |
|                                                                    |
|  f r   D R L           0 6 : 3 9           |
|  2 6 0 °           0 . 9 n m           0 + 0 0           |
|  t o   X U B S           0 6 : 4 1           M N V R >           |
|                                                                    |
|  n x   - - - - -           |
|                                                                    |
|  x t k   ( t )   L 0 . 0 6           g s           1 3 9           |
|  h e a d w i n d           - - -           b r g           2 6 3 °           |
|  w i n d           - - - t / - - -           t k e           L 0 1 5 °           |
+-----+

```

Figure 3-12 NAV 1/2 Page

3.3.1.16 Serial Number 281 Key Press History

The FMS keeps a running history of up to 100 of the most recent key presses the crew entered on the CDU. The key presses are not time-stamped. Only the sequence of key presses is recorded.

Knowing the layout of the CDU pages and the sequence of key presses, it is possible to reconstruct the crew's actions. This analysis is shown in Table 3-17. The key presses are listed from oldest to newest.

Table 3-17 Key Press History

Mode	Field	Page	Key	Crew Action	Result
FPL	43	1	R2	On the FPL page, pressed the INFO key.	Displayed information about the cursorred waypoint.

Mode	Field	Page	Key	Crew Action	Result
WPT	255	0	FPL	On the waypoint INFO page, pressed the FPL key.	Returned from the INFO page to the flight plan page.
FPL	255	1	NEXT	On the FPL page, pressed the NEXT key.	Shown the next page of the flight plan.
FPL	255	1	L5	On the FPL page, brought the cursor over the 5th position on the page.	
FPL	43	1	D		
FPL	43	1	R		
FPL	43	1	L		
FPL	43	1	ENTER	Started to insert waypoint "DRL" into the flight plan.	
WPT	16	0	ENTER	Completed insertion of waypoint "DRL" into the flight plan.	User-defined waypoint "DRL" is inserted into the active flight plan.
FPL	16	1	PREV	On the FPL page, pressed the PREV key.	Shown the previous page of the flight plan.
FPL	255	1	L3	On the FPL page, brought the cursor over the 3rd position on the page.	
FPL	25	1	R1		
FPL	25	1	R1	Deleted the cursored flight plan leg.	Deleted a waypoint from the flight plan.
FPL	25	1	L3	On the FPL page, parked the cursor.	
FPL	255	1	L4	On the FPL page, brought the cursor over the 4th position on the page.	
FPL	34	1	D		
FPL	34	1	R		
FPL	34	1	L		
FPL	34	1	1		
FPL	34	1	ENTER	Started to insert waypoint "DRL1" into the flight plan.	Started to insert user-defined waypoint "DRL1" into the flight plan.
WPT	16	0	R5	Aborted insertion of "DRL1".	DRL1 was not inserted into the flight plan.
FPL	34	1	L3	On the FPL page, brought the cursor over the 3rd position on the page.	
FPL	25	1	D		
FPL	25	1	R		
FPL	25	1	L		
FPL	25	1	1		
FPL	25	1	ENTER	Started to insert waypoint "DRL1" into the flight plan.	
WPT	16	0	ENTER	Completed insertion of waypoint "DRL1".	Inserted user-defined waypoint "DRL1" into the flight plan.
FPL	34	1	NAV	On the FPL page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	NEXT	On the NAV 1/2 page, pressed the NEXT key.	NAV 2/2 page appeared.
NAV	255	6	NEXT	On the NAV 2/2 page, pressed the NEXT key.	NAV 1/2 page appeared.

Mode	Field	Page	Key	Crew Action	Result
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	NEXT	On the FPL page, pressed the NEXT key.	Displayed the next flight plan page.
FPL	255	1	NEXT	On the FPL page, pressed the NEXT key.	Displayed the next flight plan page.
FPL	255	1	L2	On the FPL page, brought the cursor over the 2nd position on the page.	
FPL	16	1	V		
FPL	16	1	N		
FPL	16	1	O		
FPL	16	1	ENTER	Started to insert waypoint "VNO".	Started to insert "VNO", the Vilnius VOR/DME, into the flight plan.
WPT	16	0	R5	Aborted insertion of "VNO".	VNO not inserted into the flight plan.
FPL	16	1	NAV	On the FPL page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	MENU	On the FPL page, pressed the MENU key.	Flight plan MENU 1/2 appeared.
FPL	255	8	L3	On the FPL MENU 1/2 page, pressed the PPOS TO WPT key.	PPOS TO WPT view of the flight plan appeared. This shows the along-track distance from present position to each downstream waypoint in the flight plan.
FPL	255	3	NEXT	On the PPOS TO WPT page, pressed the NEXT key.	Next PPOS TO WPT page appeared.
FPL	255	3	MENU	On the PPOS TO WPT page, pressed the MENU key.	MENU 1/2 page appeared.
FPL	255	8	NEXT	On the FPL MENU 1/2 page, pressed the NEXT key.	MENU 2/2 page appeared.
FPL	255	9	L2	On the FPL MENU 2/2 page, pressed the FPL TO DEST key.	FPL TO DEST view of the flight plan appeared. This shows the along-track distance from each waypoint in the flight plan to the destination.
FPL	255	4	NEXT	On the FPL TO DEST page, pressed the NEXT key.	Next FPL TO DEST page appeared.
FPL	255	4	PREV	On the FPL TO DEST page, pressed the PREV key.	Previous FPL TO DEST page appeared.
FPL	255	4	NAV	On the FPL TO DEST page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	L4	On the FPL page, brought the cursor over the 4th position on the page.	
FPL	34	1	G		
FPL	34	1	L		
FPL	34	1	B		
FPL	34	1	ENTER	Started to insert waypoint "GLB".	Started to insert "GLB", the Gloubokoye VOR/DME, into the flight plan.
WPT	16	0	R5	Aborted insertion of "GLB".	GLB not inserted into the flight plan.

Mode	Field	Page	Key	Crew Action	Result
FPL	34	1	NAV	On the FPL page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	MENU	On the FPL page, pressed the MENU key.	FPL MENU 1/2 appeared.
FPL	255	8	L3	On the FPL MENU 1/2 pressed the PPOS TO WPT key.	PPOS TO WPT view of the flight plan appeared. This shows the along-track distance from present position to each downstream waypoint in the flight plan.
FPL	255	3	NEXT	On the PPOS TO WPT page pressed the NEXT key.	Next PPOS TO WPT page appeared.
FPL	255	3	NAV	On the PPOS TO WPT page pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	L4	On the FPL page, brought the cursor over the 4th position on the page.	
FPL	34	1	M		
FPL	34	1	G		
FPL	34	1	L		
FPL	34	1	ENTER	Started to insert waypoint "MGL".	Started to insert "MGL", the Mahiliou VOR/DME, into the flight plan.
WPT	16	0	R5	Aborted insertion of "MGL".	MGL not inserted into the flight plan.
FPL	34	1	NAV	On the FPL page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	FPL	On the FPL page, pressed the FPL key (functions as the NEXT key).	Next flight plan page appeared.
FPL	255	1	NAV	On the FPL page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	DTO	On the NAV 1/2 page, pressed the DTO key.	DTO page appeared.
DTO	3	0	ENTER	On the DTO page, selected the current TO leg.	Active TO leg became a direct-to leg.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.
FPL	255	1	MENU	On the FPL page, pressed the MENU key.	FPL MENU 1/2 appeared.
FPL	255	8	L3	On the FPL MENU 1/2 pressed the PPOS TO WPT key.	PPOS TO WPT view of the flight plan appeared. This shows the along-track distance from present position to each downstream waypoint in the flight plan.
FPL	255	3	NEXT	On the PPOS TO WPT page pressed the NEXT key.	Next PPOS TO WPT page appeared.
FPL	255	3	PREV	On the PPOS TO WPT page, pressed the PREV key.	Previous PPOS TO WPT page appeared.
FPL	255	3	NAV	On the PPOS TO WPT page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	FPL	On the NAV 1/2 page, pressed the FPL key.	Flight plan page appeared.

Mode	Field	Page	Key	Crew Action	Result
FPL	255	1	MENU	On the FPL page, pressed the MENU key.	FPL MENU 1/2 appeared.
FPL	255	8	L3	On the FPL MENU 1/2 pressed the PPOS TO WPT key.	PPOS TO WPT view of the flight plan appeared. This shows the along-track distance from present position to each downstream waypoint in the flight plan.
FPL	255	3	NEXT	On the PPOS TO WPT page pressed the NEXT key.	Next PPOS TO WPT page appeared.
FPL	255	3	NAV	On the PPOS TO WPT page, pressed the NAV key.	NAV 1/2 page appeared.
NAV	255	4	R1	On the NAV page, selected the CMD HDG field.	NAV 1/3 page appeared. This is the page where the crew can select commanded heading mode.
NAV	18	0	4		
NAV	18	0	0		
NAV	18	0	ENTER		
NAV	18	0	ENTER	Entered heading 040 and activated commanded heading mode.	Active mode became commanded heading mode with heading set to 040°.
NAV	18	0	7		
NAV	18	0	9		
NAV	18	0	ENTER		
NAV	18	0	ENTER	Entered heading 079.	Commanded heading changed to 079°.
NAV	18	0	MSG	On the NAV 1/3 page, pressed the MSG key.	MSG page appeared.
MSG	255	0	MSG	On the MSG page, pressed the MSG key (functions as the RETURN key).	NAV 1/3 page appeared.
NAV	18	0	R5	On the NAV 1/3 heading page pressed the CNCL HDG key.	Commanded heading mode canceled. Resumed steering to the active NAV leg.

4 CONCLUSION

The effort to extract data from the heavily damaged NCU Serial Number 1577 is ongoing. This data was not available for this report.

The data extracted from the NCU Serial Number 281 appeared to be completely intact. There was no indication that memory had been corrupted in the accident.

The amount of raw binary data that was captured electronically is very large. UASC software engineering can convert additional parameters to human-readable format if they are needed for the investigation.

APPENDIX A CHECKLIST FOR DATA EXTRACTION

Checklist for Data Extraction from SRAM (SCN 6XX-series FMS)

This checklist details the procedure for downloading a binary dump file of SRAM memory from an FMS CPU board running SCN 6XX-series software.

Verification of Bench Setup

1. PC running Windows 98 or higher, with a serial communications port.
2. U:\NTSB\Tupolev\FMSReader\FMSReader.exe should already be on the PC.
3. A wiring harness should be installed connecting the FMS monitor port pins to the PC's serial port via an RS-232 connection.
4. Have a 6XX-series FMS available and hooked up to a power source, with both the FMS and the power source **turned off. Also have a jumper available.**

Removing the CPU Board from the Customer FMS

5. Put on grounding strap.
6. Closely examine the physical condition of the FMS. Note any damage, etc.
7. Open the FMS. Note any obvious damage inside.
8. Remove the CPU board.
9. Verify CPU board part number = 01017010 Rev C or higher.

Installing the CPU Board into the Lab FMS

10. Install the boot jumper (E1) on the CPU board.
11. Verify connectivity across E1 pins.
12. Install the CPU board into the lab FMS, making sure that the CPU board does not catch on protrusions from any neighboring boards.
13. Turn on the power supply, but do NOT turn on the FMS.

Running the Download Program

14. Open the U:\NTSB\Tupolev\FMSReader\FMSReader application.
15. Select the serial communications port = COM2.

16. Verify that the baud rate is set to 9600.
17. Using the "Browse" button, specify the ASCII dump file path and name
U:\NTSB\Tupolev\SN281\DumpX.txt.
18. Using the "Browse" button, specify the converted binary file path and name
U:\NTSB\Tupolev\SN281\BinaryX.bin.
19. Select the "Run Memory Download And Binary Conversion" run option.
20. Click the "Run" button. An instruction window will be displayed. The first two items in the instruction window just serve as reminders to make sure the monitor port connection and software load jumper have been installed.
21. Turn ON the FMS (ON/OFF DIM).
22. Click the "OK" button after you've turned on the FMS. The download should begin. A progress bar will be displayed during the download. A "CDU DATA BUS FAILURE" message will be displayed on the FMS. This is expected.
23. When the download is complete, verify that both the ASCII dump file and the binary file have been generated, and perform a sanity check on the contents of the ASCII dump file (i.e., review some known memory locations for valid content).
24. Turn the FMS off, and turn off the power supply.
25. Remove the CPU board from the lab FMS, and remove the boot jumper from the board.