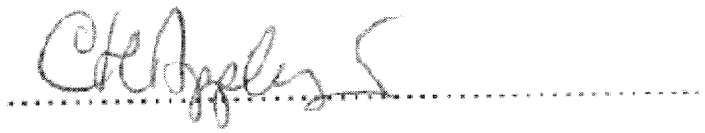
TRANSMITTER CERTIFICATION
OF
FCC ID: KV6TFS-SDU82155A1
THALES AVIONICS
(APPLICANT)
TOP FLIGHT SATCOM
SATELLITE DATA UNIT
PART NUMBER 82155/A
(SINGLE CHANNEL SBB TERMINAL)

TO
FEDERAL COMMUNICATIONS COMMISSION
RULE PART 87

CLASS 7 TEST REPORT
(Exhibit 6)

Any enquiries concerning this document should be addressed to:

The TopFlight Satcom Program Manager
Thales Avionics Limited
86 Bushey Road
London
SW20 0JW



Prepared By
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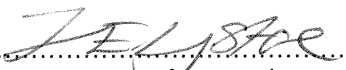

Approved
Jennifer Livingstone
(Topflight Satcom Systems Project Leader)

Authorised
B Feehan
(Topflight Satcom Product Design Authority)

ISSUE RECORD

	Date	By	Comments
A	27 May 2008	Colin Appleyard	Initial Draft
B	4 August 2008	Colin Appleyard	After RASS6060 review
1	11 August 2008	Colin Appleyard	For formal release
2	25 September 2008	P. Gillick	TFS062/DCN-4920

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FIGURES

TABLES

1 Introduction

1.1 Objective

1.1.1 The objective of this document is to present the test results required for FCC approval of the Thales Topflight Satcom (TFS) Satellite Data Unit (SDU).

1.1.2 The Thales Top Flight Satcom System is a satellite communication system designed for use in air transport and corporate business jet aircraft. The system is designed for the Inmarsat Swift Broadband (SBB) service of Inmarsat, available with the Inmarsat I-4 series of satellites. This application covers the SBB Class 7 service.

1.1.3 The SDU described herein is substantially the same as the SDU currently approved for the Inmarsat SBB Service, Class 3A (FCC Id: KV6-TFS-SDU82155A). The principal differences between Class 7 and Class 3A are the addition of QAM bearers and higher output power for Class 7.

1.1.4 The system includes Line Replaceable Units (LRUs) provided by both Thales Avionics Ltd and EMS Satcom. Thales provide the SDU and SDU Configuration Module (SCM) LRUs and EMS provide the Diplexer/Low Noise Amplifier (DLNA) and Intermediate Gain Antenna (IGA) LRUs.

1.2 Scope

1.2.1 The scope of this document is the test results for FCC Appproval of the TFS SDU only.

1.2.2 All tests and measurement data presented for FCC Approval have been performed in accordance with FCC Rules and Regulations, Volume II:Part 2, Sub-part J, Sections 2.947, 2.1033 c, 2.1041, 2.1046, 2.1047, 2.1079, 2.1053, 2.1055, 2.1057 (Ref. 1.4.1), Section 15.209 and Part 87- Aviation Services.

1.3 Applicability

1.3.1 The results in this test report are applicable to SDU equipment Type 82155A single channel Class 7 SBB equipment only.

1.4 References

1.4.1 FCC Rules and Regulations, Volume II:Part 2, Sub-part J, United States Federal Communications Commission, Code of Federal Regulations, Parts as detailed in section 1.2.1.

1.4.2 P13B, Documentation Standard, P13B, Thales.

1.4.3 TuV Sud Report 75903387 Issue 6 FCC testing of the Thales Aerospace Division Top Flight Satcom SDU 82155.

1.4.4 System Test procedures for the TopFlight System, Thales, A111/SAT001/SYSTP-001, Issue 5.

1.5 Terminology

APM	Avionics Processor Module
BGAN	Broadband Global Area Network
CCM	Channel Card Module
CFR	Code of Federal Regulations
CPM	Communications Processor Module
DLNA	Diplexer Low Noise Amplifier
EIRP	Effective Isotropic Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
HPA	High Power Amplifier
IGA	Intermediate Gain Antenna
IL	Insertion Loss
LRU	Line Replaceable Unit
NF	Noise Figure
PFD	Power Flux Density
OCXO	Oven Controlled Crystal Oscillator
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
RF	Radio Frequency
Rx	Receive
SBB	(Inmarsat) Swift BroadBand
SDU	(TopFlight) Satellite Data Unit
TFS	TopFlight Satcom
Tx	Transmit
UT	User Terminal
VDT	Verification and Debug Tool

2 Information Required for Approval

2.1 **Name and Address of Applicant:**

Thales Avionics Limited
86 Bushey Road
Raynes Park
London, SW20 0JW

2.2 **Name and Address of Authorised Test House:**

TUV Product Service Ltd
Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
UK, PO15 5RL

2.3 **Manufacturer:**

Applicant

2.4 **FCC ID:**

KV6TFS-SDU82155A1

2.5 **Model Number:**

Satellite Data Unit 82155A

2.6 **Type of Emission:**

25K0G1W, 50K0G1W, 100KG1W, 200KG1W,
50K0D1W, 100KD1W, 200KD1W

2.7 **Frequency Range MHz:**

Receive: 1525.0 to 1559.0 MHz,
Transmit: 1626.5 to 1660.5 MHz

2.8 **Power Rating:**

Nominal Power 21W (approx.)

2.9 **Voltages & Currents in all Final RF Stages:**

3 output stages with 27VDC 5A total at rated O/P power of 30W, split between each stage.

2.10 **Exhibits**

2.10.1 A list of the other exhibits that are required for approval is supplied as Exhibit 13a.

3 Testing – EUT Identity and Configuration

3.1 Test Conditions and Engineering Practices

3.1.1 Unless otherwise stated in the specific measurement results the ambient temperature of the SDU was maintained within the range of 10 ºC to 40 ºC.

3.1.2 Unless otherwise stated the humidity levels were in the range of 10% to 90% relative humidity.

3.1.3 Prior to testing at Thales Avionics or at the authorised test house the SDU was started up in accordance with the Start Up procedures detailed in the Thales Avionics System Test Procedures SYSTP-001 Chapter 2 (Ref. 1.4.4)

3.1.4 Measurement results, unless otherwise noted, are worst case measurements.

3.2 External Equipment

3.2.1 Details of the external test equipment used in the tests are provided in the Test House report (ref 1.4.3).

3.3 SDU Configuration

3.3.1 Details of the SDU equipment configuration used in the tests are listed below:

SDU Part Number: 82155/A30E, serial number 10018

SDU Sub-module	Hardware	Software	Serial No.
CPM	82155/DAD002	SW0200A	S04261
APM	9009304	SW0200A	E29615000125
PSM	9009306	N/A	127
CCM1	9009368	V6.3.1.0	1182
CCM2	Not fitted in this configuration		
HPA	9009550	N/A	01039
BACKPLANE	82155/DBC	N/A	S00162
FILTER	82155/DHC	N/A	S01664
FRONT PANEL	82155/AVB	N/A	C73385
PCI Bridge	82155/DEA	N/A	S00219
BACK PANEL	82155/BE	N/A	C71000
OCXO	82155/CV	N/A	C70725
CAPACITOR ASSEMBLY	82155/AK	N/A	C73068

Table 1 SDU Configuration

3.4 Hardware and Software Configuration Changes

3.4.1 The same SDU hardware and software configuration was maintained for all tests described herein.

4 Testing – Set Up, Procedures &Conditions

4.1 Test Dates

4.1.1 The tests were carried out over the period 12 to 22 May 2008.

4.2 Test Result Summary

4.2.1 The SDU passed all required tests.

4.2.2 Details of the measurements are contained in the associated Exhibit 6b (ref 1.4.3).

4.3 RF Power Output Testing

4.3.1 The SDU was tested for RF Carrier Output Power as per FCC 47 CFR Parts 2.1046 and 87.131

4.3.2 The RF Carrier Output Power testing was performed at the Authorised Test House (See Section 2.2).

4.3.3 Figure 1 shows the test configuration used for testing RF Output Power. The test procedure and test results are detailed in the Test House report (Ref. 1.4.3, Exhibit 6b).

4.3.4 The RF Output Power Test was conducted under ambient environmental conditions.

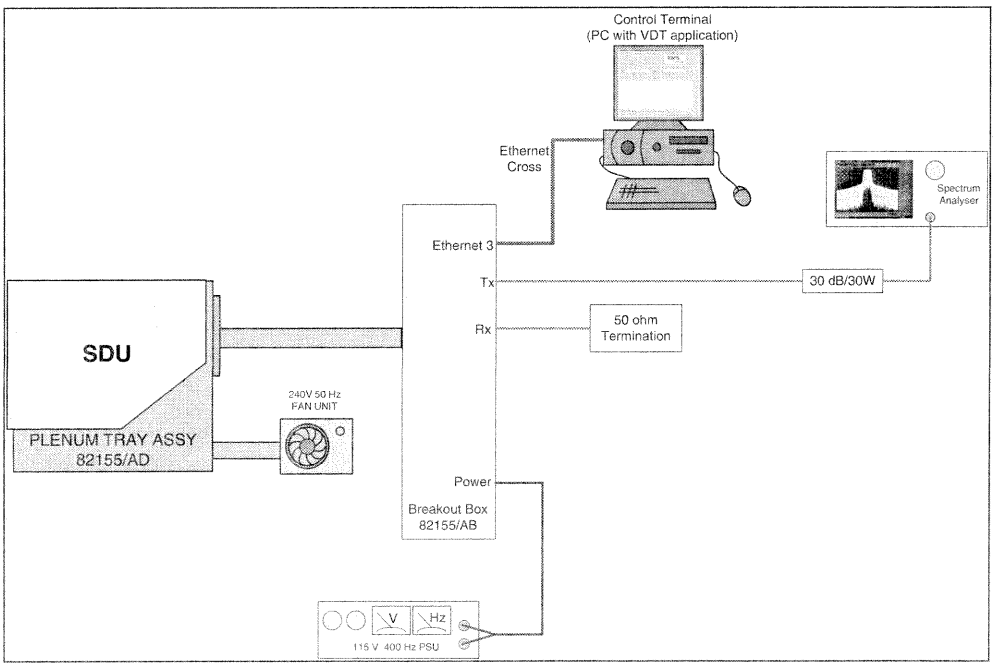


Figure 1 Configuration for RF Power and Occupied Bandwidth Testing at TUV.

4.4 Occupied Bandwidth

4.4.1 The SDU was tested for Occupied Bandwidth as per FCC 47 CFR Parts 2.1049 and 87.135

4.4.2 The Occupied Bandwidth testing was performed at the Authorised Test House (See Section 2.2).

4.4.3 Figure 1 shows the test configuration used for testing RF Output Power. The test procedure and test results are detailed in the Test House report (Ref. 1.4.3, Exhibit 6b).

4.4.4 The Occupied Bandwidth test was conducted under ambient environmental conditions.

4.5 Frequency Stability

4.5.1 The SDU was tested for Frequency Stability as per FCC 47 CFR Parts 2.1053 and 87.139.

4.5.2 The Frequency Stability testing was performed at the Authorised Test House (See Section 2.2).

4.5.3 Figure 2 shows the test configuration used for testing Fequency Stability. The test procedure and test results are detailed in the Test House report (Ref. 1.4.3, Exhibit 6b).

4.5.4 For Frequency Stability Testing the SDU was placed in a temperature controlled chamber. Measurements of RF transmit frequency were made at temperature intervals of 10 ºC from –20 ºC to +50 ºC inclusive. The equipment was allowed to stabilise for 90 minutes at each temperature before measurements were taken.

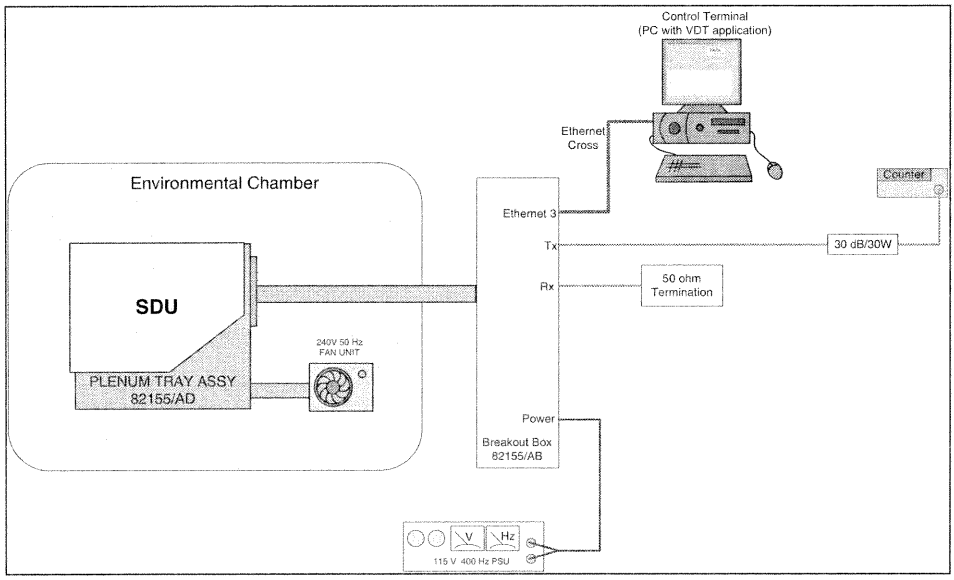


Figure 2 Configuration for Frequency Stability Testing at TUV

4.6 Conducted Spurious Emissions

4.6.1 The SDU was tested for Conducted Emissions as per FCC 47 CFR Parts 2.1051 & 87.139

4.6.2 The Conducted Spurious Emissions testing was performed at the Authorised Test House (See Section 2.2).

4.6.3 Figure 2 shows the test configuration used for testing Conducted Emissions.

4.6.4 Section 5.4 fully details the alternative test approach used by Thales and the justification for it's use. The Test House report (Ref 1.4.3, Exhibit 6b) contains all of the test results and spectrum plots for this alternative test approach.

4.6.5 The Conducted Spurious Emissions test was conducted under ambient environmental conditions.

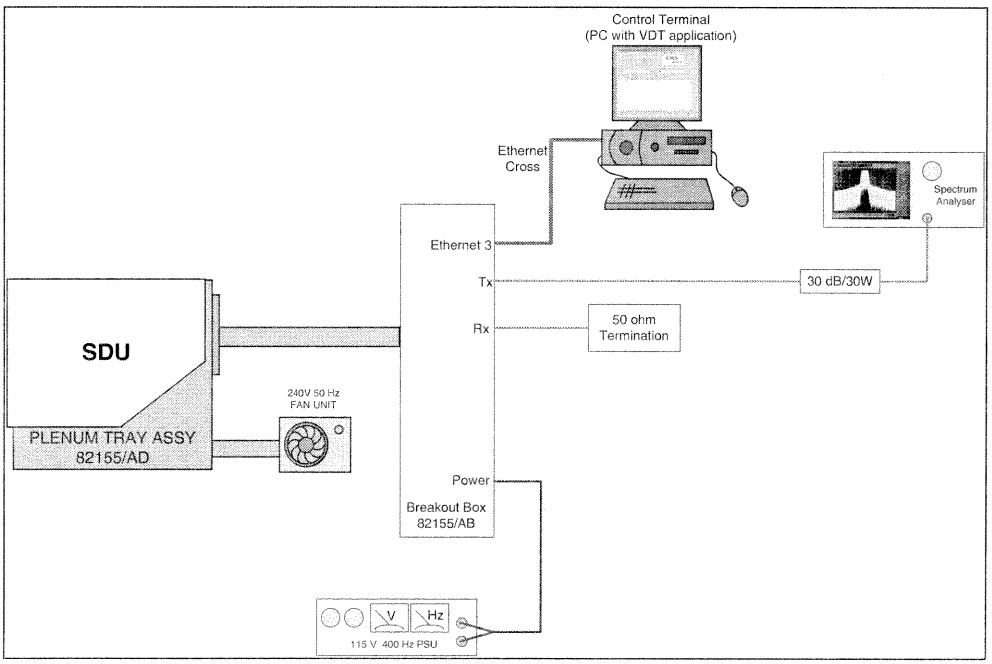


Figure 3 Configuration for Conducted Emissions Testing at TUV.

4.7 Radiated Spurious Emissions

4.7.1 The SDU was tested for Radiated Emissions as per FCC 47 CFR Part 15.209.

4.7.2 The Radiated Emissions testing was performed at the Authorised Test House (See Section 2.2).

4.7.3 The Radiated Spurious Emissions test was conducted under ambient environmental conditions.

4.7.4 Figure 4 shows the test configuration used for the Radiated Emissions testing. The test procedure and test results are detailed in the Test House report (Ref.1.4.3, Exhibit 6b). The conclusion from the test house report is that the SDU met the requirements of FCC 47 CFR Part 15.209.

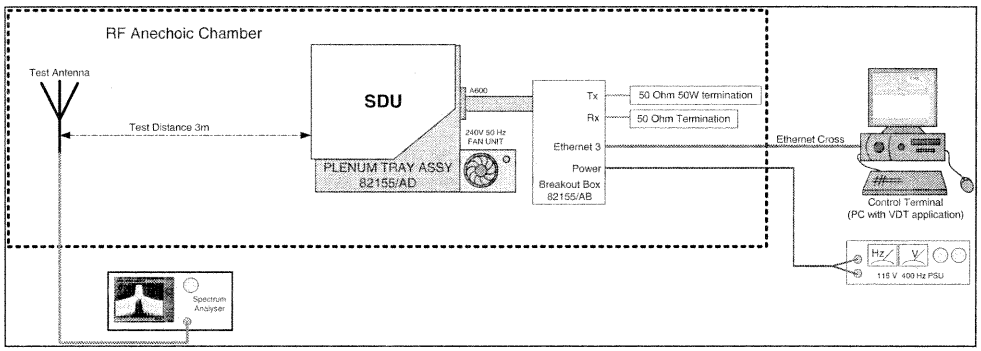


Figure 4 Configuration for Radiated Emissions.

4.8 Face Definitions for Radiated Emissions Testing

4.9

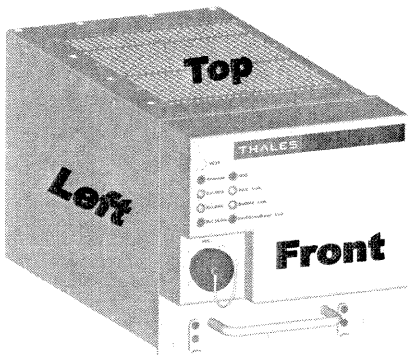


Figure 5 Face Definitions for Radiated Emissions Testing.

5 Conclusions, Deviations and Waiver Requests.

5.1 RF Output Power

5.1.1 As stated in the Test House Test Report (Ref. 1.4.3) the Thales SDU, FCC ID: KVSTFS-SDU82155A1 meets the requirements of FCC 47 CFR Parts 2.1046 and 87.131 for RF Output Power.

5.2 Occupied Bandwidth

5.2.1 As stated in the Test House Test Report (Ref. 1.4.3) the Thales SDU, FCC ID: KVSTFS-SDU82155A1 meets the requirements of FCC 47 CFR Parts 2.1049 and 87.135 for RF Occupied Bandwidth.

5.3 Frequency Stability

5.3.1 As stated in the Test House Test Report (Ref. 1.4.3) the Thales SDU, FCC ID: KVSTFS-SDU82155A1 meets the requirements of FCC 47 CFR Parts 2.1055 and 87.133 for Frequency Stability.

5.4 Conducted Spurious Emissions

5.4.1 As stated in the Test House Test Report (Ref. 1.4.3) the Thales SDU, FCC ID: KVSTFS-SDU82155A1 meets the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions.

5.4.2 Thales tested the SDU at the test house using an alternative method. The following paragraphs outline the justification for the use of this alternative method.

5.4.3 The requirements of FCC 47CFR Part 87.139 (i) (1) are such that the conducted spurious emissions are to be measured at the antenna output. For a transmitter delivering powers in the region of 15 dBW, these requirements are physically impossible to meet. For example, the spurious emission requirement in the frequency band 1525 to 1559 MHz is stated as an attenuation of 203 dB relative to the carrier level, measured in a 4 KHz bandwidth. For a transmitter rated output of 15 dBW EIRP, this translates to an absolute power level of –158 dBm in 4 KHz, which is lower than thermal noise for temperatures above 3 degrees Kelvin.

5.4.4 Thales concluded that the only practical way to measure conducted spurious was to make the measurement at the HPA output, before the DLNA, and compute the resultant spurious at the antenna by adding the specified attenuation of the DLNA.

5.4.5 The DLNA is purchased as part of the antenna subsystem, and is not manufactured by Thales Avionics Limited. The DLNA attenuation assumed is per the standards for a "Modified Type A" DLNA as published in ARINC Characteristic 741. It is worth noting that this is the same type of DLNA as used on many thousands of existing installations from several manufactures already approved by the FCC. The test method described is the same as that used for FCC qualification of the Thales SDU FCC ID KVS-TFS-SDU82155A designed for operation as an Inmarsat Class 3A SDU.

5.4.6 Exhibit 6b contains plots of the Conducted Spurious Emissions measured at the SDU Output and shows the calculation of new limits referred to the Modified Type A DLNA output.

Frequency band (MHz)	Part 87 limit (dBc) (1)	DLNA rejection (dB)		Limit at HPA (dBc) with Modified Type A attenuation added	Limit translated to bandwidth used for measurements	Notes
		Modified Type A	Type F			
0.01 to 1525	-135 / 4KHz	>80	>80	-55 / 4KHz	-51 / 10 KHz	
1525 to 1559	-203 / 4KHz	>120	>120	-83 / 4KHz	-79 / 10 KHz	
1559 to 1585	-155 / MHz	>100	>111	-55 / MHz	-55 / MHz	
1585 to 1605	-143 / MHz	>88	>95	-55 / MHz	-55 / MHz	
1605 to 1610	-117 / MHz	>62	>62	-55 / MHz	-55 / MHz	
1610 to 1610.6	-95 / MHz	>40	>40	-55 / MHz	-55 / MHz	
1610.6 to 1613.8	-80 dBW / MHz	>40	>40	-40 dBW / MHz	-40 dBW / MHz	3
1613.8 to 1614	-95 / MHz	>40	>40	-55 / MHz	-55 / MHz	
1614 to 1620	-70 / 4KHz	Decreases	>30	-70 / 4KHz	-66 / 10 KHz	
1620 to 1624.5	-70 / 4KHz	Decreases	>20	-70 / 4KHz	-66 / 10 KHz	
1624.5 to 1625.5	-70 / 4KHz	Decreases	>10	-70 / 4KHz	-66 / 10 KHz	
1625.5 to 1626.5	-70 / 4KHz	Decreases	Decreases	-70 / 4KHz	-66 / 10 KHz	
1626.5 to 1660	-70 / 4KHz	<0.8	<0.8	-70 / 4KHz	-66 / 10 KHz	2,3,4
1660 to 1670	-49.5 dBW / 20 KHz	Increases	Increases	-49.5 dBW / 20 KHz	-47.5 dBW / 30 KHz	2,3,4
1670 to 1735	-60 / 4KHz	Increases	Increases	-60 / 4KHz	-56 / 10 KHz	
1735 to 1865	-105 / 4KHz	>50	>50	-55 / 4KHz	-51 / 10 KHz	
1865 to 3250	-105 / 4KHz	>50	>20	-55 / 4KHz	-51 / 10 KHz	
3250 to 3330	-105 / 4KHz	>50	>50	-55 / 4KHz	-51 / 10 KHz	
3330 to 4000	-105 / 4KHz	>50	>40	-55 / 4KHz	-51 / 10 KHz	
4000 to 2000	-105 / 4KHz	>50	>50	-55 / 4KHz	-51 / 10 KHz	5
2000 to 12000	-105 / 4KHz	>50	>50	-55 / 4KHz	-51 / 10 KHz	5
12000 to 18000	-70 / 4KHz	>15	>15	-55 / 4KHz	-51 / 10 KHz	

Notes:
1 Attenuation limit in dB relative to carrier power
2 Excludes occupied bandwidth
3 Not applicable for intermodulation products
4 Narrow band spurious signal limit 10 dB above table value
5 Spectrum analyser sweep split at 2000 MHz

Table 2 Modified Conducted Spurious Limits

5.4.7 From the results in and the plots shown in Exhibit 6b, Thales have concluded that using this alternative method SDU FCC ID KV6TFS-SDU82155A1 does meet the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions.

5.4.8 Further, the SDU FCC ID KV6TFS-SDU82155A1 may be evaluated against the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions when using the alternative method with the attenuation characteristics of an ARINC Type F DLNA.

5.4.9 The Type F DLNA offers more signal attenuation at frequencies between 1559 and 1605 MHz, 1614 and 1625.5 MHz, but less at frequencies in the range 1865 to 3250 MHz and 3330 to 4000 MHz. Inspection of the Test House report (ref 1.4.3) shows that there are no measurable spurious in these last two bands, and so Thales conclude that the SDU also meets the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions when used with an ARINC Type F DLNA.

5.4.10 Thales are therefore requesting a waiver against the test method used for the measurement of the SDU FCC ID KVSTFS-SDU82155A1 Conducted

Spurious Emissions. This waiver in test method was approved for KVS-TFS-SDU82155A.

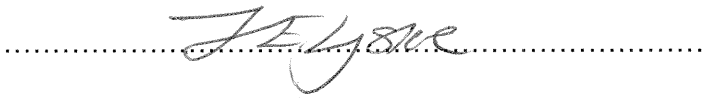
5.5 Radiated Emissions

5.5.1 As stated in the Test House Test Report (Ref. 1.4.3) The Thales SDU, FCC ID: KV6TFS-SDU82155A1 meets the requirements of FCC 47 CFR Part 15.209 for radiated emissions.

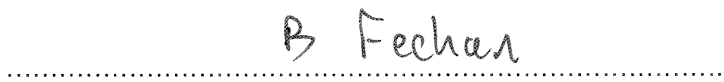
6 Testimonial and Statement of Certification

The Thales Avionics Ltd Satellite Data Unit Type Number 82155A (FCC ID: KV6TFS-SDU82155A1) has been tested in accordance with the requirements contained in the appropriate Commission regulations. To the best of my knowledge these tests were performed using measurement procedures consistent with industry or Commission standards and demonstrate that the Satellite Data Unit Type Number 82155A complies with the appropriate standards. Each unit manufactured, imported or marketed, as defined in the Commission's regulations, will conform to the samples within the variations that can be expected due to quantity production and testing on a statistical basis. I hereby certify that the tests described in this report were performed at my direction and under my supervision, and that the results and test data contained in this report truly and accurately show the performance of the Satellite Data Unit Type Number 82155A. I further certify that the ancillary information contained herein accurately reflects the design, installation requirements, alignment procedures and operational instructions of and for this equipment.

C. Appleyard
(Technical Consultant, Certifying Engineer)



J. Livingstone
(Topflight Satcom Systems Project Leader)



B. Feehan
(Topflight Satcom Product Design Authority)