TRANSMITTER CERTIFICATION
OF
FCC ID: KV6TFS-SDU82155D
THALES AVIONICS
(APPLICANT)
TOP FLIGHT SATCOM
SATELLITE DATA UNIT
PART NUMBER 82155D
(DUAL- CHANNEL TERMINAL)
TO
FEDERAL COMMUNICATIONS COMMISSION
RULE PART 87

TEST REPORT

(Exhibit 6a)

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ISSUE RECORD

	Date	By	Comments
A	14 October 2008	P. Gillick	Initial Draft
B	22 October 2008	R. Thorburn	Intermodulation testing results added
C	27 October 2008	P.Gillick	PMG, JEL comments
1	31 October 2008	P.Gillick / R. Thorburn	RASS6060 comments

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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) FCC ID: KV6TFS-SDU82155D.

1.1.2 This dual channel unit supports both Inmarsat Class 6 (Swift BroadBand - SBB) and Inmarsat Classic Aero services.

1.1.3 The SDU has three modes of operation:

- Class 6 service with internal High Power Amplifier (HPA),
- Class 6 with an external HPA,
- Classic service with an external HPA.

1.1.4 This document contains either actual test results or references to Test house results covering these modes of operation.

1.1.5 The external HPA to be used with the SDU is a Thales product and application for FCC certification, (using the FCC ID: KV6TFS-HPA82166A) will be made and linked to this application for the SDU. The external HPA is referred to in this document by the abbreviation FMHPA (Flange Mount HPA).

1.1.6 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 SDU described herein has different modulation types, but the most significant difference between SBB Class 3A and this SDU is the higher output power used to support higher data rates/channel types.

1.1.7 A single channel SDU variant which is intended for Inmarsat SwiftBroadBand (SBB) Class 7 service is being applied for FCC certification, using the FCC ID: KV6TFS-SDU82155A1. The SDU (FCC ID: KV6TFS-SDU82155A1) is the same as the SDU (FCC ID: KV6TFS-SDU82155D) except that in the former case only one channel card is fitted whereas in the latter case two channel cards are fitted.

1.1.8 The transmitted channel Modulation type/Bandwidth are the same for Inmarsat Class 6 and Class 7. The differences between the two classes is that class 7 is 1.1 dB higher, whilst class 7 is single channel and class 6 is dual channel. In cases where Class 7 results are applicable for class 6 results these are read across from the Class 7 report - (Ref. 1.4.3).

1.1.9 In cases when Classic mode results will be worse than Class 6, for instance highest power, these results are presented in this report.

1.1.10 In all three modes Radiated spurious measurements have been made.

1.1.11 The Inmarsat Class 6 mode includes QAM channels, which are non approved FCC emission types, Thales are therefore requesting a waiver to permit certification of these channel types – see exhibit 13d.

1.1.12 Table 1 summarises the test evidence rationale whilst Table 2 summarises the contents of the TuV Test House reports:

Type	Test	Test evidence	Comment
Class 6 internal HPA	RF Power output	Class 7 TuV report reference 1.4.3 section 2.3	Class 6 is 1.1 dB lower output power but use class 7 level as worse case
	BW/Modulation	Class 7 TuV report reference 1.4.3, section 2.5	Same as class 7
	Freq stability	Class 6 TuV report reference 1.4.4, section 2.3	-
	Conducted spurious	Class 7 TuV report reference 1.4.3, sections 2.6, 2.7	Class 6 is 1.1 dB lower output power but use class 7 level as worse case
	Radiated (EMC)	Class 6 TuV report reference 1.4.4, sections 2.1, 2.2	-
	Intermods	This report, section 5.1.3	-
Class 6 external HPA	RF Power output	This report, section 5.3 (Classic + FMHPA)	Use Classic + FMHPA results as they are the highest/worse power case with external HPA
	BW/Modulation	Class 7 TuV report reference 1.4.3, section 2.5	Same as class 7
	Freq stability	Class 6 TuV report reference 1.4.4, section 2.3	-
	Conducted spurious	This report, section 5.3 (Classic + FMHPA)	Use Classic + FMHPA results as they are the highest/worse power case with external HPA -> most spurious
	Radiated (EMC)	Class 6 TuV report reference 1.4.4, sections 2.1, 2.2	-
	Intermods	This report, section 5.2.2	
Classic external HPA	RF Power output	This report, section 5.3 (Classic + FMHPA)	-
	BW/Modulation	This report, section 5.3 (Classic + FMHPA)	-
	Freq stability	Class 6 TuV report reference 1.4.4, section 2.3	Same hardware as class 6.
	Conducted spurious	This report, section 5.3 (Classic + FMHPA)	-
	Radiated (EMC)	Classic TuV report reference 1.4.5, sections 2.1, 2.2	-
	Intermods	This report, section 5.3.6	-

Table 1 Test Evidence Summary

TuV report	Section	Test
Class 7, reference 1.4.3 exhibit 6b	2.1, 2.2	Radiated Emissions
	2.3	RF Power output
	2.4	Freq stability
	2.5	BW/Modulation
	2.6, 2.7	Conducted spurious
Class 6, reference 1.4.4 exhibit 6c	2.1, 2.2	Radiated Emissions
	2.3	Freq stability
Classic, reference 1.4.5 exhibit 6d	2.1, 2.2	Radiated Emissions

Table 2 TuV Test Report summary

1.1.13 The Topflight system includes Line Replaceable Units (LRUs) provided by both Thales Avionics Ltd and EMS Satcom. Thales provide the SDU, SDU Configuration Module (SCM) and Flange Mount High Power Amplifier (FMHPA) LRUs and EMS provide the Diplexer/Low Noise Amplifier (DLNA) and High Gain Antenna (HGA) LRUs.

1.2 Scope

1.2.1 The scope of this document is the presentation of test results for FCC Approval of the Topflight Satcom (TFS) Satellite Data Unit (SDU) FCC ID: KV6TFS-SDU82155D

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 Section 15.209 and Part 87- Aviation Services (Ref. 1.4.1). In a response to a query regarding Intermodulation testing from oetech@fccsun27w.fcc.gov Thales were advised that for Intermodulation testing "Limit usually is -13dBm conducted" at the Antenna. Thales have adopted the Conducted Suprious limits that have been fully defined by the FCC as their guideline values for Intermodulation Products as stated above and invoke the –13dBm limit stated above where practical to do so.

1.3 Applicability

1.3.1 The results in this test report are applicable to SDU equipment Type 82155D and the FMHPA 82166A.

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 1.2.2.

1.4.2 P13B, Documentation Standard, P13B, Thales.

1.4.3 TuV Sud Report 759033387 Report 2 Issue 6 FCC testing of the Thales Aerospace Division Inmarsat Class 7 Topflight Satcom SDU.

1.4.4 TuV Sud Report 75903406-2 Issue 2 FCC testing of the Thales Aerospace Division Inmarsat Class 6 SDU.

1.4.5 TuV Sud Report 75903406-1 Issue 2 FCC testing of the Thales Aerospace Division Inmarsat Classic Aero SDU.

1.4.6 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
FMHPA	Flange Mount High Power Amplifier
HGA	High Gain Antenna
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
OQPSK	Offset QPSK
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
England.

2.2 Name and Address of Authorised Test House:

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

2.3 Manufacturer:

Applicant

2.4 FCC ID:

KV6TFS-SDU82155D

2.5 Model Number:

Satellite Data Unit 82155D

2.6 Type of Emission:

25K0G7W, 50K0G7W, 100KG7W, 200KG7W,
50K0D7W, 100KD7W, 200KD7W,
840HG1D, 1K68G1D, 8K40G1D, 10K5G1D

2.7 Frequency Range MHz:

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

2.8 Power Rating:

SDU: 30 W maximum
(with FMHPA: 35W maximum)

2.9 Voltages & Currents in all Final RF Stages:

Three parallel output stages 28VDC, 5A total current for maximum RF power output.
(FMHPA: 3 parallel output stages each 28VDC with 7.5A total current for maximum RF power output.)

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 °C to 40 °C.

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.1.4.6)

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 reports (refs 1.4.3, 1.4.4 and 1.4.5).

3.3 SDU Configuration

3.3.1 Details of the SDU equipment configuration used is listed below:

SDU Part Number: 82155/D30G, serial number 10070

SDU Sub-module	Hardware	Software	Serial No.
CPM	82155/DAD002	SW0200A	S04266
APM	9009304	SW0200A	E29615000123
PSM	9009306	N/A	173
CCM1	9009367	V6.3.1.0	1974
CCM2	9009367	V6.3.1.0	1976
HPA	9009550	N/A	01051
BACKPLANE	82155/DBC	N/A	S01504
FILTER	82155/DHC	N/A	S01694
FRONT PANEL	82155/AVB	N/A	C74298
PCI Bridge	82155/DEA	N/A	S01577
BACK PANEL	82155/BH	N/A	C71806
OCXO	82155/CV	N/A	C71760
CAPACITOR ASSEMBLY	82155/AK	N/A	C74381

Table 3 SDU Configuration

3.3.2 The details of the SDU used for class 7 results is in (ref. 1.4.3).

3.4 FMHPA Part Record

3.4.1 Details of the FMHPA (FCC ID: KV6TFS-HPA82166A) used for some of the testing is given in Table 4.

Description	Part Number	Type Number	Serial No.
FMHPA 10001	F0052 62001793AA 00	82166A	62001793/01001

Table 4: FMHPA Part Record

3.5 Hardware and Software Configuration Changes

3.5.1 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 May to 31 August 2008.

4.2 Class 6 with internal HPA

4.2.1 RF Power Output Testing (Class 6 with internal HPA)

4.2.1.1 The SDU was tested for RF Carrier Output Power per FCC 47 CFR Parts 2.1046 and 87.131 (ref.1.4.1).

4.2.1.2 The RF Carrier Output Power testing was performed at the authorised test house, on an SDU configured for Inmarsat SBB Class 7 operation. The power output of an SDU operating Class 7 is slightly higher than an SDU operating in Class 6, by about 1.1 dB. As the class 7 results are a worse case Thales offers these results for the purposes of assessing RF Output Power, to show that Class 6 performance also satisfies the requirements of this submission.

4.2.1.3 Figure 1 shows the test configuration used for testing RF Output Power with a class 7 terminal. The test procedure is in the Test House report (ref. 1.4.3).

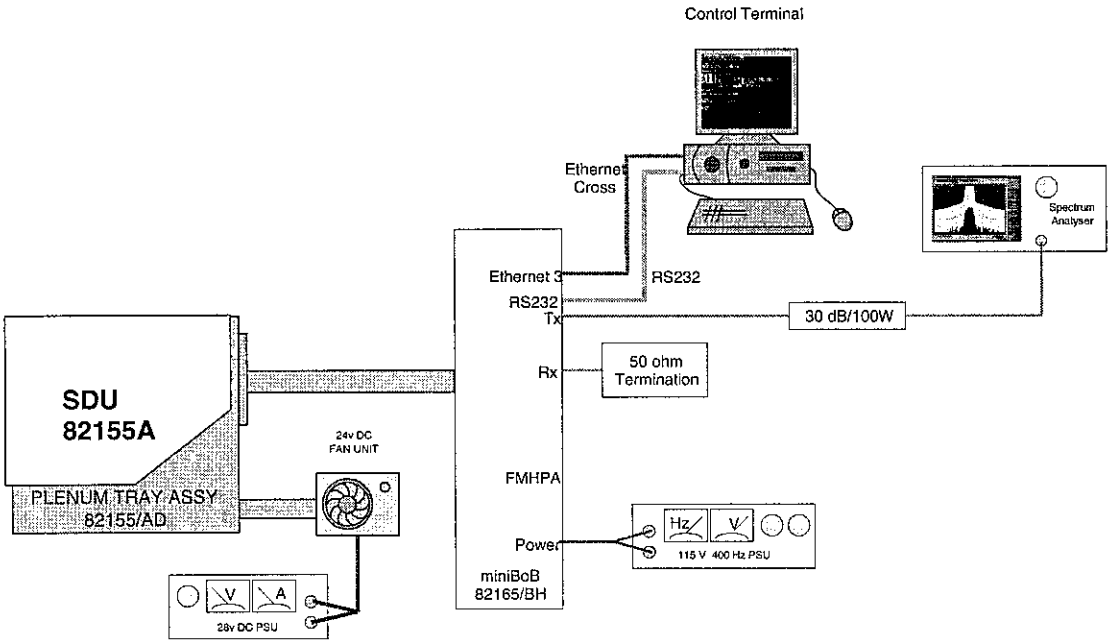


Figure 1 RF Power, Occupied Bandwidth and Conducted Emissions Test Configuration

4.2.2 Occupied Bandwidth (Class 6 with internal HPA)

4.2.2.1 The SDU was tested for Occupied Bandwidth as per FCC 47 CFR Parts 2.1049 and 87.135 (ref.1.4.1).

4.2.2.2 The Occupied Bandwidth testing was performed at the authorised test house, on an SDU configured for Inmarsat SBB Class 7 operation. The modulations of an SDU operating Class 7 are identical to those of an SDU operating Class 6. As the modulations are identical Thales offers these results for the purposes of assessing Occupied Bandwidth, to show that Class 6 performance also satisfies the requirements of this submission.

4.2.2.3 The Inmarsat Class 6 mode includes QAM channels Thales are therefore requesting a waiver to certify these modes – exhibit 13d.

4.2.2.4 Figure 1 shows the test configuration used for testing Occupied Bandwidth with a class 7 terminal. The test procedure is in the Test House report (Ref. 1.4.3).

4.2.3 Frequency Stability (Class 6 with internal HPA)

4.2.3.1 The SDU was tested for Frequency Stability as per FCC 47 CFR Parts 2.1053 and 87.139 (ref.1.4.1).

4.2.3.2 The Frequency Stability testing was performed at the authorised test house, on an SDU configured for Inmarsat SBB Class 6 operation.

4.2.3.3 Figure 2 shows the test configuration used for testing Frequency Stability. The test procedure is in the Test House report (ref. 1.4.4).

4.2.3.4 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 °C from –20 °C to +50 °C inclusive. The equipment was allowed to stabilise for 30 minutes at each temperature before measurements were taken.

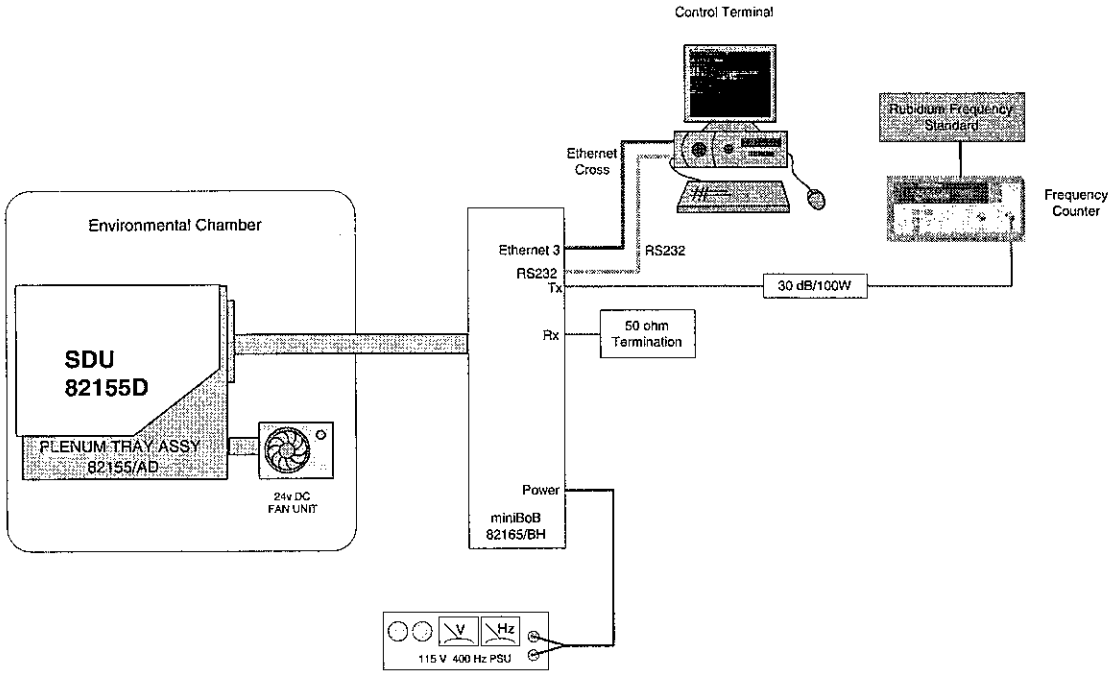


Figure 2 Frequency Stability Test Configuration

4.2.4 Conducted Spurious Emissions (Class 6 with internal HPA)

4.2.4.1 The SDU was tested for Conducted Emissions as per FCC 47 CFR Parts 2.1051 & 87.139 (ref.1.4.1).

4.2.4.2 The Conducted Emissions testing was performed at the authorised test house, on an SDU configured for Inmarsat SBB Class 7.

4.2.4.3 The power output of an SDU operating Class 6 is slightly lower than an SDU operating in Class 7, by about 1.1 dB. Because the power output of a Class 7 SDU is slightly higher, the spurious emissions can be expected to be equal to or worse than an SDU operating Class 6. Thales consider that for the purposes of assessing RF Output Power, the Class 7 testing provides measurements that also satisfy the requirements of this submission.

4.2.4.4 Thales tested the SDU using an alternative method. 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. The following paragraphs outline the justification for the use of this alternative method.

4.2.4.5 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 20 dBW EIRP, 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 20 dBW EIRP, this translates to an absolute power level of –153 dBm in 4 KHz, which is much lower than thermal noise for temperatures above 10 degrees Kelvin.

4.2.4.6 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.

4.2.4.7 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 "Type F" DLNA as published in ARINC Characteristic 741.

4.2.4.8 Table 5 shows the calculation of the new limits referred to the output of a Type F DLNA.

4.2.4.9 Thales are therefore requesting a waiver against the test method used for the measurement of the SDU FCC ID: KVSTFS-SDU82155D for Conducted Spurious Emissions. This waiver in test method was approved for the class 3A terminal KVS-TFS-SDU82155A.

4.2.4.10 Figure 1 shows the configuration used for testing Conducted Emissions with a class 7 terminal. The test procedure is in the Test House report (Ref. 1.4.3).

Frequency band (MHz)	Part 87 limit (dBc) (1)	Type F DLNA rejection (dB)	Limit at HPA output (dBc) with DLNA attenuation added	Limit at HPA output (dBc) translated to bandwidths used for measurements of Classic mode in section 5.3.4 (see Note 5)	Limit at HPA output (dBc) translated to bandwidths used for measurements of Class 7 mode in (ref.1.4.3) (see Note 6)	Notes
0.01 to 1525	-135 / 4KHz	>80	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	
1525 to 1559	-203 / 4KHz	>120	-83 / 4KHz	-84.2 / 3 KHz	-59 / MHz	
1559 to 1585	-155 / MHz	>111	-44 / MHz	-44 /MHz	-44 / MHz	
1585 to 1605	-143 / MHz	>95	-48 / MHz	-48 /MHz	-48 / MHz	
1605 to 1610	-117 / MHz	>62	-55 / MHz	-55 /MHz	-55 / MHz	
1610 to 1610.6	-95 / MHz	>40	-55 / MHz	-55 /MHz	-55 / MHz	
1610.6 to 1613.8	-80 dBW / MHz	>40	-40 dBW / MHz	-40 /MHz	-40 dBW / MHz	3
1613.8 to 1614	-95 / MHz	>40	-55 / MHz	-55 /MHz	-55 / MHz	
1614 to 1620	-70 / 4KHz	>30	-40 / 4KHz	-41.2 / 3 KHz	-16 / MHz	
1620 to 1624.5	-70 / 4KHz	>20	-50 / 4KHz	-51.2 / 3 KHz	-26 / MHz	
1624.5 to 1625.5	-70 / 4KHz	>10	-60 / 4KHz	-61.2 / 3 KHz	-36 / MHz	
1625.5 to 1626.5	-70 / 4KHz	Decreases	-70 / 4KHz	-71.2 / 3 KHz	-46 / MHz	
1626.5 to 1660	-70 / 4KHz	<0.8	-70 / 4KHz	-71.2 / 3 KHz	-46 / MHz	2,3,4
1660 to 1670	-49.5 dBW / 20 KHz	Increases	-49.5 dBW / 20 KHz	-49.5 dBW/ 20 KHz	-32.3 dBW / MHz	2,3,4
1670 to 1735	-60 / 4KHz	Increases	-60 / 4KHz	-61.2 / 3 KHz	-36 / MHz	
1735 to 1865	-105 / 4KHz	>50	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	
1865 to 3250	-105 / 4KHz	>20	-85 / 4KHz	-86.2 / 3 KHz	-61 / MHz	
3250 to 3330	-105 / 4KHz	>50	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	
3330 to 4000	-105 / 4KHz	>40	-65 / 4KHz	-66.2 / 3 KHz	-41 / MHz	
4000 to 2000	-105 / 4KHz	>50	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	
2000 to 12000	-105 / 4KHz	>50	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	
12000 to 18000	-70 / 4KHz	>15	-55 / 4KHz	-56.2 / 3 KHz	-31 / MHz	

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 In plots Limit line level = Carrier level – Limit at HPA output above (to nearest 0.5 dB).
6 In plots Carrier level is 43 dBm and Limit line of –13 dBm is equivalent to – 56 dBc

Table 5: Modified Conducted Spurious Limits

4.2.5 Radiated Spurious Emissions (Class 6 with internal HPA)

4.2.5.1 The SDU was tested for Radiated Emissions as per FCC 47 CFR Part 15.209 (ref.1.4.1).

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

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

4.2.5.4 Figure 3 shows the test configuration used for the Radiated Emissions testing. The test procedure is detailed in the Class 6 Test House report (ref.1.4.4).

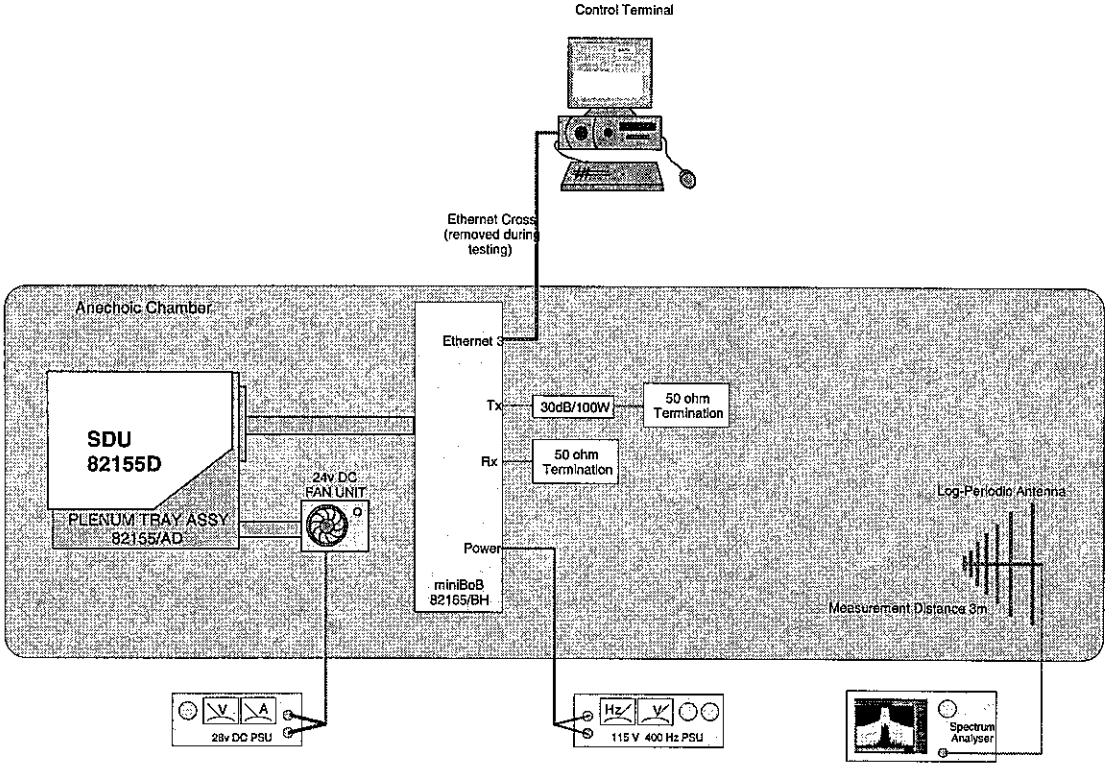


Figure 3 Radiated Emissions Test Configuration

4.2.6 Intermodulation Products (Class 6 with internal HPA)

4.2.6.1 The SDU was tested for Intermodulation Products to support this submission to the FCC of the TopFlight Satcom system.

4.2.6.2 Thales note that without a Part 87 FCC specification for Intermod testing the Intermodulation Products limits were measured against the formalised FCC Conducted Emissions limits presented in Table 5 of this report.

4.2.6.3 The Intermodulation Products testing was performed at Thales Avionics on an SDU configured in Inmarsat SwiftBroadBand (SBB) Class 6 mode (TopFlight SATCOM Type-D Dual Channel SDU).

4.2.6.4 Intermodulation Products testing was conducted as a series of modulated carrier pairs as the SDU is only capable of producing two SBB channels.

4.2.6.5 Multiple tests have been conducted with carrier at both minimum and maximum carrier frequency separations. The SDU in Class 6 mode is capable of both QPSK and 16-QAM modulations over a range of symbol rates.

4.2.6.5.1 The SBB (Class 6) Intermodulation Product tests were conducted at the highest symbol rate (151.2kBps) 16-QAM modulation with 200KHz spacing, with both closely spaced and maximum frequency separation modulated carrier tests as follows:

- Two modulated carriers were produced at 1627.15 and 1627.35 MHz respectively for the lower edge test.
- Two modulated carriers were produced at 1659.65 and 1659.85MHz for the upper edge test.
- Two modulated carriers were produced at 1627.15 and 1659.85MHz for the maximum frequency separation test.

4.2.6.5.2 Full Rated Power for the Internal HPA is 30W (44.7dBm) therefore each modulated carrier was refined to produce 41.7dBm (+/-1dB).

4.2.6.6 The stated test cases are considered by Thales to be the worst-case conditions.

4.2.6.7 As in the Conducted spurious emissions testing (section 4.2.4.5), Thales concluded that the only practical way to measure Intermodulation Products 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 Type F DLNA.

4.2.6.8 Table 5 shows the calculation of the limits referred to the output of a Type F DLNA.

4.2.6.9 Figure 4 shows the configuration used for testing Intermodulation Products.

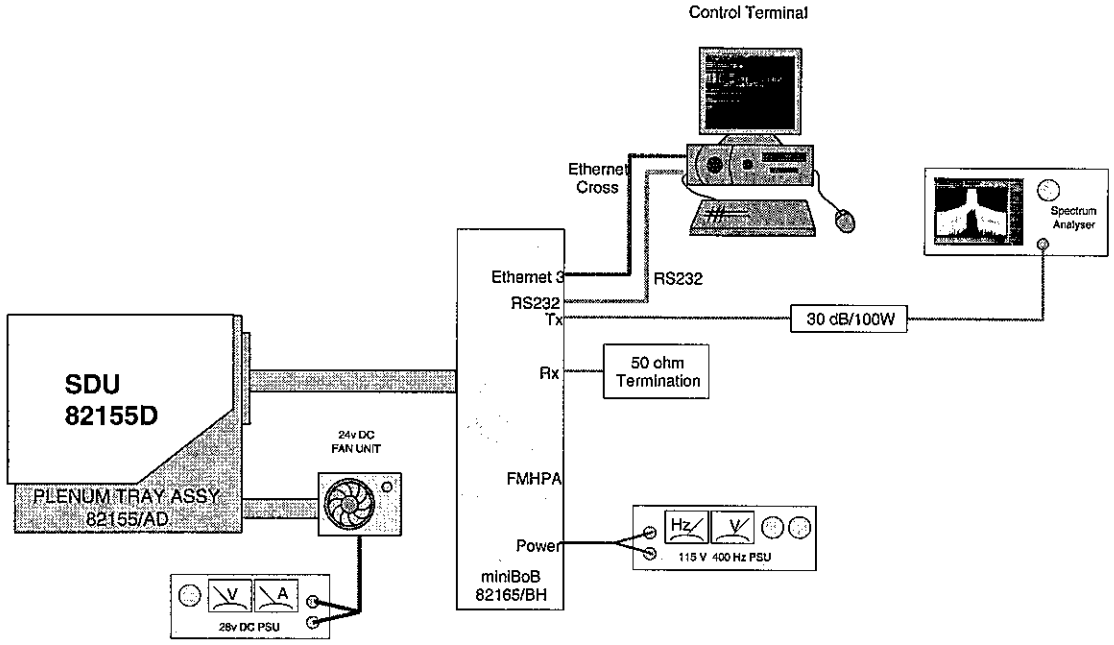


Figure 4 Intermods Test Configuration

4.3 Class 6 with external HPA

4.3.1 RF Power Output Testing (Class 6 with external HPA)

4.3.1.1 The power output of an SDU operating Classic Aero series is 2dB higher than an SDU operating in Class 6, namely 22 dBW EIRP versus 20 dBW EIRP. Thales consider that for the purposes of assessing RF Carrier Output Power, the Classic Aero testing provides measurements that also satisfy the requirements of this submission – see section 4.4.1.

4.3.2 Occupied Bandwidth (Class 6 with external HPA)

4.3.2.1 The Modulation types/Bandwidths are the same whether an internal or external HPA is used so the test in section 4.2.2 is valid and was not repeated.

4.3.3 Frequency Stability (Class 6 with external HPA)

4.3.3.1 The SDU Frequency Stability is the same whether an internal or external HPA is used so the test in section 4.2.3 is valid and was not repeated.

4.3.4 Conducted Spurious Emissions (Class 6 with external HPA)

4.3.4.1 The power output of an SDU operating Classic Aero is 2 dB higher than an SDU operating as in Class 6, namely 22 dBW EIRP versus 20 dBW EIRP. Because the power output of a Classic Aero SDU is higher, the spurious emissions can be expected to be equal to or worse than an SDU operating in SBB Class 6. Thales considers that for the purposes of assessing RF Output Power, the Classic Aero testing provides measurements that also satisfy the requirements of this submission - (see section 4.3.4.1).

4.3.5 Radiated Spurious Emissions (Class 6 with external HPA)

4.3.5.1 The SDU was tested for Radiated Emissions as per FCC 47 CFR Part 15.209 (ref.1.4.1).

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

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

4.3.5.4 Figure 5 shows the test configuration used for the Radiated Emissions testing. The test procedure is detailed in the Test House report (ref. 1.4.4).

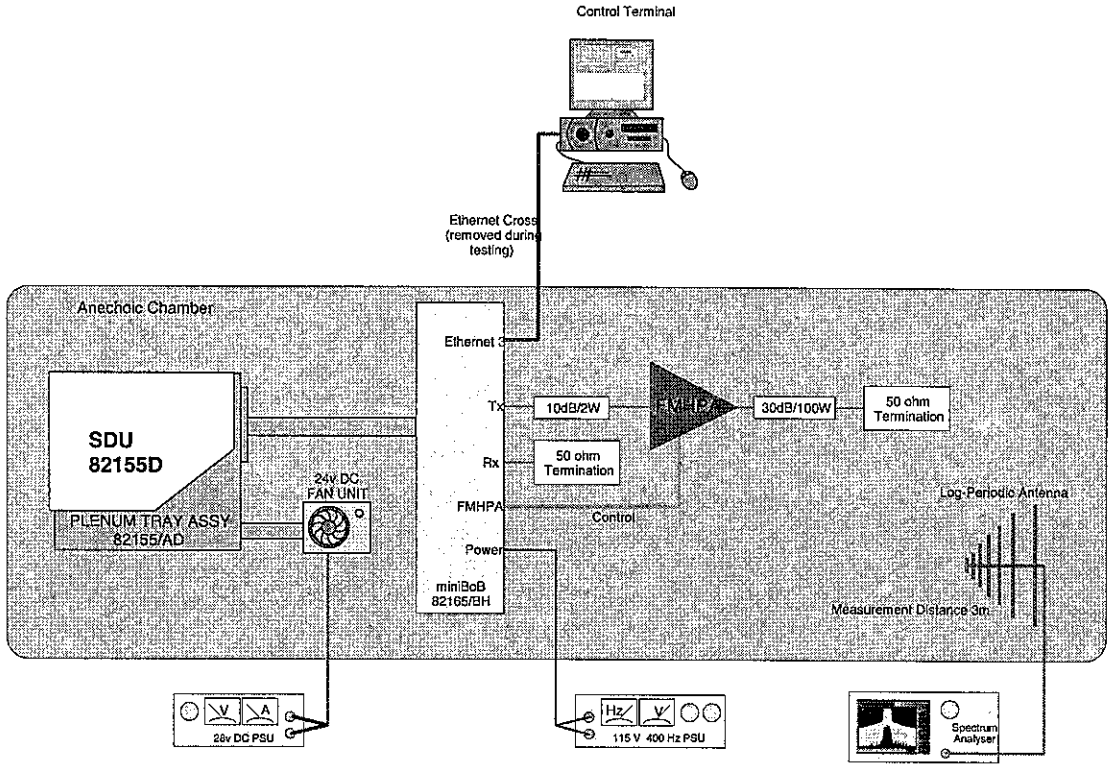


Figure 5 Radiated Emissions Test Configuration

4.3.6 Intermodulation Products (Class 6 with external HPA)

4.3.6.1 The SDU with FMHPA was tested for Intermodulation Products to support the submission to the FCC of the TopFlight Satcom system.

4.3.6.2 Thales note that without a formal FCC specification for Intermod testing the Intermodulation Products limits were measured against the formalised FCC Conducted Emissions limits presented in Table 5 of this report.

4.3.6.3 The Intermodulation Products testing was performed at Thales Avionics, on an SDU configured in Inmarsat SwiftBroadBand (SBB) Class 6 mode.

4.3.6.4 Intermodulation Products testing was conducted as a series of modulated carrier pairs, as the SDU is only capable of producing two SBB channels.

4.3.6.5 Multiple tests have been conducted with carrier at both minimum and maximum carrier frequency separations. The SDU in Class 6 mode is capable of both QPSK and 16-QAM modulations over a range of symbol rates.

4.3.6.5.1 The SBB (Class 6) Intermodulation Product tests were conducted at the highest symbol rate (151.2kBps) 16-QAM modulation with 200KHz spacing, with both closely spaced and maximum frequency separation modulated carrier tests as follows:

- Two modulated carriers were produced at 1627.15 and 1627.35 MHz respectively for the lower edge test.
- Two modulated carriers were produced at 1659.65 and 1659.85MHz for the upper edge test.
- Two modulated carriers were produced at 1627.15 and 1659.85MHz for the maximum frequency separation test.

4.3.6.5.2 Full Rated Power for the External FMHPA is 35W (45.4dBm) therefore each modulated carrier was refined to produce 42.4dBm (+/-1dB).

4.3.6.6 The stated test cases are considered by Thales to be the worst-case conditions. The tests were conducted using the Type-D SDU with FMHPA configuration.

4.3.6.7 As in the Conducted spurious emissions testing (section 4.2.4.5), Thales concluded that the only practical way to measure Intermodulation Products was to make the measurement at the FMHPA output, before the DLNA, and compute the resultant spurious at the antenna by adding the specified attenuation of the Type F DLNA.

4.3.6.8 Table 5 shows the calculation of the limits referred to the output of a Type F DLNA.

4.3.7 Figure 4 shows the configuration used for testing Intermodulation Products.

4.4 Classic with external HPA

4.4.1 RF Power Output Testing (Classic with external HPA)

4.4.1.1 The SDU was tested for RF Carrier Output Power as per FCC 47 CFR Parts 2.1046 and 87.131 (ref.1.4.1).

4.4.1.2 The RF Carrier Output Power testing was performed at Thales Avionics Ltd.

4.4.1.3 Figure 6 shows the test configuration used for testing RF Output Power.

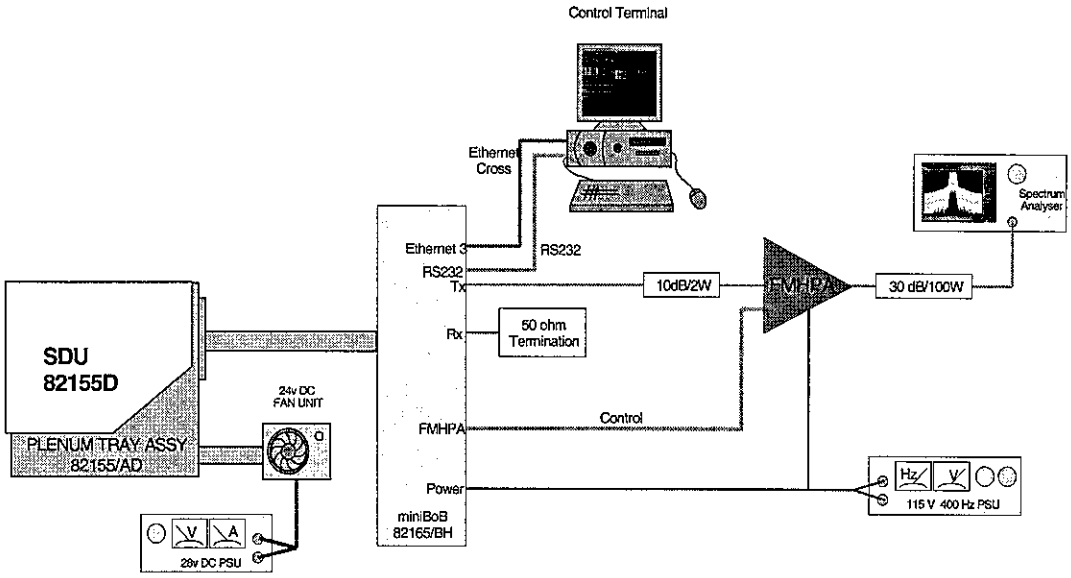


Figure 6 RF Power, Occupied Bandwidth and Conducted Emissions Test Configuration

4.4.2 Occupied Bandwidth (Classic with external HPA)

4.4.2.1 The SDU was tested for Occupied Bandwidth as per FCC 47 CFR Parts 2.1049 and 87.135 (ref.1.4.1).

4.4.2.2 The Occupied Bandwidth testing was performed at Thales Avionics Ltd.

4.4.2.3 Figure 6 shows the test configuration used for testing Occupied Bandwidth.

4.4.3 Frequency Stability (Classic with external HPA)

4.4.3.1 The SDU Frequency Stability is the same whether the SDU is in Class 6 or Classic mode so the test in section 4.2.3 is valid and was not repeated.

4.4.4 Conducted Spurious Emissions (Classic with external HPA)

4.4.4.1 The SDU was tested for Conducted Emissions as per FCC 47 CFR Parts 2.1051 & 87.139 (ref.1.4.1).

4.4.4.2 The Conducted Spurious Emissions testing was performed at Thales Avionics Ltd.

4.4.4.3 Thales tested the SDU using an alternative method as used for FCC qualification of the Thales SDU FCC ID KVS-TFS-SDU82155A and described in sections 4.2.4.4 to 4.2.4.8.

4.4.4.4 Thales are therefore requesting a waiver against the test method used for the measurement of the SDU FCC ID: KVSTFS-SDU82155D for Conducted Spurious Emissions. This waiver in test method was approved for KVS-TFS-SDU82155A.

4.4.4.5 Figure 6 shows the configuration used for testing Conducted Emissions.

4.4.5 Radiated Spurious Emissions (Classic with external HPA)

4.4.5.1 The SDU was tested for Radiated Emissions as per FCC 47 CFR Part 15.209 (ref.1.4.1).

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

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

4.4.5.4 Figure 5 shows the test configuration used for the Radiated Emissions testing. The test procedure is detailed in the Test House report (Ref. 1.4.5).

4.4.6 Intermodulation Products (Classic with external HPA)

4.4.6.1 The SDU with FMHPA was tested for Intermodulation Products to support the submission to the FCC of the TopFlight Satcom system.

4.4.6.2 Thales note that without a formal FCC specification for Intermod testing the Intermodulation Products limits were measured against the formalised FCC Conducted Emissions limits presented in Table 5 of this report.

4.4.6.3 The Intermodulation Products testing was performed at Thales Avionics, on an SDU configured in Inmarsat Classic mode (TopFlight SATCOM Type-D Dual Channel SDU).

4.4.6.4 Intermodulation Products testing was conducted as a series of modulated carrier pairs. The system was tested with two carriers due to current software limitations that enable only two carriers to be set up simultaneously.

4.4.6.5 Multiple tests have been conducted with carriers at both minimum and maximum carrier frequency separations.

4.4.6.5.1 The Classic Aeronautical Intermodulation Product tests were conducted at the lowest symbol rate (600bps) QPSK modulation with 2.5KHz spacing, with both closely spaced and maximum frequency separation modulated carrier tests as follows:

- Two modulated carriers were produced at 1626.6025 and 1626.6 MHz respectively for the lower edge test.
- Two modulated carriers were produced at 1660.3975 and 1660.4MHz for the upper edge test.
- Two modulated carriers were produced at 1626.6 and 1660.4MHz for the maximum frequency separation test.

4.4.6.5.2 Full Rated Power for the FMHPA with a Type-D SDU testing is 35W (45.4dBm) therefore; each modulated carrier was refined to produce 42.4dBm (+/-1dB).

4.4.6.6 The stated test cases are considered by Thales to be the worst-case conditions. The tests were conducted using the Type-D SDU with FMHPA configuration. The SDU internal High Power Amplifier is set to Low Power mode in this configuration.

4.4.6.7 As in the Conducted spurious emissions testing (section 4.2.4.5), Thales concluded that the only practical way to measure Intermodulation Products was to make the measurement at the FMHPA output, before the DLNA, and compute the resultant spurious at the antenna by adding the specified attenuation of the Type F DLNA.

4.4.6.8 Table 5 in this report shows the calculation of the limits referred to the output of a Type F DLNA.

4.4.6.9 Figure 4 shows the configuration used for testing Intermodulation Products.

5 Results.

5.1 Class 6 with internal HPA

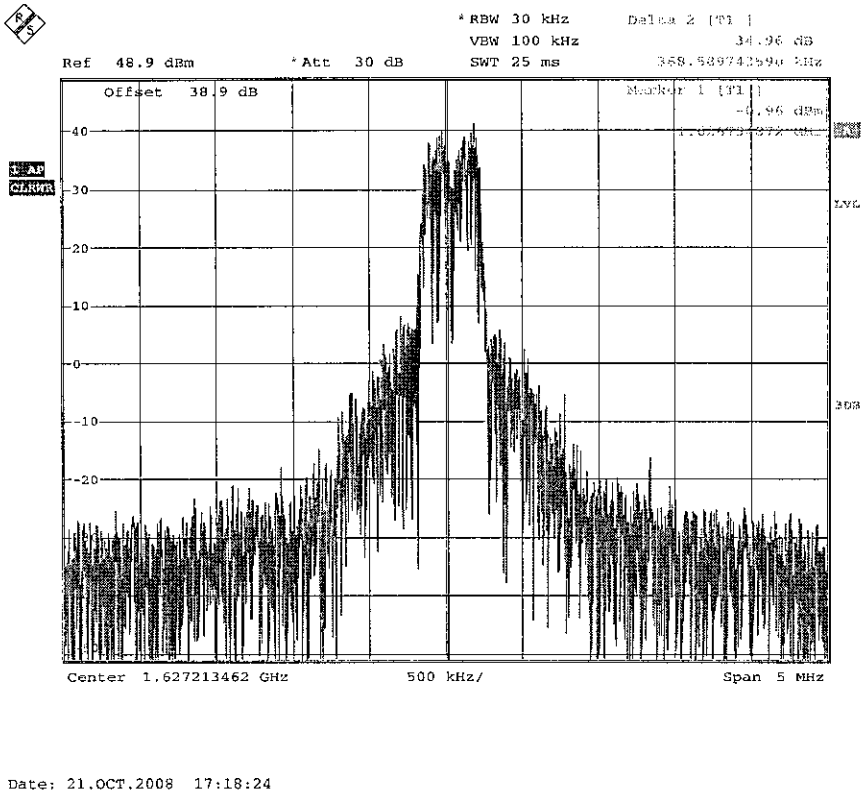
5.1.1 The location of test results for RF Power, Occupied Bandwidth, Frequency Stability, Conducted Spurious, and Radiated Emissions is defined in Table 1.

5.1.2 In the Conducted Spurious plots in (ref. 1.4.3) for Class 7 mode, the limit line is set to a level of –13 dBm in all plots. For a Carrier level of 43 dBm the Limit line level of –13 dBm is equivalent to -56 dBc. This Limit level is the worse-case across all frequencies, except for 1525 to 1559 MHz where the limit is –59dBc. Visual inspection of this one plot shows compliance with a 3dB more strict limit.

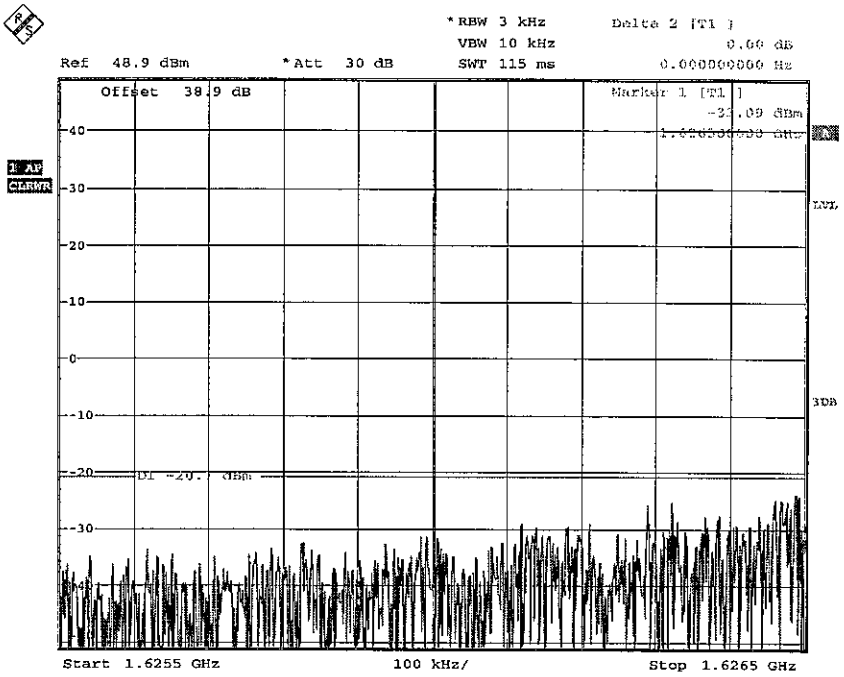
5.1.3 Intermodulation Products

5.1.3.1 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1625.5MHz to 1660MHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 30 W. Both carriers are produced at close to the lower edge of the transmit band with 200KHz spacing.

5.1.3.1.1 Overview Image

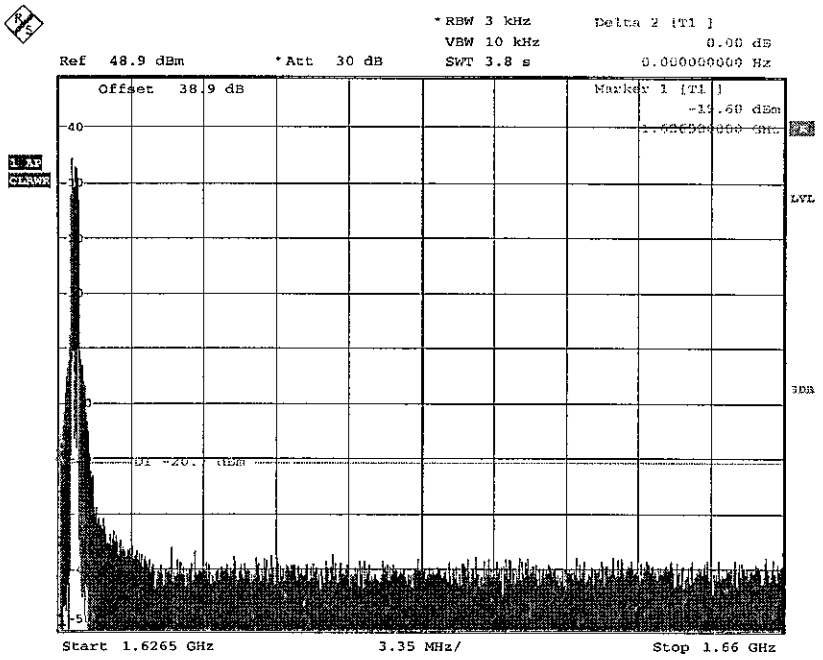


5.1.3.1.2 1625.5 MHz to 1626.5 MHz



Date: 21.OCT.2008 17:19:41

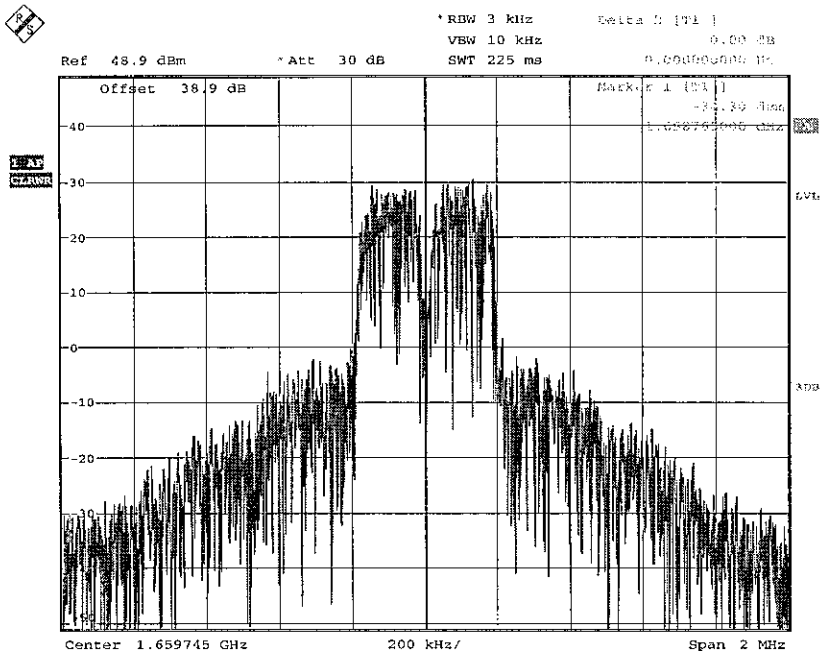
5.1.3.1.3 1626.5 MHz to 1660 MHz



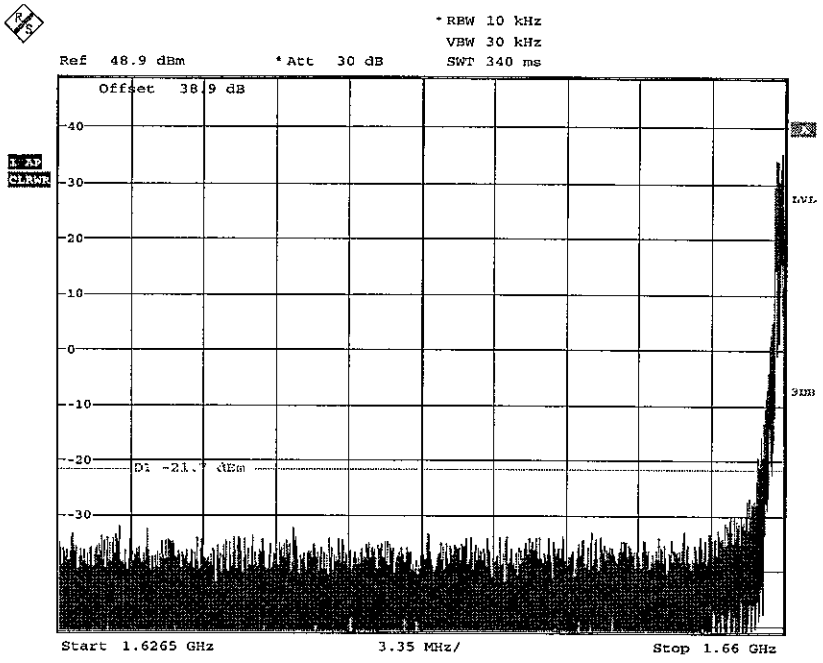
Date: 21.OCT.2008 17:20:36

5.1.3.2 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1626.5MHz to 1670MHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 30 W. Both carriers are produced at close to the upper edge of the transmit band with 200KHz spacing.

5.1.3.2.1 Overview Image

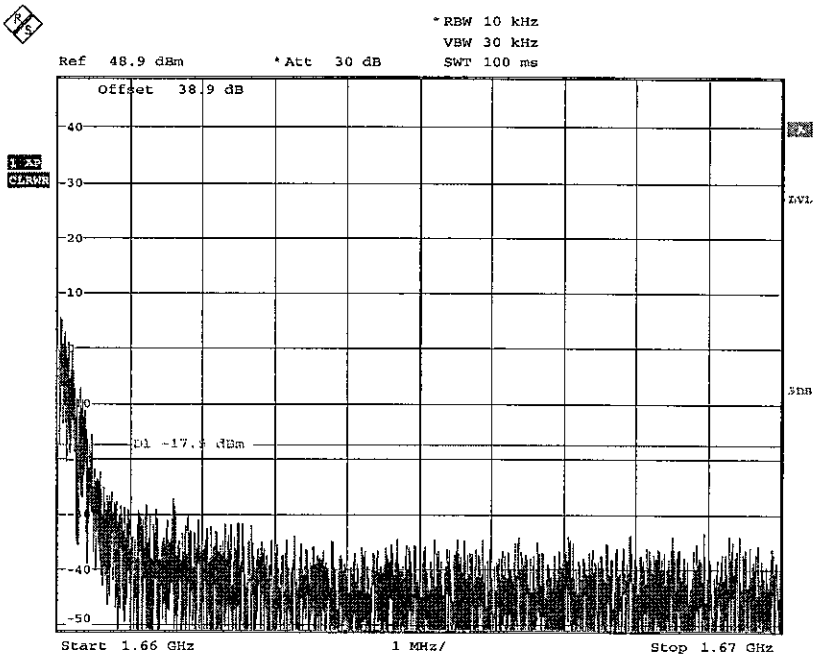


5.1.3.2.2 1626.5 MHz to 1660 MHz



Date: 21.OCT.2008 17:28:11

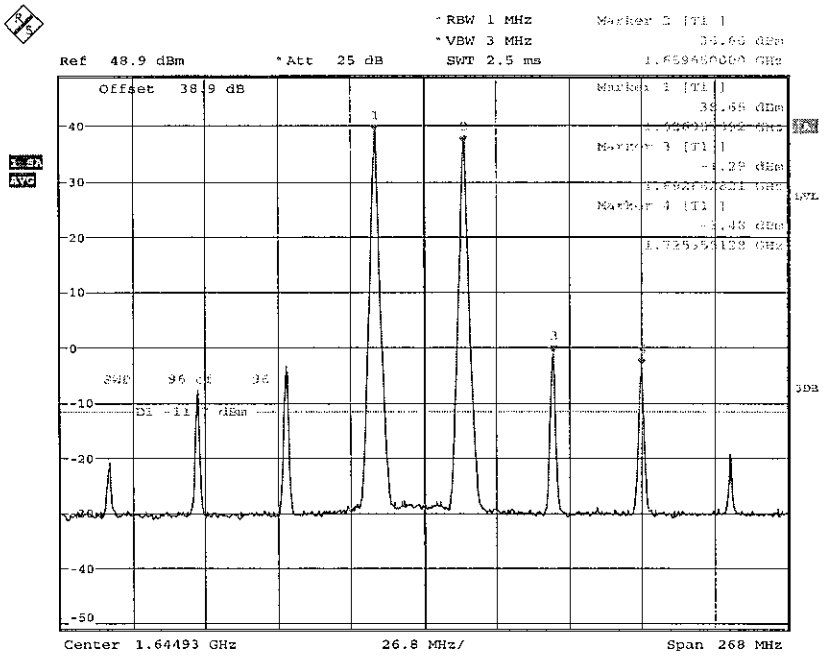
5.1.3.2.3 1660 MHz to 1670 MHz



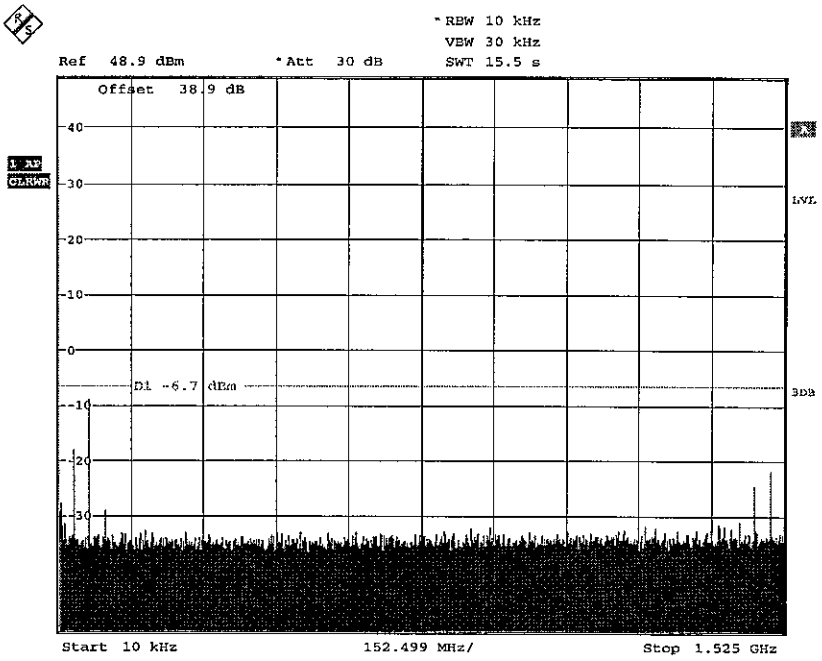
Date: 21.OCT.2008 17:28:49

5.1.3.3 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 10 KHz to 18 GHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 30 W. One carrier is produced at close to the lower edge of the transmit band and one carrier is produced at close to the upper edge of the transmit band.

5.1.3.3.1 Overview Image

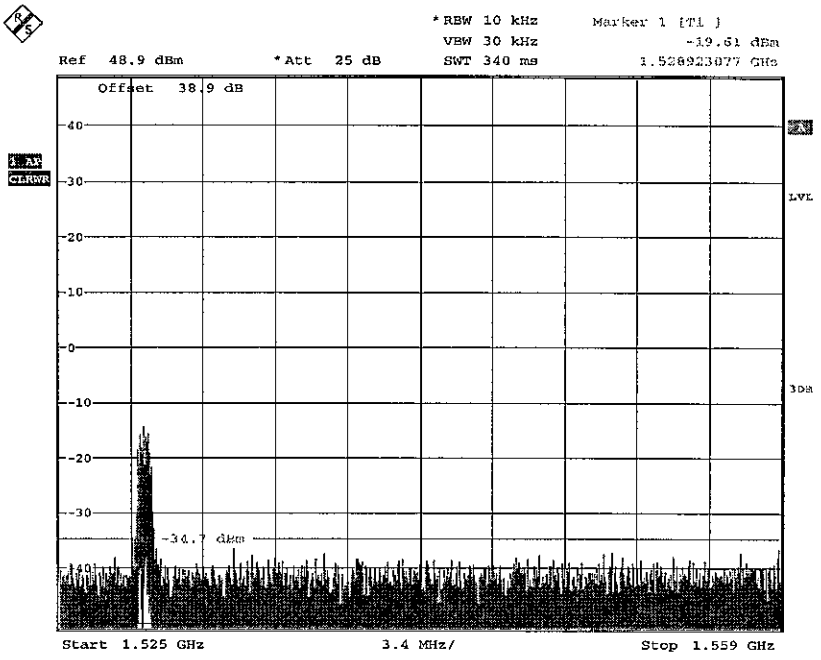


5.1.3.3.2 10 KHz to 1525 MHz



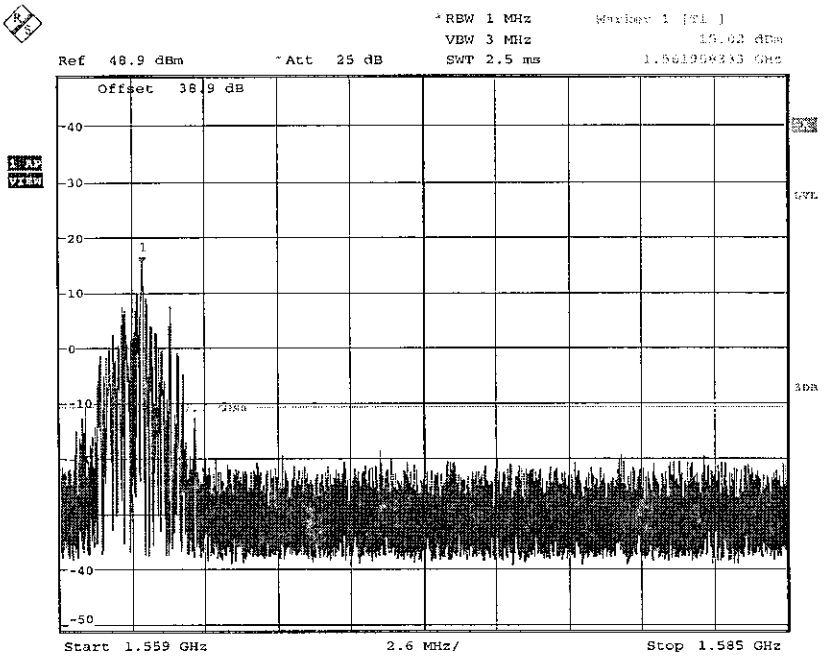
Date: 21.OCT.2008 17:33:49

5.1.3.3.3 1525 MHz to 1559 MHz



Date: 21.OCT.2008 17:35:17

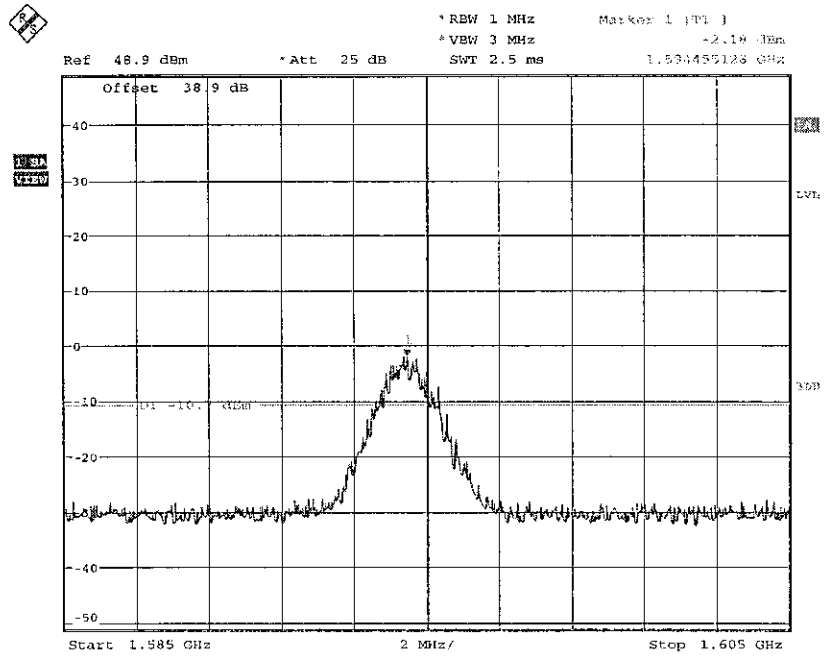
5.1.3.3.4 1559 MHz to 1585 MHz



Date: 21.OCT.2008 17:36:48

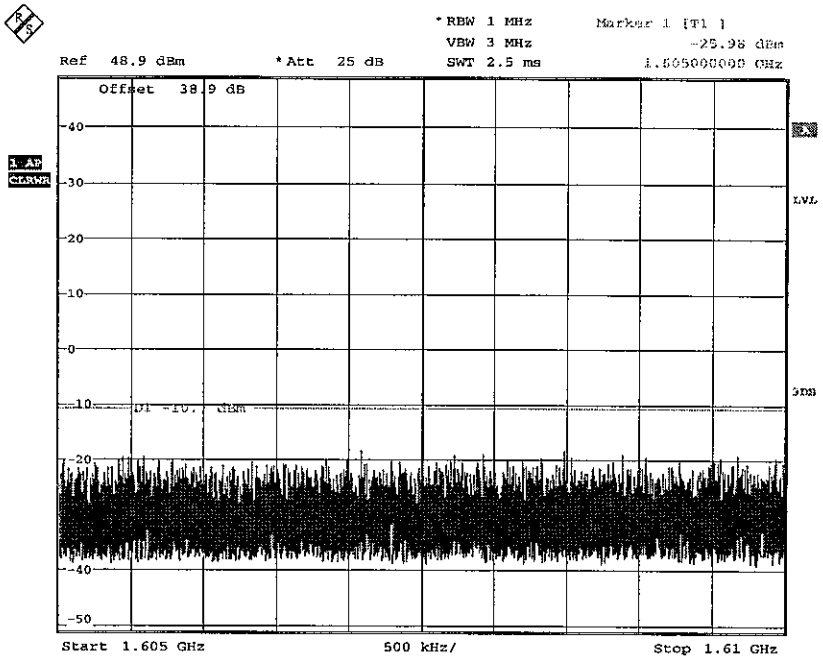
NB: Averaging not applied to this plot, visual analysis suggests the peak of this plot would be below 0dBm if averaged (and in-line with other existing testing).

5.1.3.3.5 1585 MHz to 1605 MHz



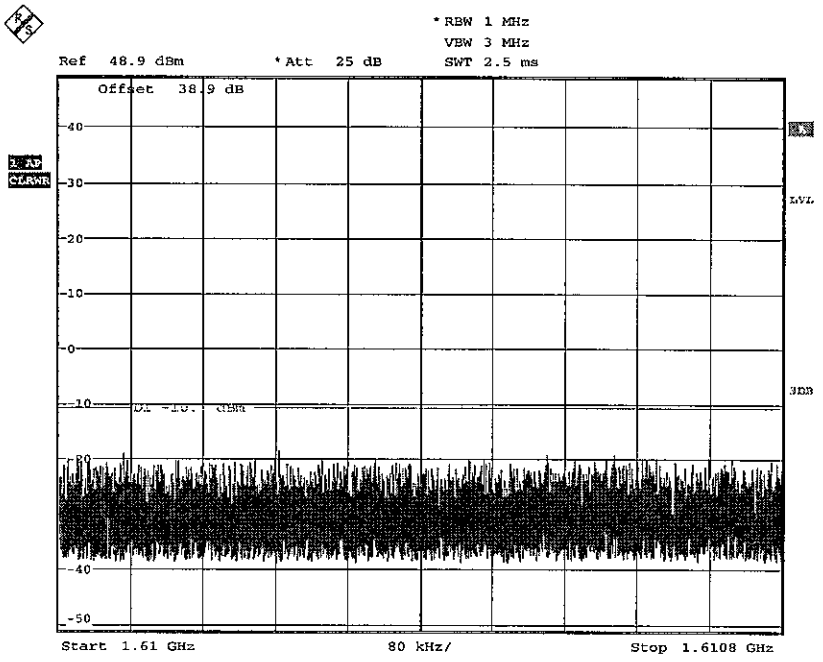
Date: 22.OCT.2008 10:43:30

5.1.3.3.6 1605 MHz to 1610 MHz



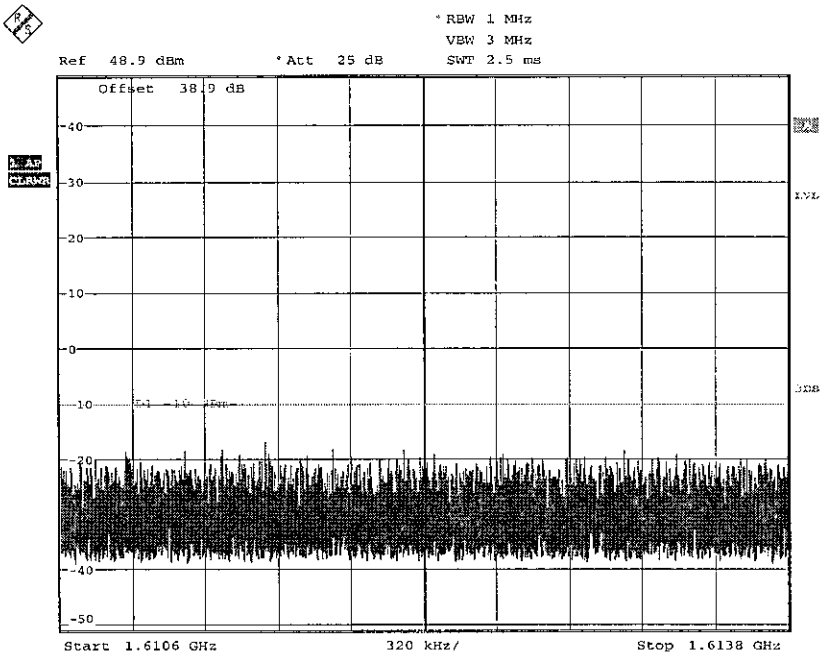
Date: 21.OCT.2008 17:38:52

5.1.3.3.7 1610 MHz to 1610.8 MHz



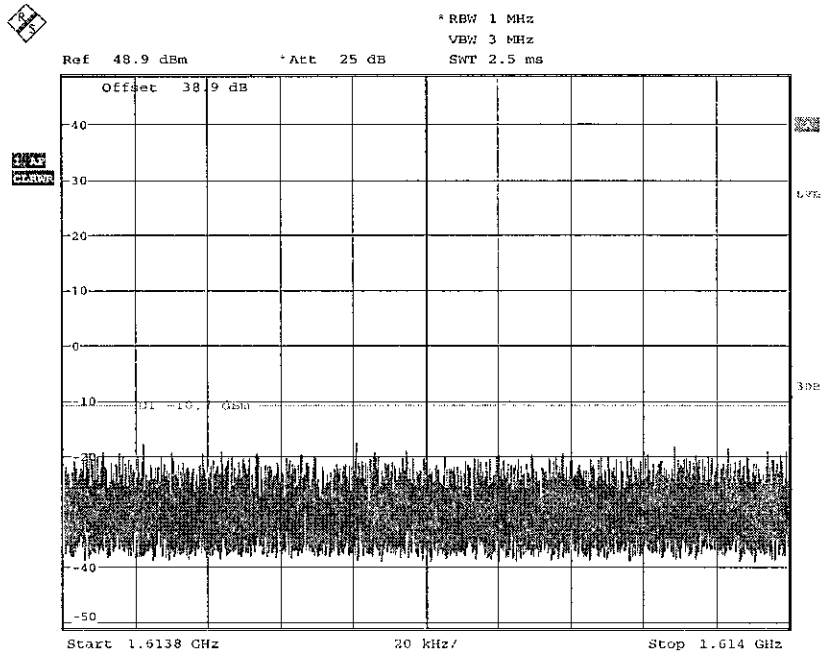
Date: 21.OCT.2008 17:39:36

5.1.3.3.8 1610.6 MHz to 1613.8 MHz



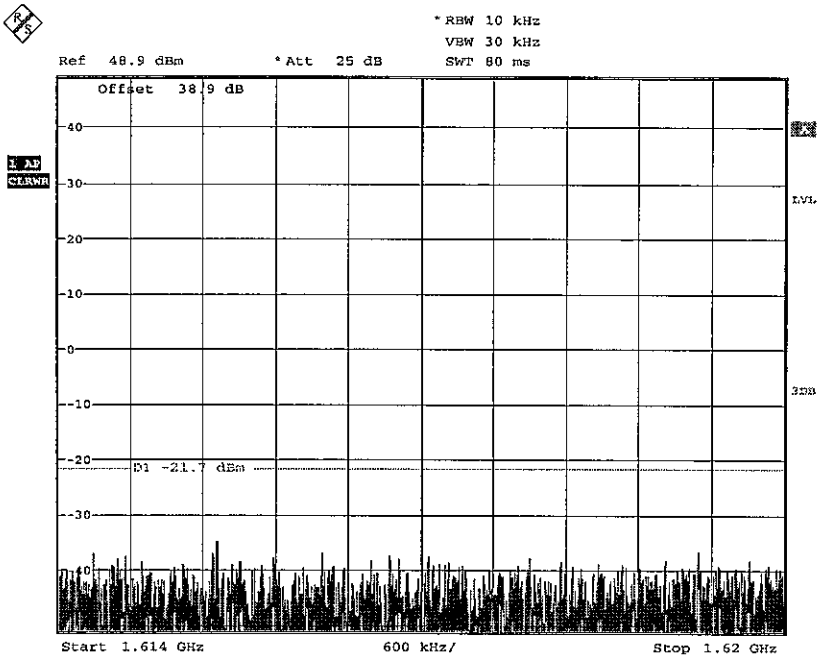
Date: 21.OCT.2008 17:40:39

5.1.3.3.9 1613.8 MHz to 1614 MHz



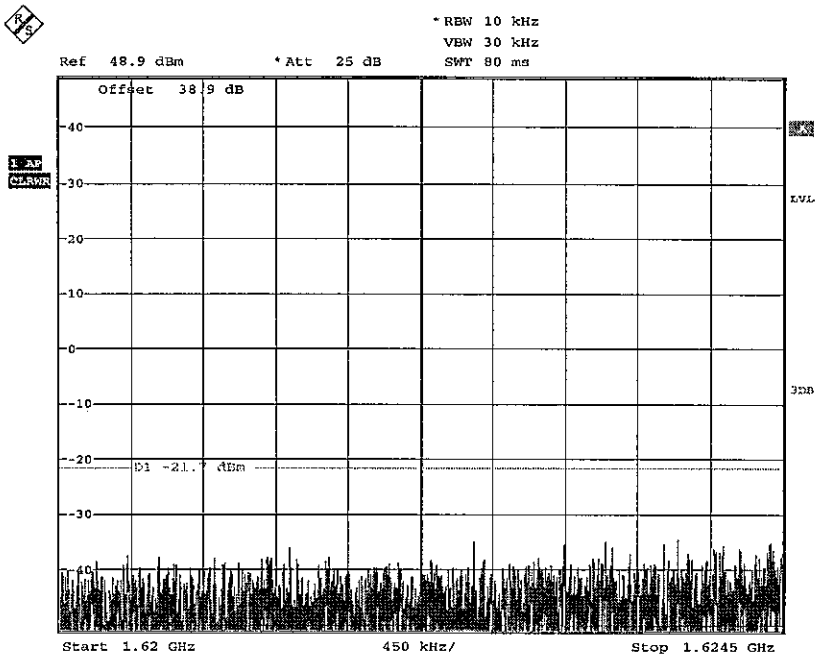
Date: 21.OCT.2008 17:41:27

5.1.3.3.10 1614 MHz to 1620 MHz



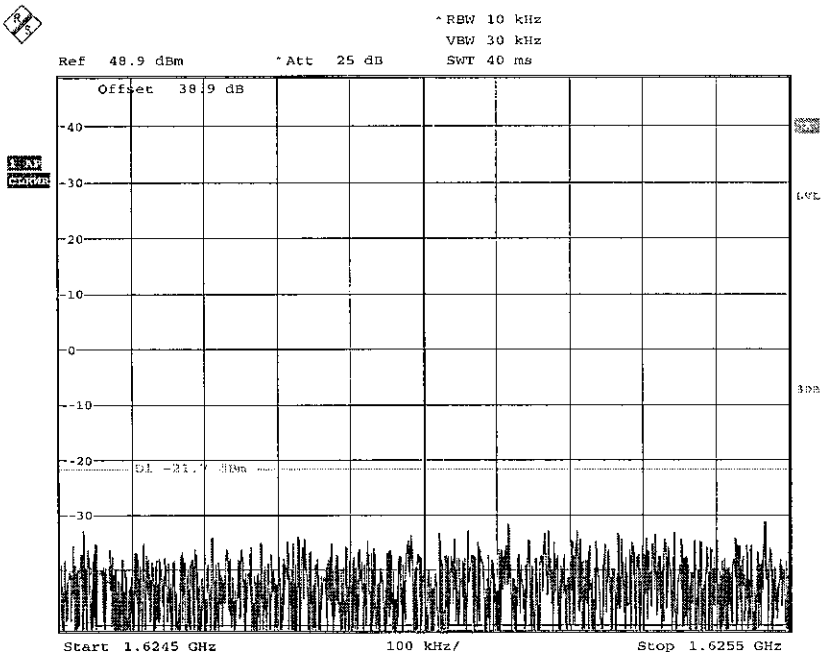
Date: 21.OCT.2008 17:42:27

5.1.3.3.11 1620 MHz to 1624.5 MHz



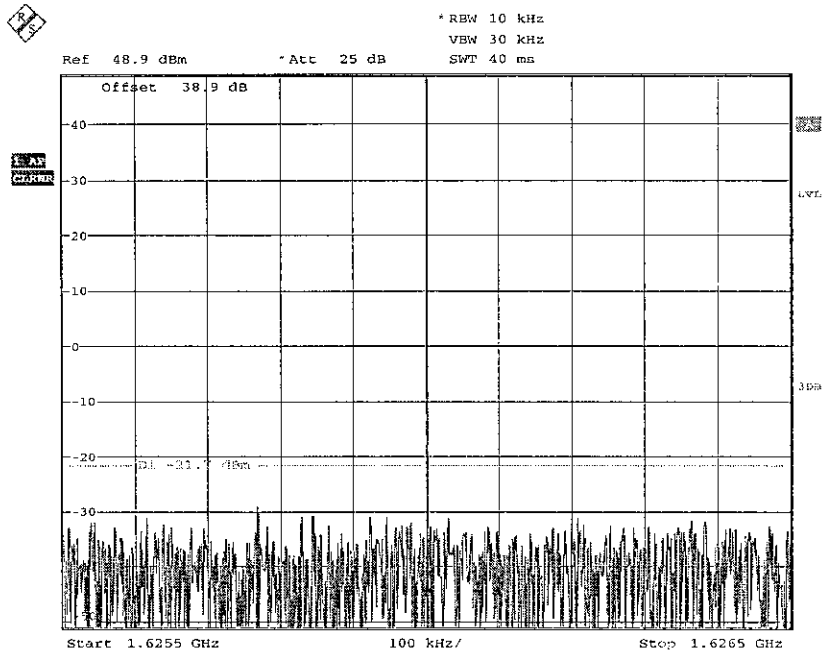
Date: 21.OCT.2008 17:42:55

5.1.3.3.12 1624.5 MHz to 1625.5 MHz



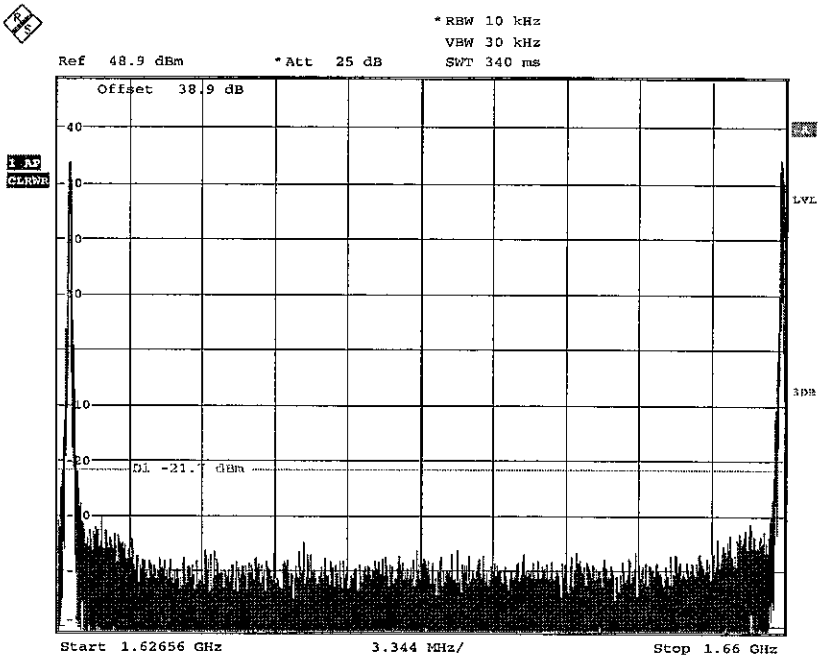
Date: 21.OCT.2008 17:43:26

5.1.3.3.13 1625.5 MHz to 1626.5 MHz



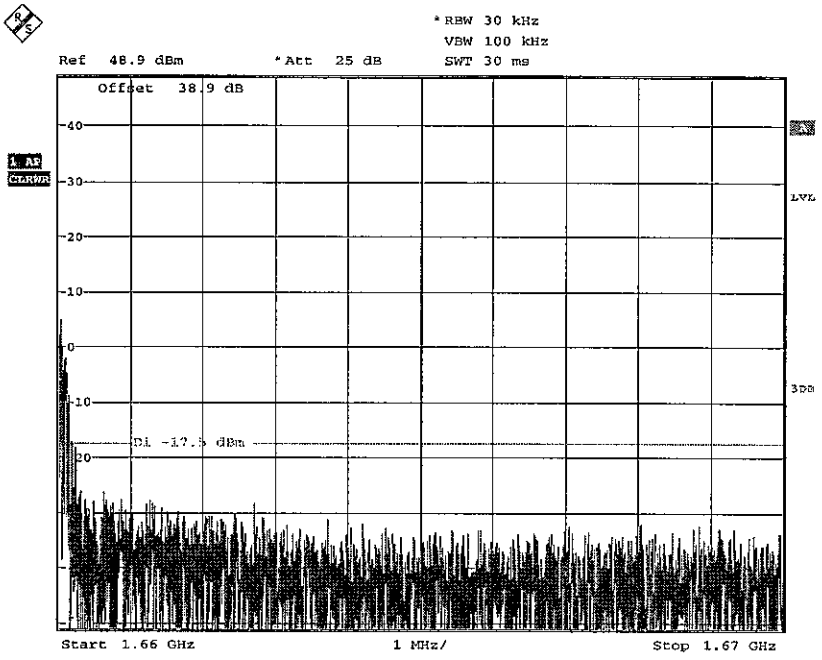
Date: 21.OCT.2008 17:44:01

5.1.3.3.14 1626.5 MHz to 1660 MHz



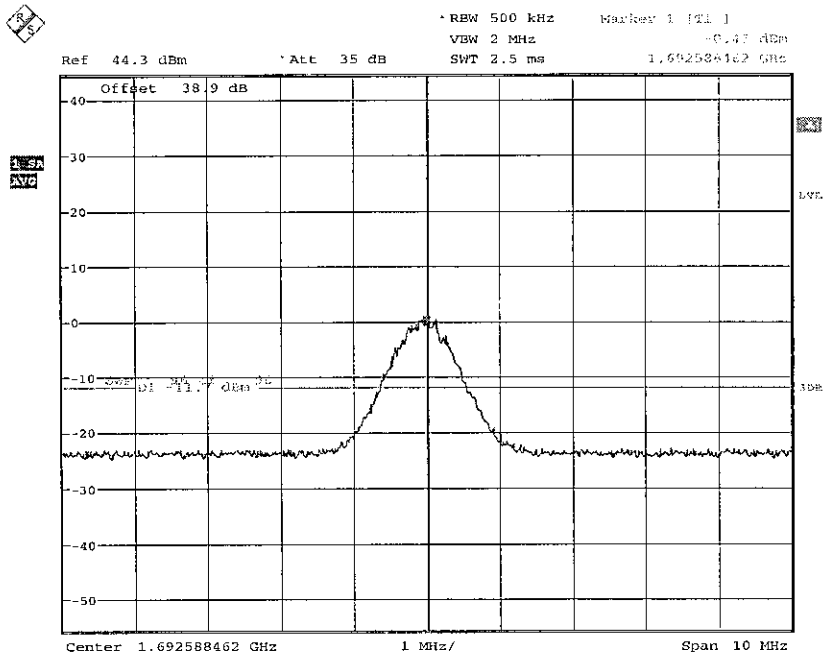
Date: 21.OCT.2008 17:44:33

5.1.3.3.15 1660 MHz to 1670 MHz



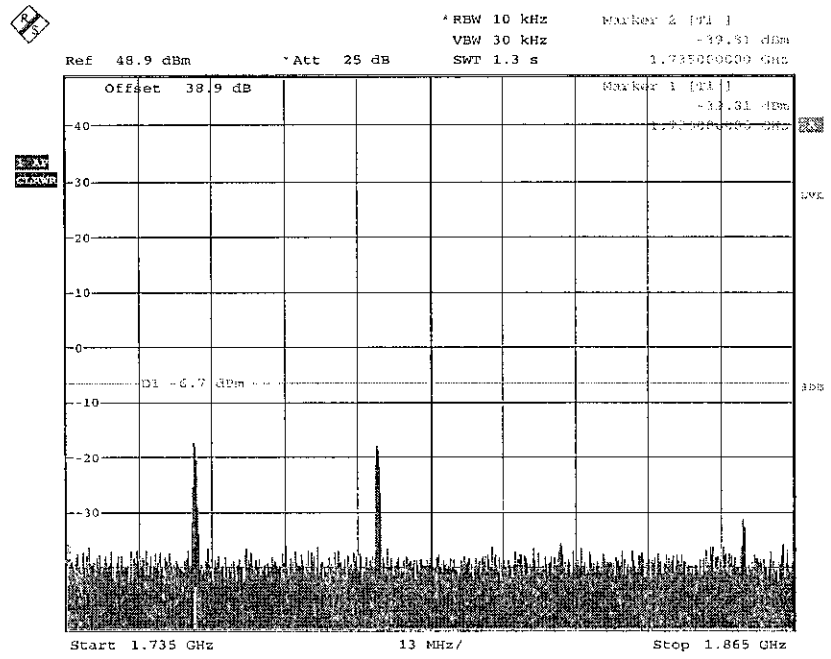
Date: 21.OCT.2008 17:46:51

5.1.3.3.16 1670 MHz to 1735 MHz



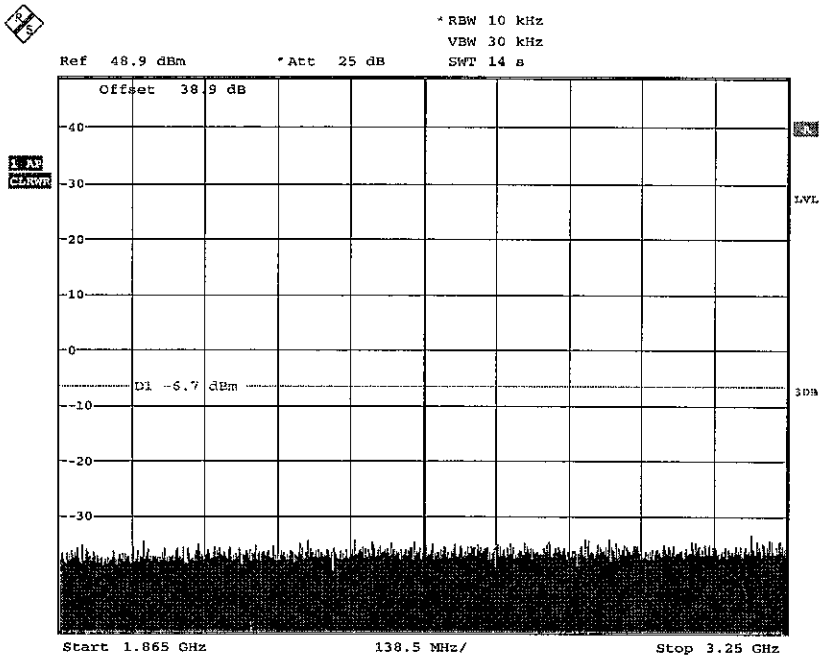
Date: 22.OCT.2008 11:39:15

5.1.3.3.17 1735 MHz to 1865 MHz



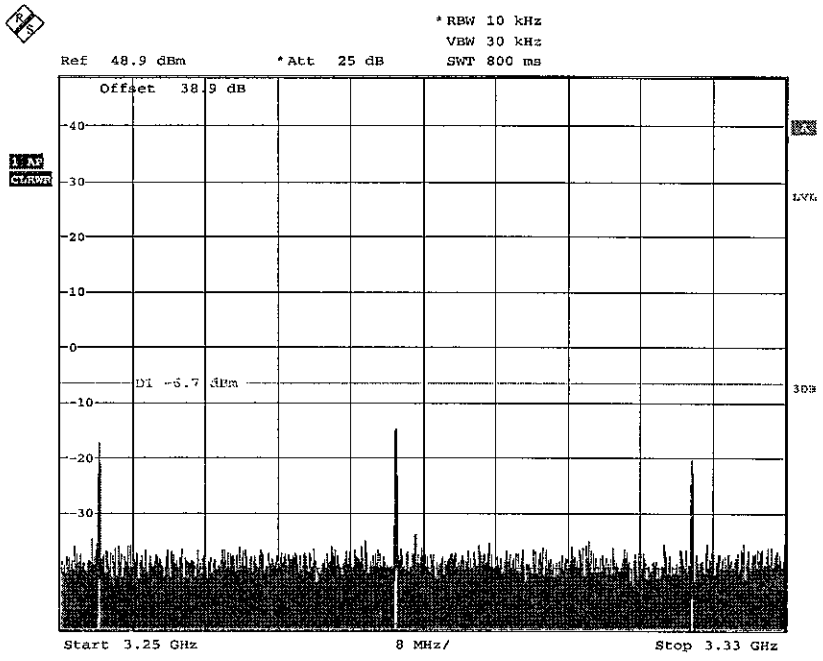
Date: 21.OCT.2008 17:49:21

5.1.3.3.18 1865 MHz to 3250 MHz



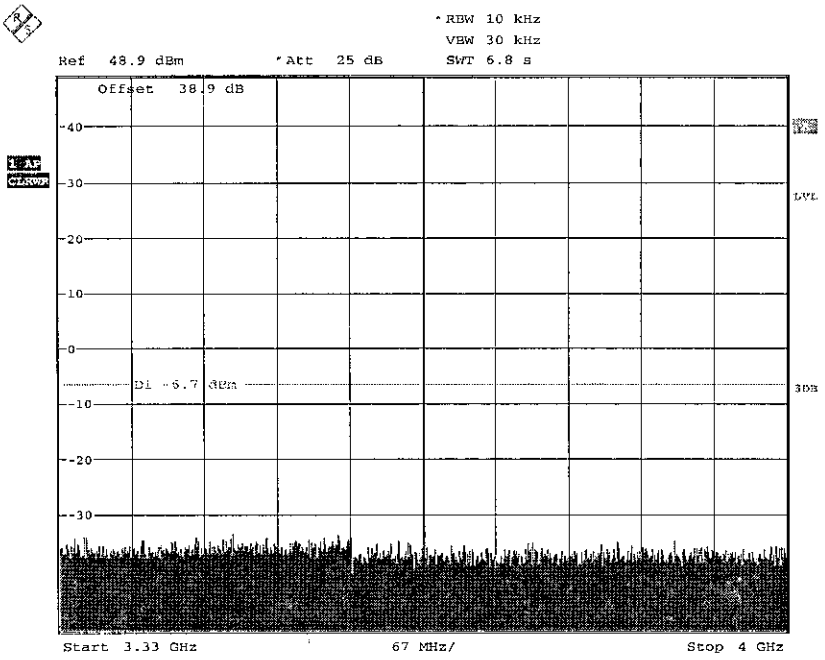
Date: 21.OCT.2008 17:50:03

5.1.3.3.19 3250 MHz to 3330 MHz



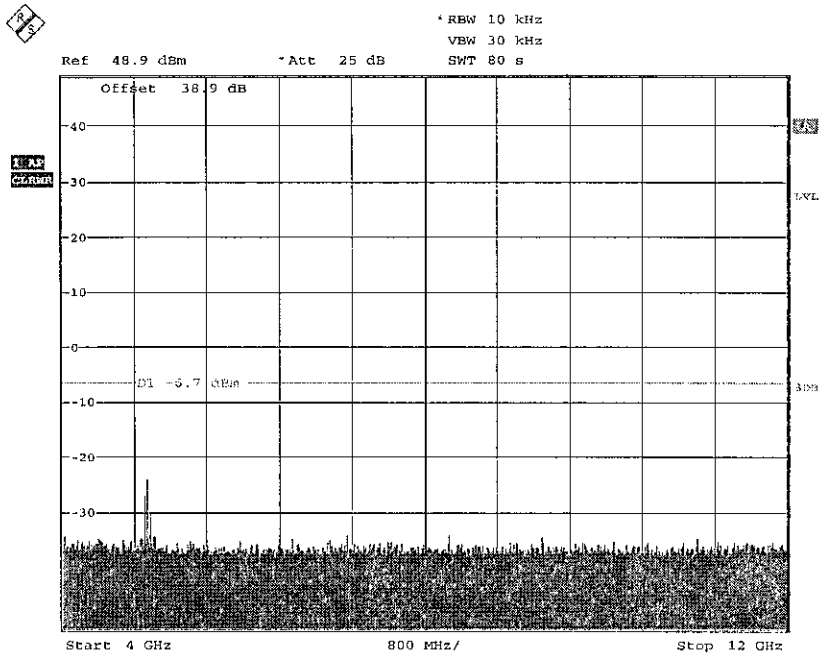
Date: 21.OCT.2008 17:50:32

5.1.3.3.20 3330 MHz to 4000 MHz



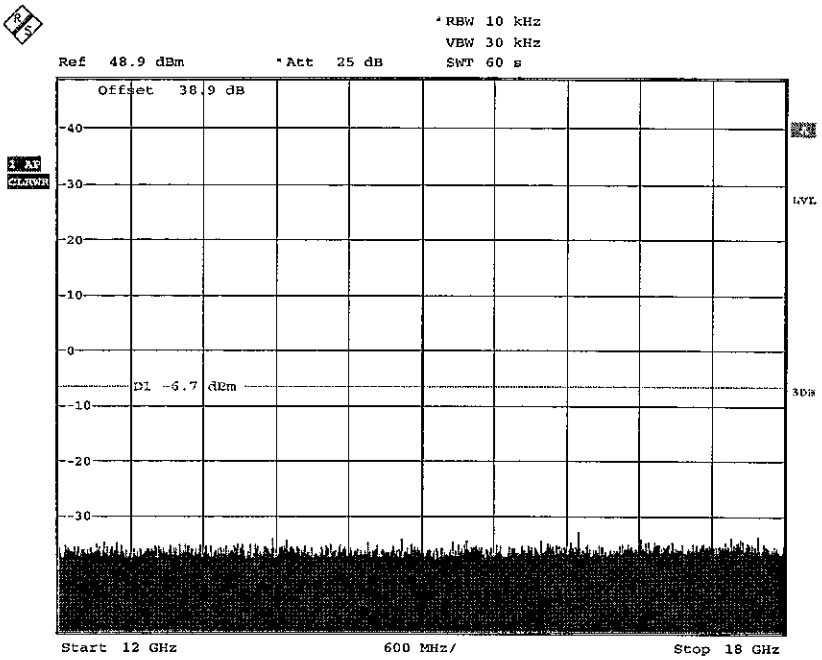
Date: 21.OCT.2008 17:51:12

5.1.3.3.21 4 GHz to 12 GHz



Date: 21.OCT.2008 17:52:55

5.1.3.3.22 12 GHz to 18 GHz



Date: 21.OCT.2008 17:54:17

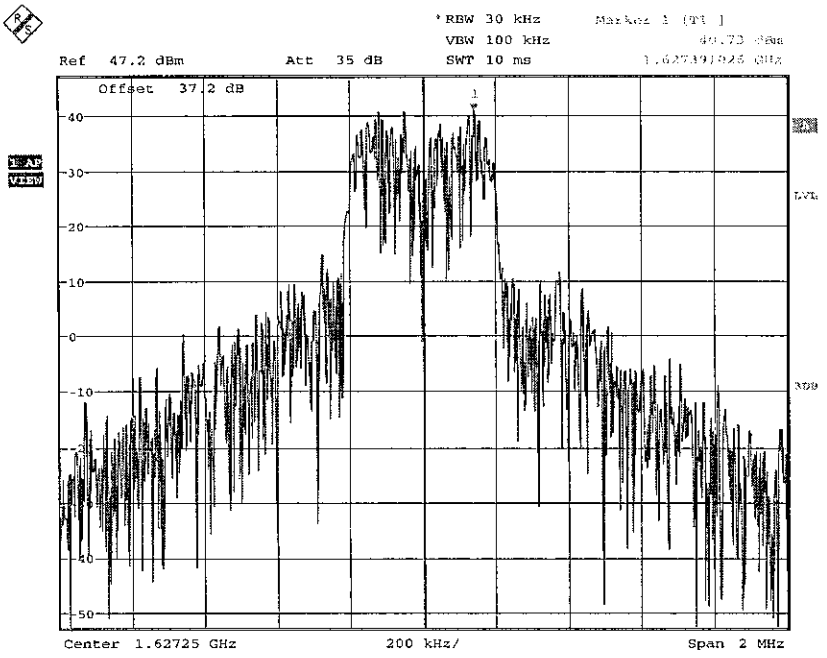
5.2 Class 6 with external HPA

5.2.1 The location of test results for RF Power, Occupied Bandwidth, Frequency Stability, Conducted Spurious, and Radiated Emissions is defined in Table 1.

5.2.2 Intermodulation Products

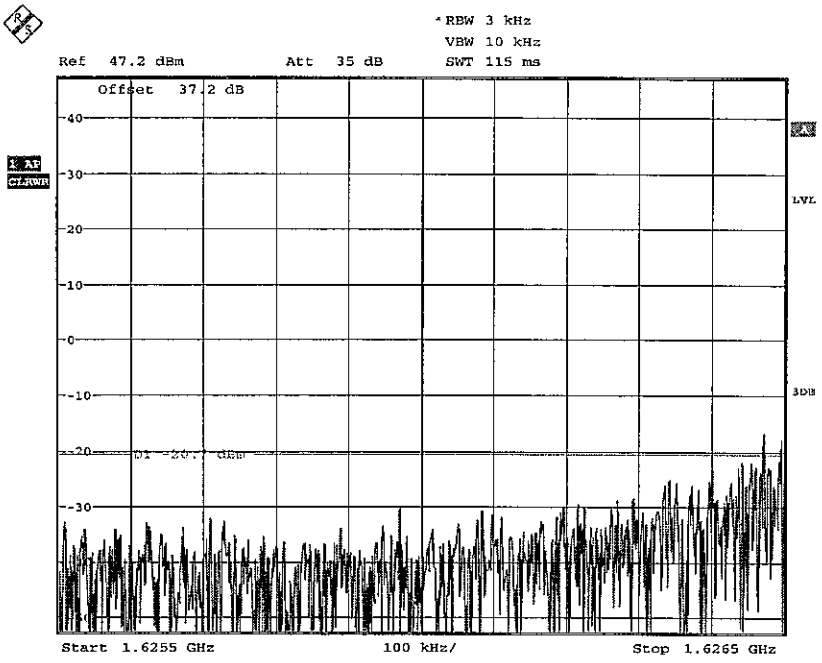
5.2.2.1 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1625.5MHz to 1660MHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 35 W. Both carriers are produced at close to the lower edge of the transmit band with 200KHz spacing.

5.2.2.1.1 Overview Image



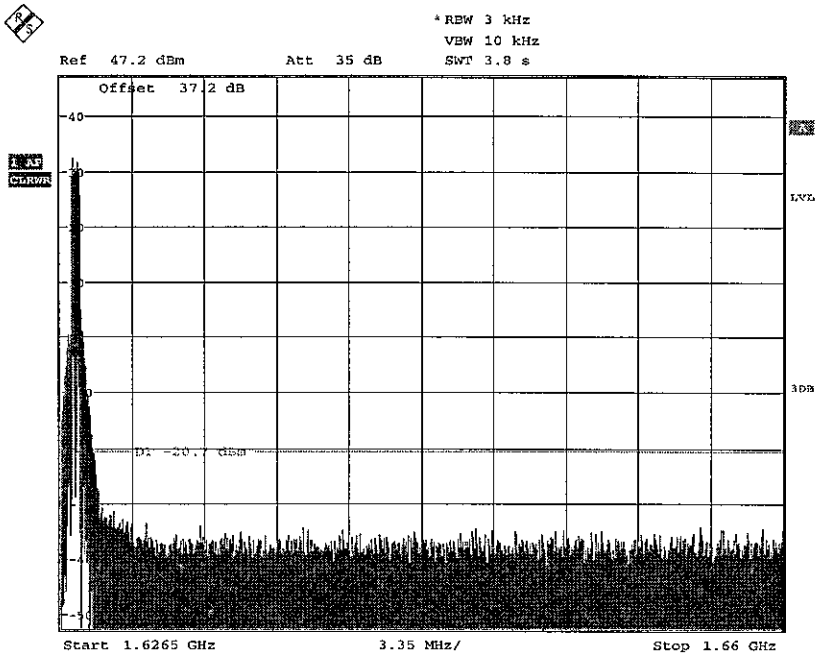
Date: 21.OCT.2008 16:06:38

5.2.2.1.2 1625.5 MHz to 1626.5 MHz



Date: 21.OCT.2008 16:10:28

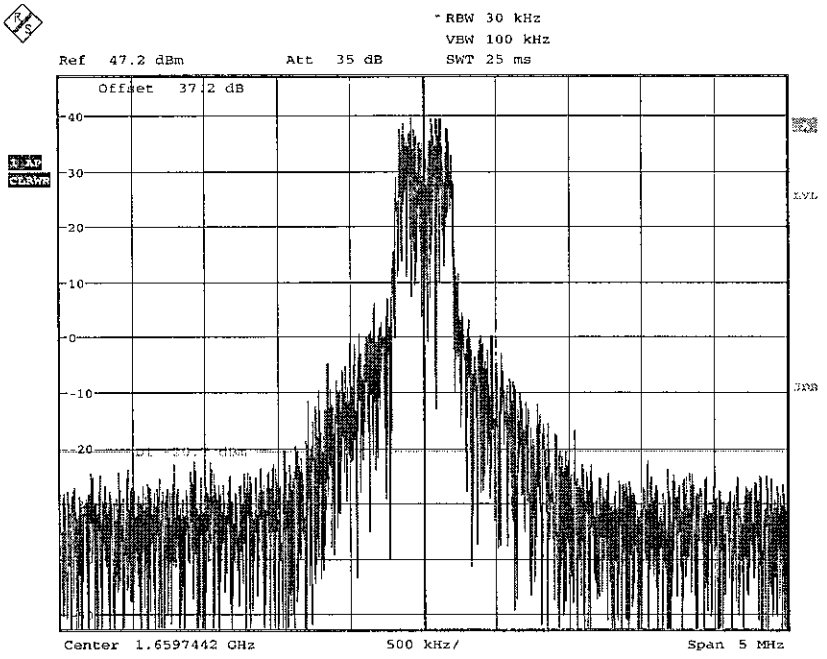
5.2.2.1.3 1626.5 MHz to 1660 MHz



Date: 21.OCT.2008 16:11:41

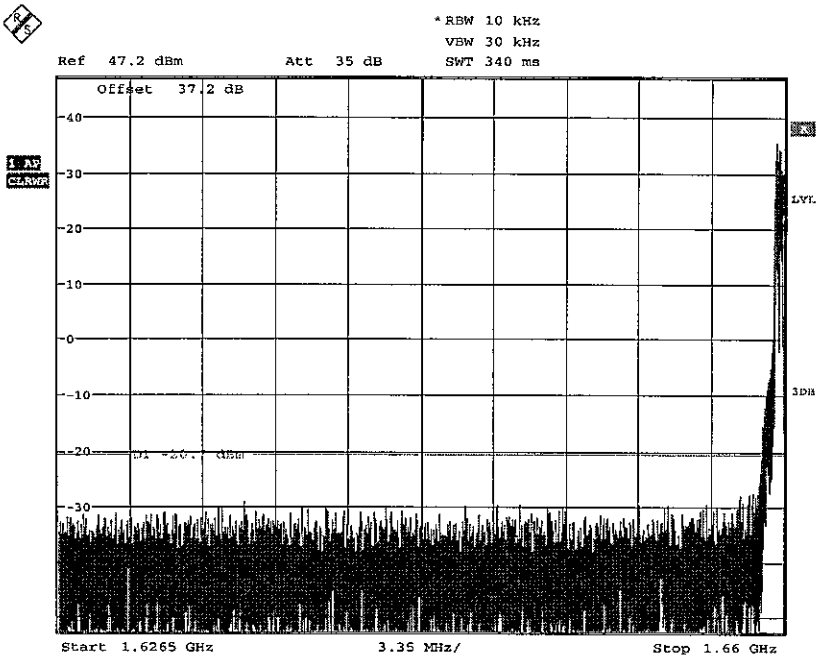
5.2.2.2 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1626.5MHz to 1670MHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 35W. Both carriers are produced at close to the upper edge of the transmit band with 200KHz spacing.

5.2.2.2.1 Overview Image



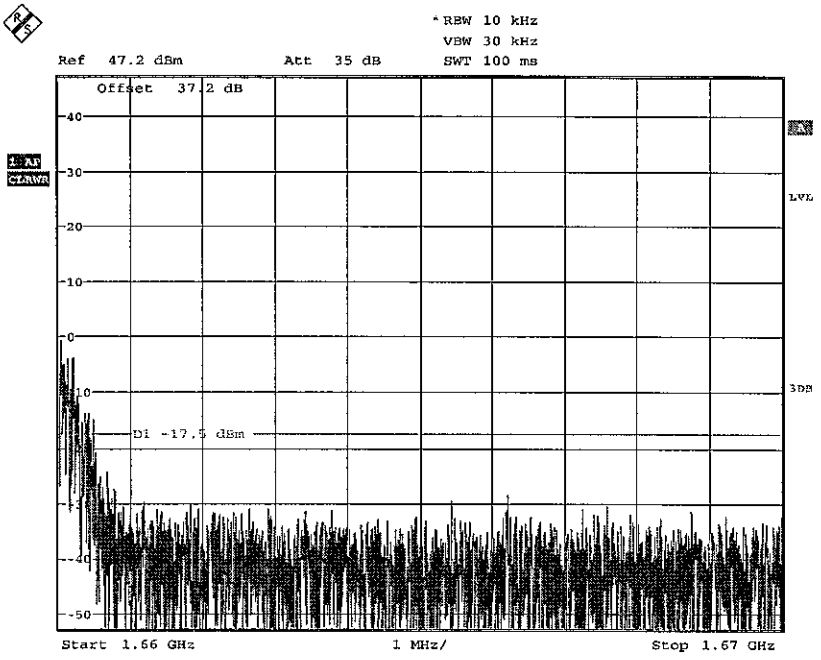
Date: 21.OCT.2008 16:14:38

5.2.2.2.2 1626.5 MHz to 1660 MHz



Date: 21.OCT.2008 16:16:51

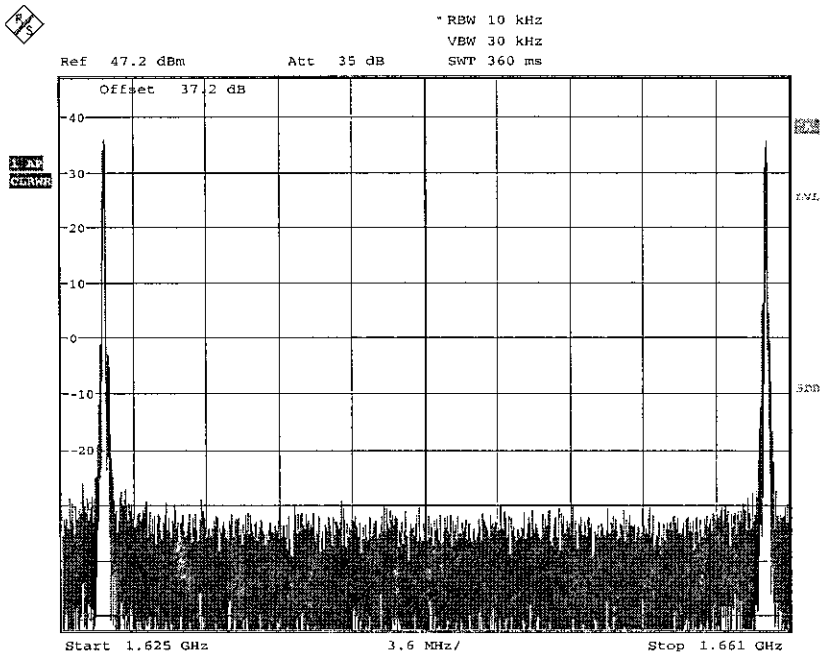
5.2.2.2.3 1660 MHz to 1670 MHz



Date: 21.OCT.2008 16:18:00

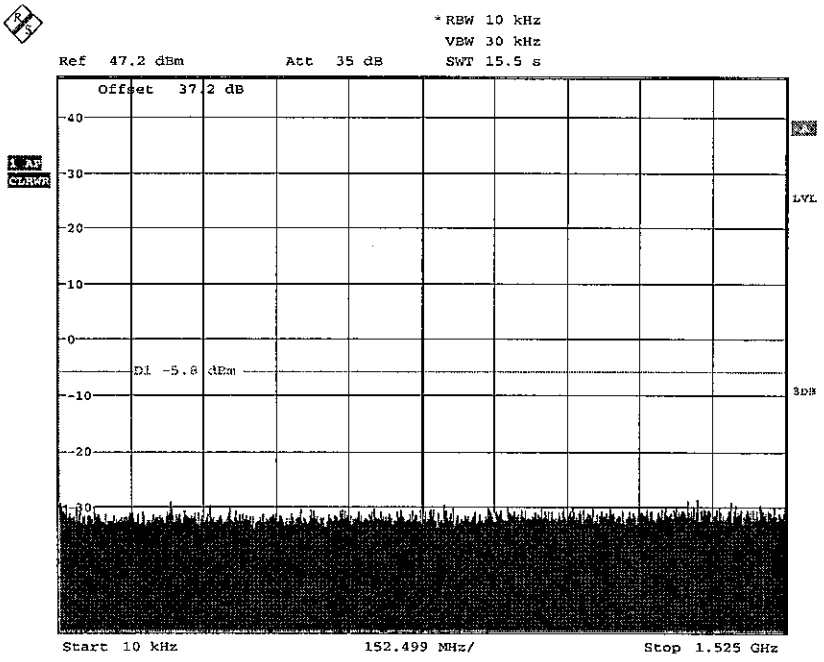
5.2.2.3 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 10 KHz to 18 GHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 35 W. One carrier is produced at close to the lower edge of the transmit band and one carrier is produced at close to the upper edge of the transmit band.

5.2.2.3.1 Overview Image



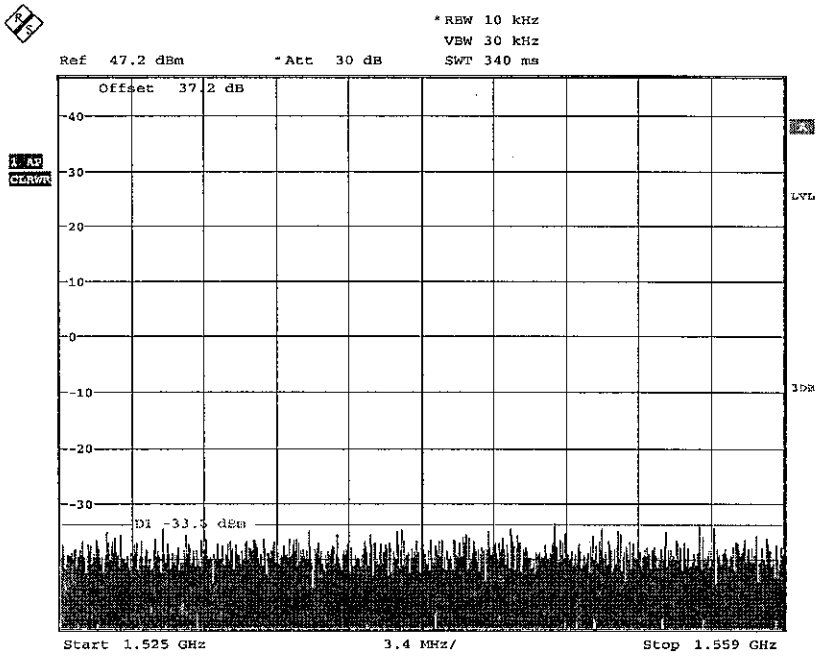
Date: 21.OCT.2008 16:23:00

5.2.2.3.2 10 KHz to 1525 MHz



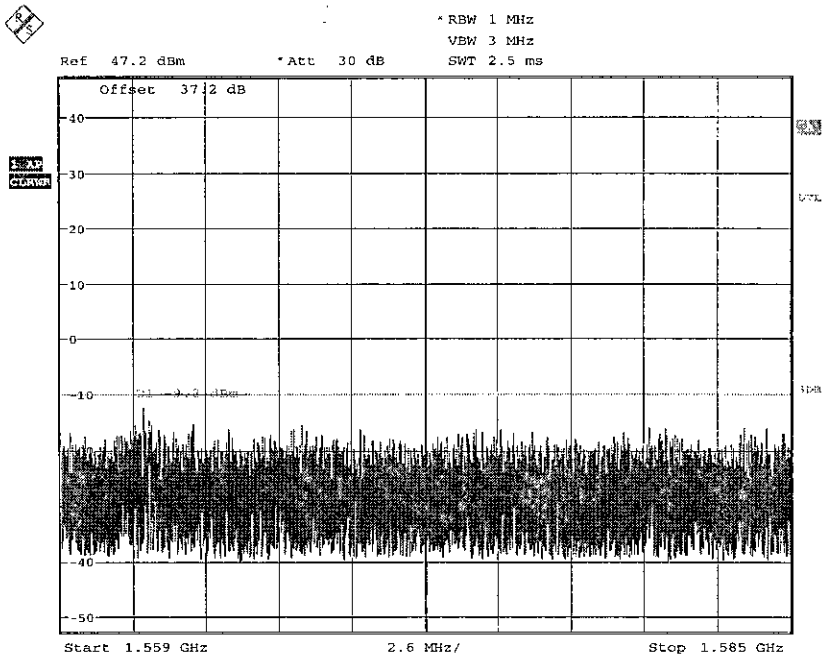
Date: 21.OCT.2008 16:25:33

5.2.2.3.3 1525 MHz to 1559 MHz



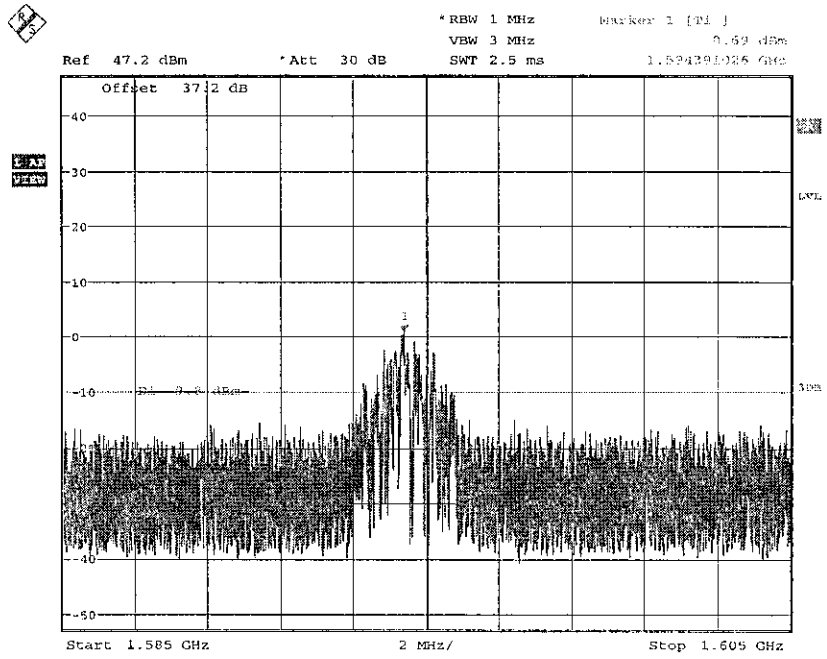
Date: 21.OCT.2008 16:27:02

5.2.2.3.4 1559 MHz to 1585 MHz



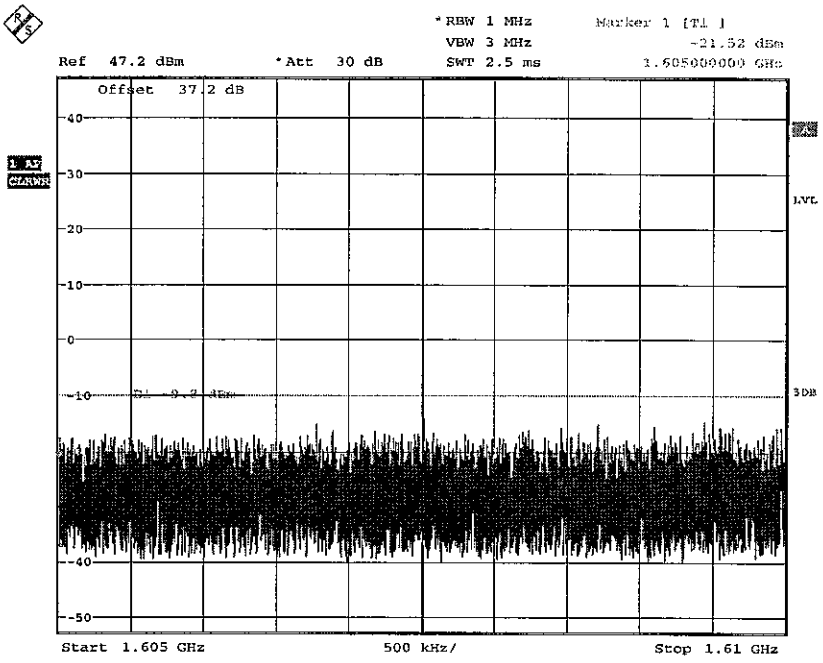
Date: 21.OCT.2008 16:28:55

5.2.2.3.5 1585 MHz to 1605 MHz



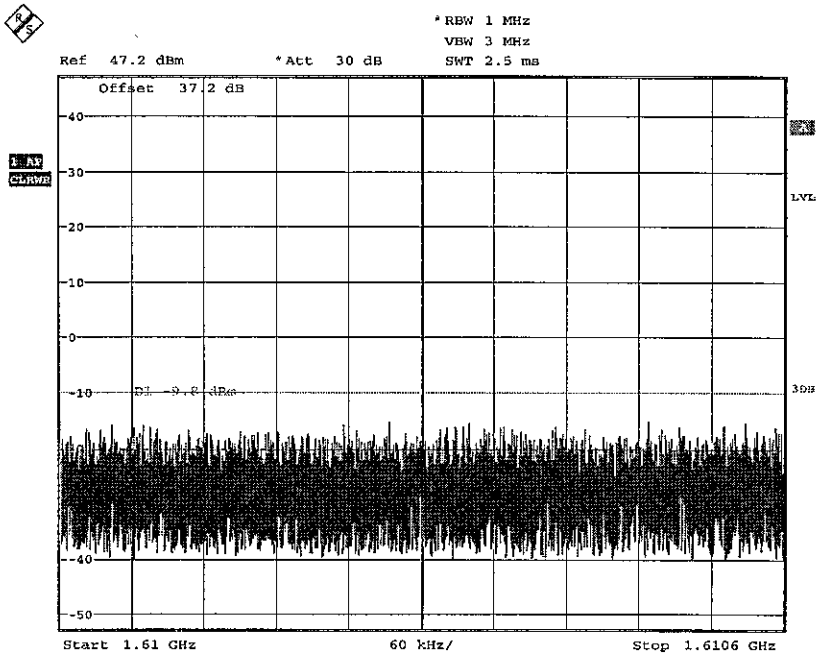
Date: 21.OCT.2008 16:30:29

5.2.2.3.6 1605 MHz to 1610 MHz



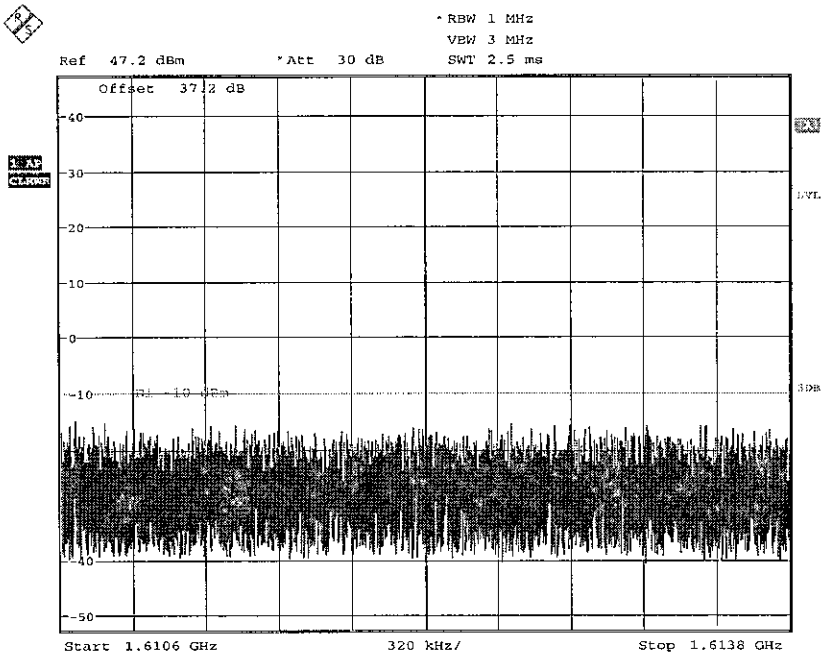
Date: 21.OCT.2008 16:31:27

5.2.2.3.7 1610 MHz to 1610.6 MHz



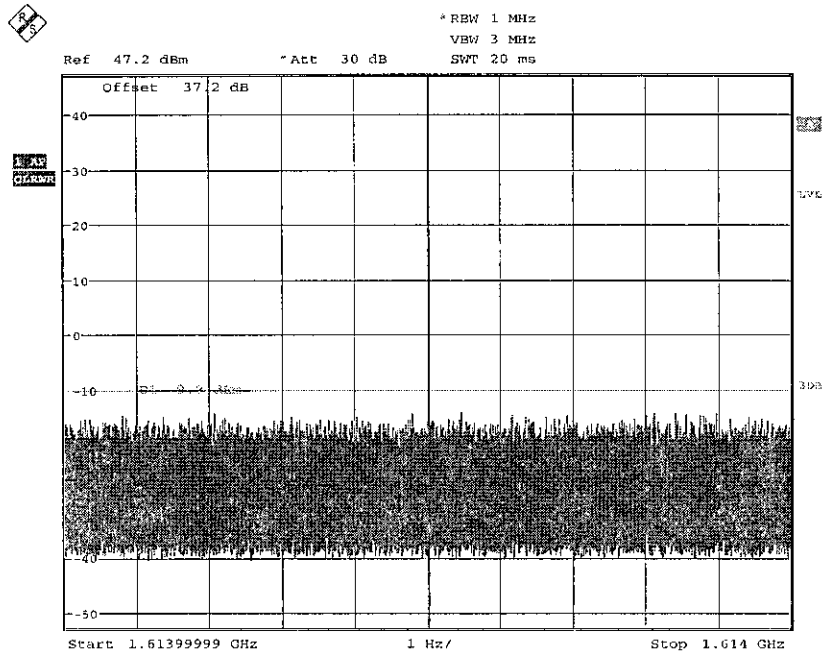
Date: 21.OCT.2008 16:32:04

5.2.2.3.8 1610.6 MHz to 1613.8 MHz



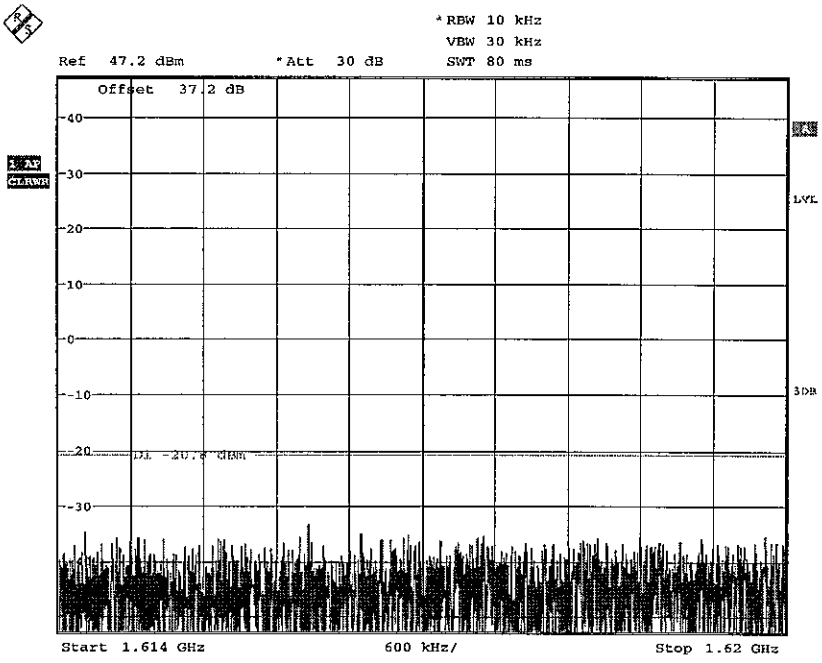
Date: 21.OCT.2008 16:33:31

5.2.2.3.9 1613.8 MHz to 1614 MHz



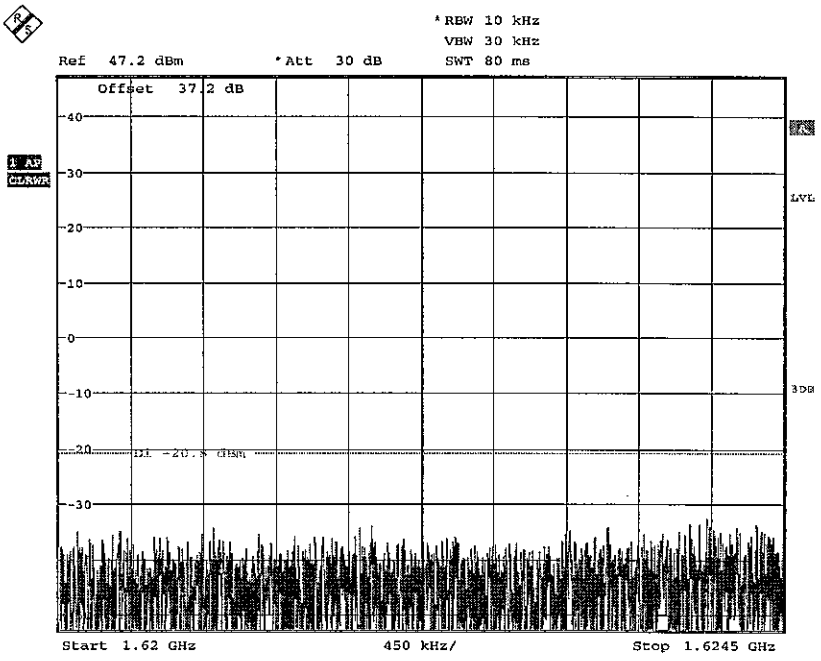
Date: 21.OCT.2008 16:34:28

5.2.2.3.10 1614 MHz to 1620 MHz



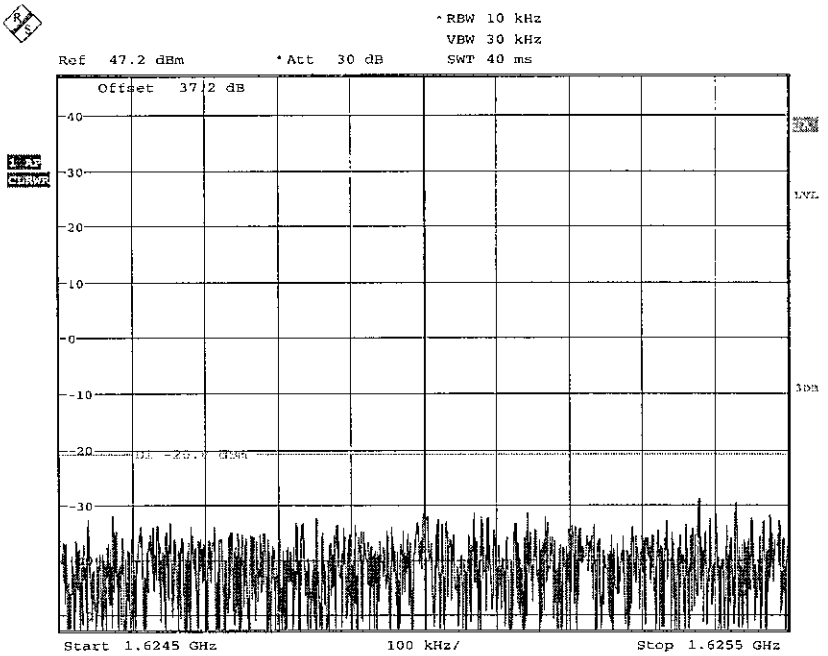
Date: 21.OCT.2008 16:35:46

5.2.2.3.11 1620 MHz to 1624.5 MHz



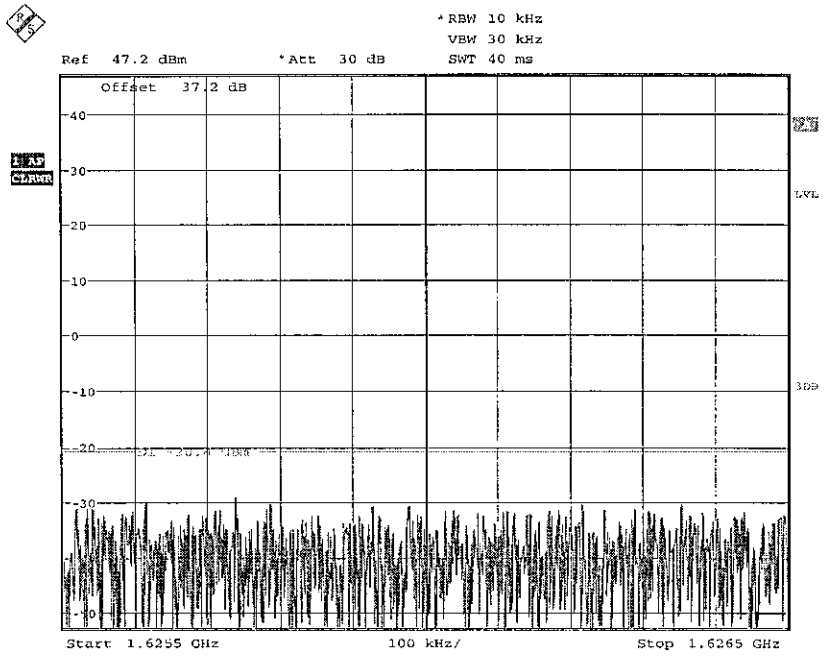
Date: 21.OCT.2008 16:36:27

5.2.2.3.12 1624.5 MHz to 1625.5 MHz



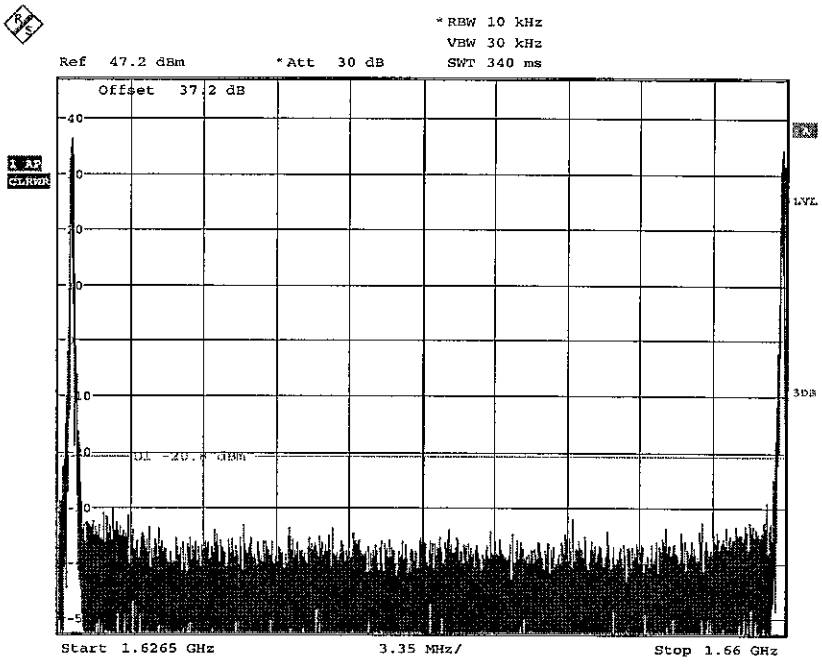
Date: 21.OCT.2008 16:37:11

5.2.2.3.13 1625.5 MHz to 1626.5 MHz



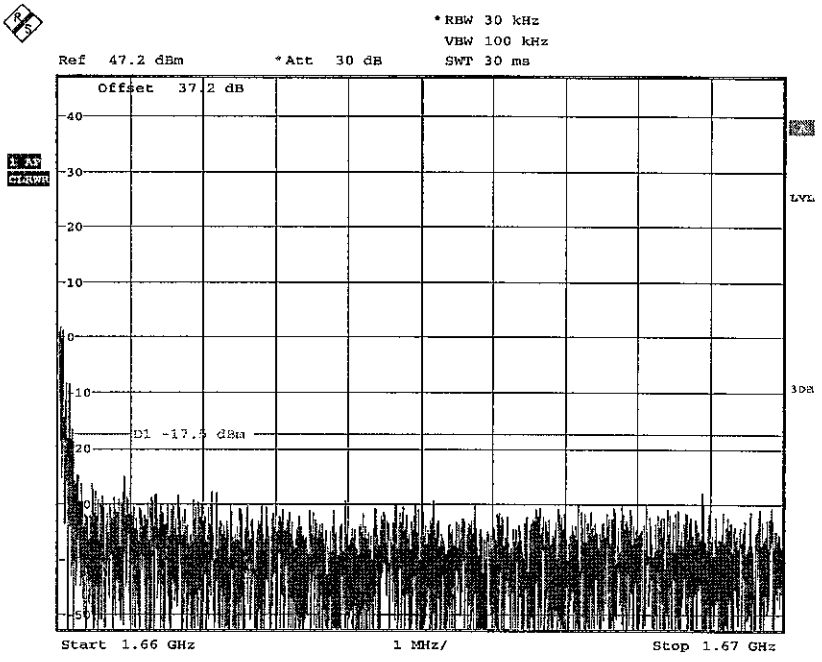
Date: 21.OCT.2008 16:38:12

5.2.2.3.14 1626.5 MHz to 1660 MHz



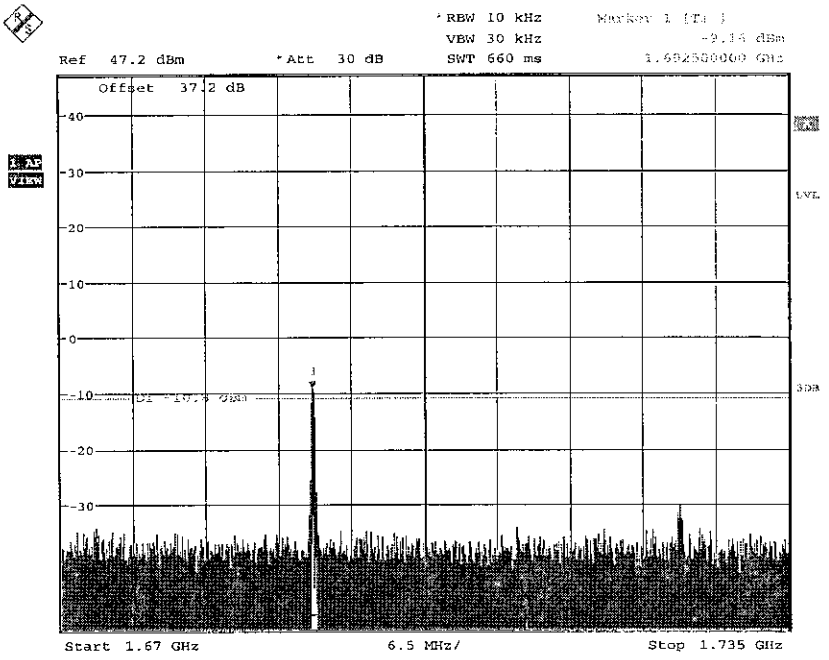
Date: 21.OCT.2008 16:38:55

5.2.2.3.15 1660 MHz to 1670 MHz



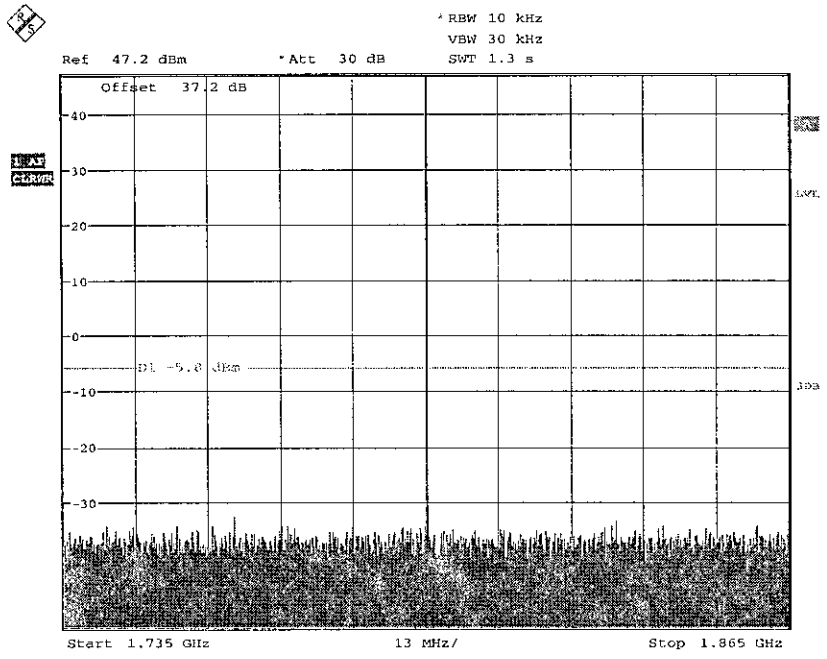
Date: 21.OCT.2008 16:50:35

5.2.2.3.16 1670 MHz to 1735 MHz



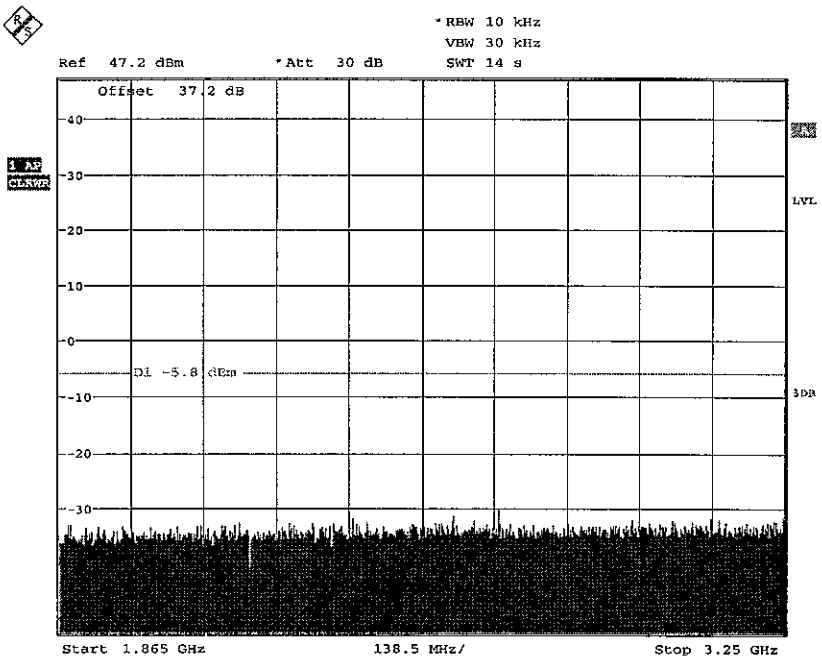
Date: 21.OCT.2008 16:42:39

5.2.2.3.17 1735 MHz to 1865 MHz



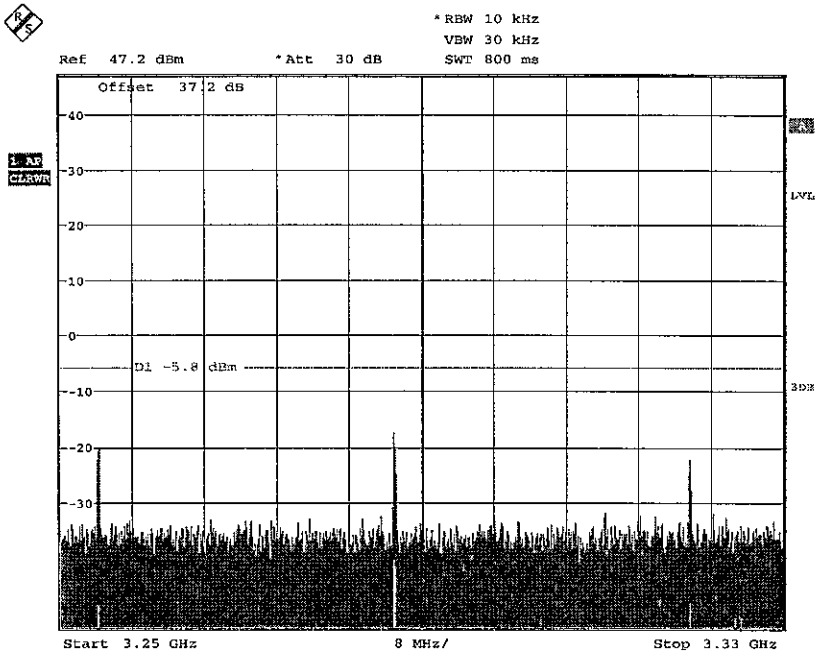
Date: 21.OCT.2008 16:44:29

5.2.2.3.18 1865 MHz to 3250 MHz



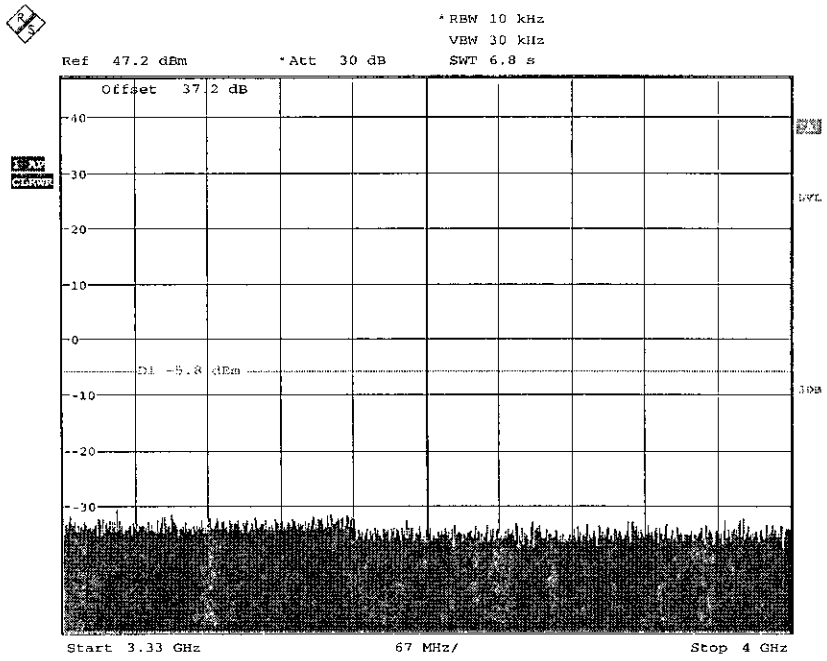
Date: 21.OCT.2008 16:45:16

5.2.2.3.19 3250 MHz to 3330 MHz



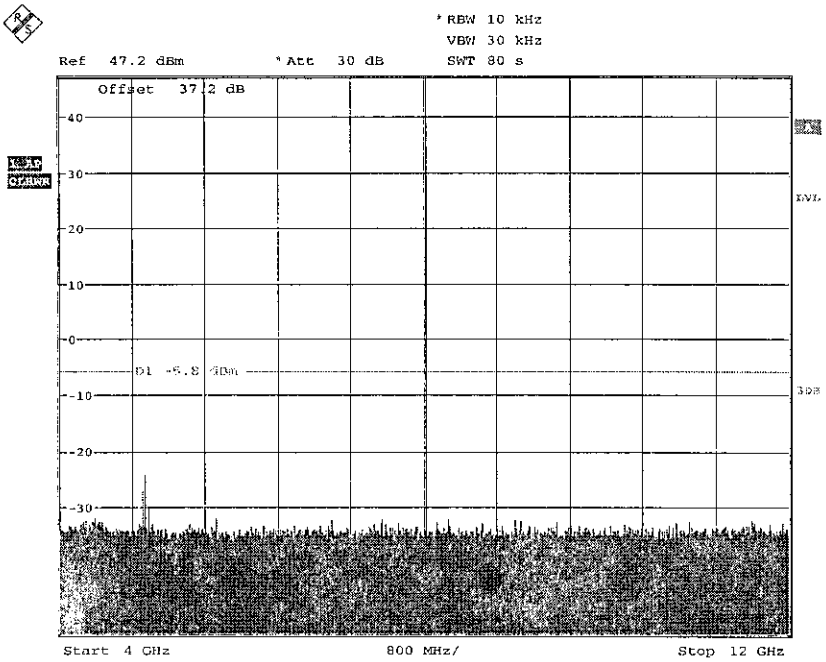
Date: 21.OCT.2008 16:45:48

5.2.2.3.20 3330 MHz to 4000 MHz



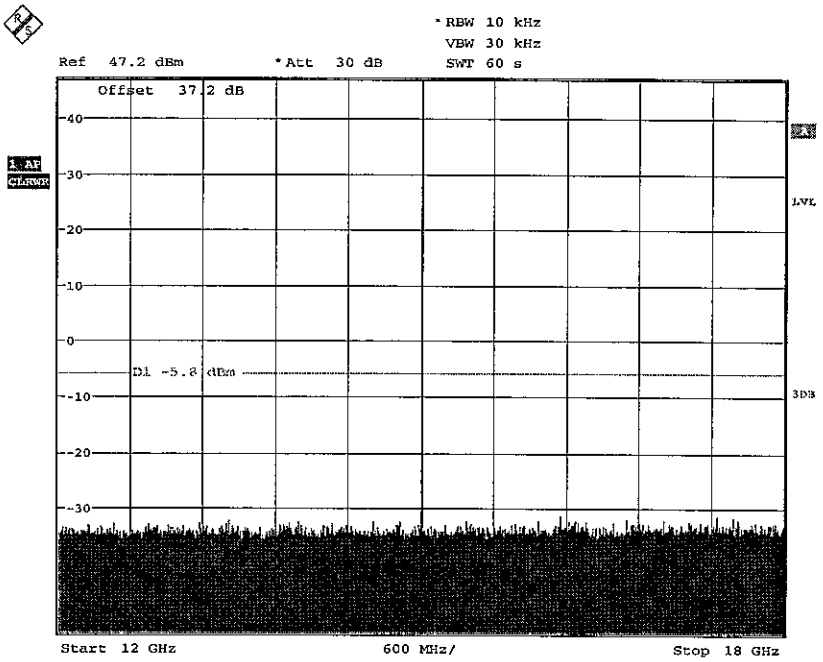
Date: 21.OCT.2008 16:46:21

5.2.2.3.21 4 GHz to 12 GHz



Date: 21.OCT.2008 16:48:03

5.2.2.3.22 12 GHz to 18 GHz



Date: 21.OCT.2008 16:49:32

5.3 Classic with external HPA

5.3.1 RF Output Power

5.3.1.1 The RF Output Power measurements are listed in Table 6 below.

		Measurement Frequency / Power Output		
Emission Designator	**Data rate (bps)**	**1626.5 MHz**	**1643.5 MHz**	**1660.5 MHz**
840HG1D	600	45.5 dBm 35 W	45.3 dBm 34 W	45.0 dBm 32 W
1K68G1D	1200	45.4 dBm 35 W	45.2 dBm 33 W	44.9 dBm 31 W
8K40G1D	8400	45.4 dBm 35 W	45.2 dBm 33 W	44.9 dBm 31 W
10K5G1D	10500	45.5 dBm 35 W	45.3 dBm 34 W	45.0 dBm 32 W

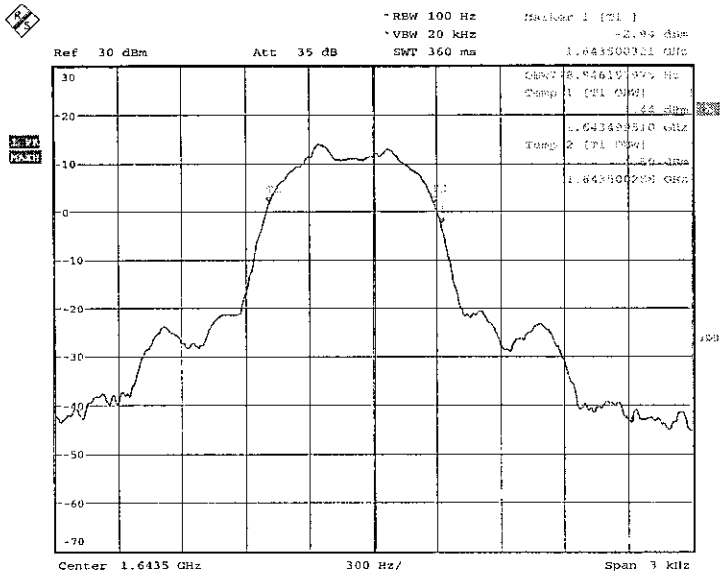
Table 6 RF Output Power Measurements

Maximum Power: 35 W.

5.3.2 Occupied Bandwidth

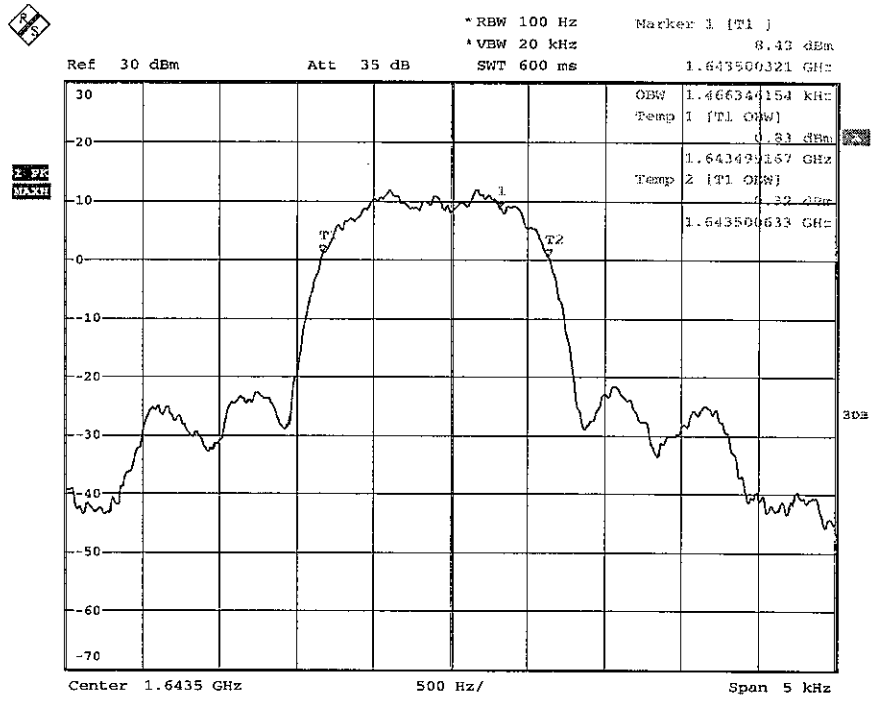
5.3.2.1 Measurements of Occupied bandwidth are provided below as spectrum plots at each data rate at the middle RF carrier frequency.

5.3.2.2 600 bps BPSK



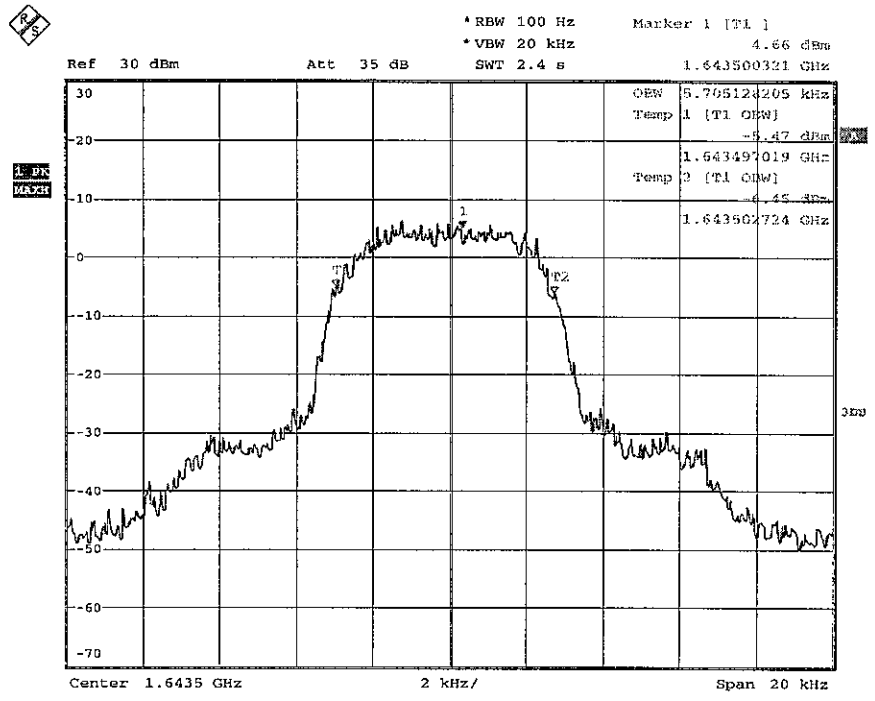
Date: 9.SEP.2008 17:56:24

5.3.2.3 1200 bps BPSK



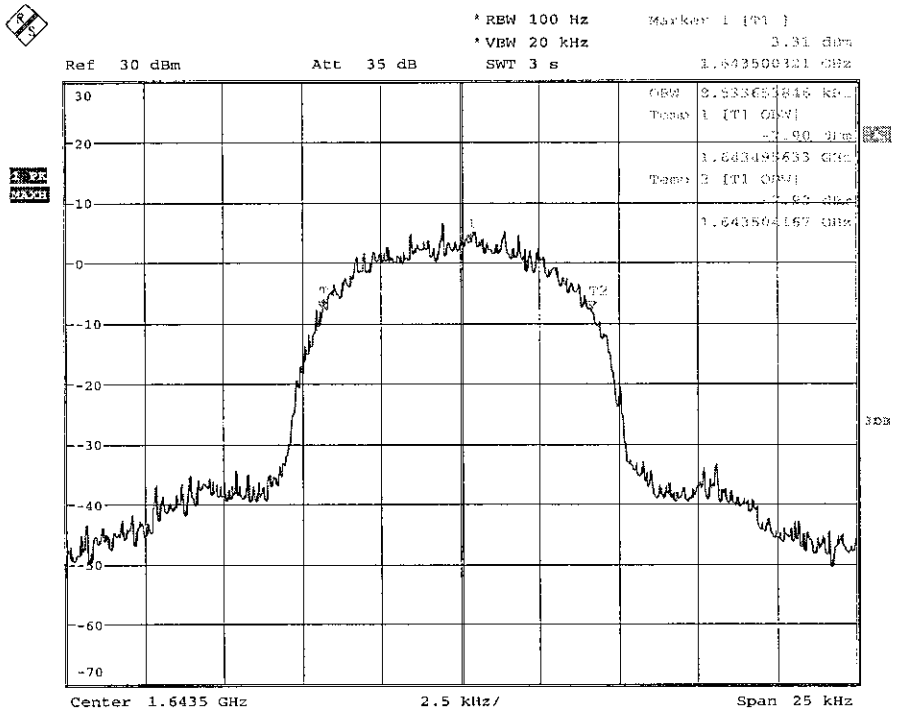
Date: 9.SEP.2008 17:55:27

5.3.2.4 8400 bps OQPSK, 1643.5 MHz



Date: 9.SEP.2008 17:58:08

5.3.2.5 10500 bps OQPSK, 1643.5 MHz



Date: 9.SEP.2008 17:53:47

5.3.3 Frequency Stability

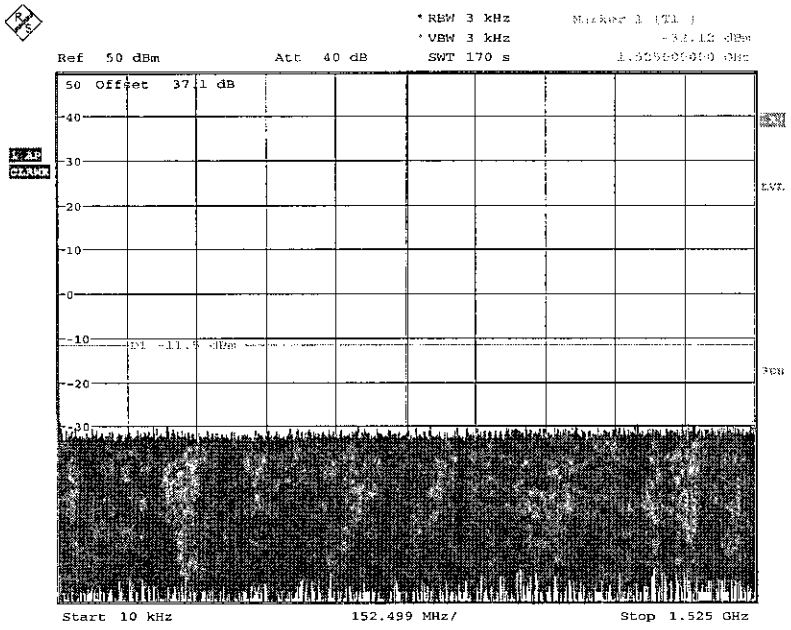
5.3.3.1 The test results for Frequency stability are in the Test House Test Report for the Thales SBB Class 6 SDU (ref. 1.4.4) section 2.3.

5.3.4 Conducted Spurious Emissions

5.3.4.1 Measurements of Conducted Spurious Emissions are provided below, in screen plots covering the frequency range from 10 KHz to 18 GHz with a signal level of 30 W (44.8 dBm).

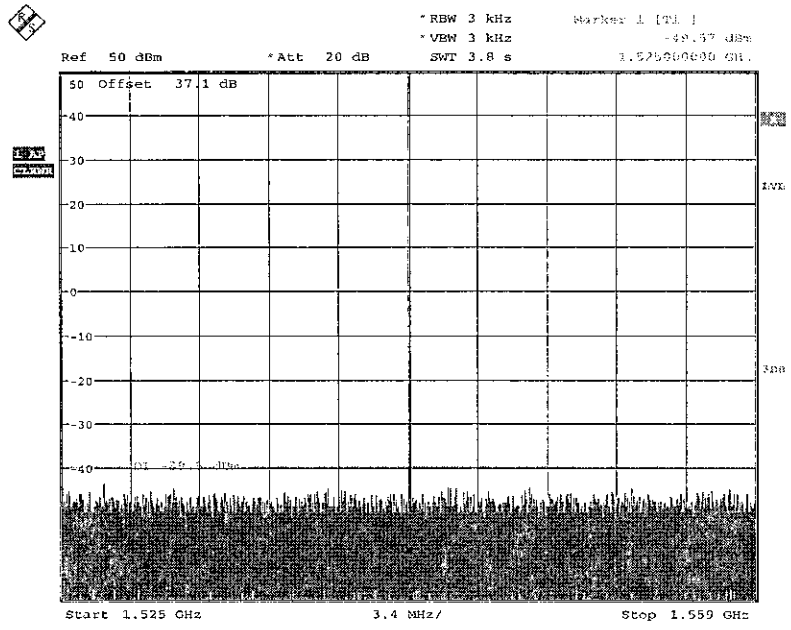
5.3.4.2 In the following plots, the Limit line level is set to the levels in Table 5, that is Limit line level = Carrier level – Limit at HPA output (to 0.5 dB).
For example, for Frequency band 0.01 to 1525 MHz, then for Carrier level of 44.8 dBm and limit of – 56.2 dBc, then the Limit line level is –11.5 dBc (to 0.5 dB) as in plot in section 5.3.4.3.

5.3.4.3 10 KHz to 1525 MHz



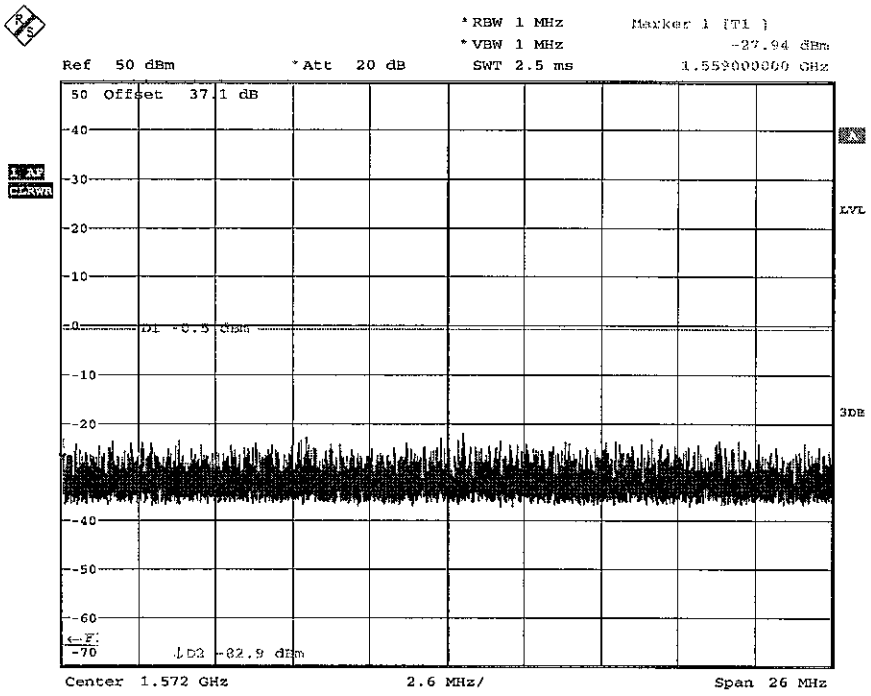
Date: 18.AUG.2008 12:37:08

5.3.4.4 1525 MHz to 1559 MHz



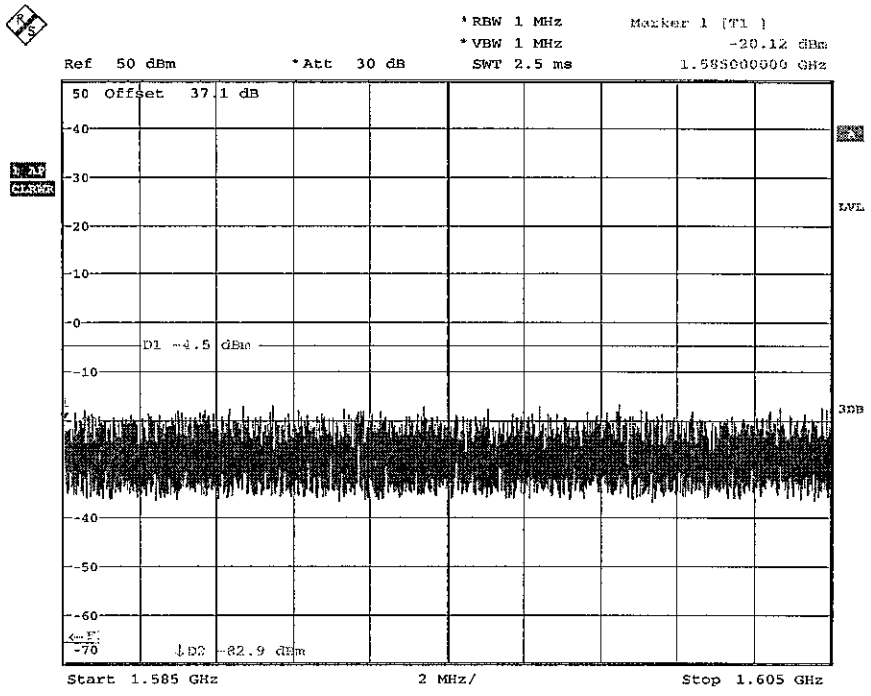
Date: 18.AUG.2008 12:41:41

5.3.4.5 1559 MHz to 1585 MHz



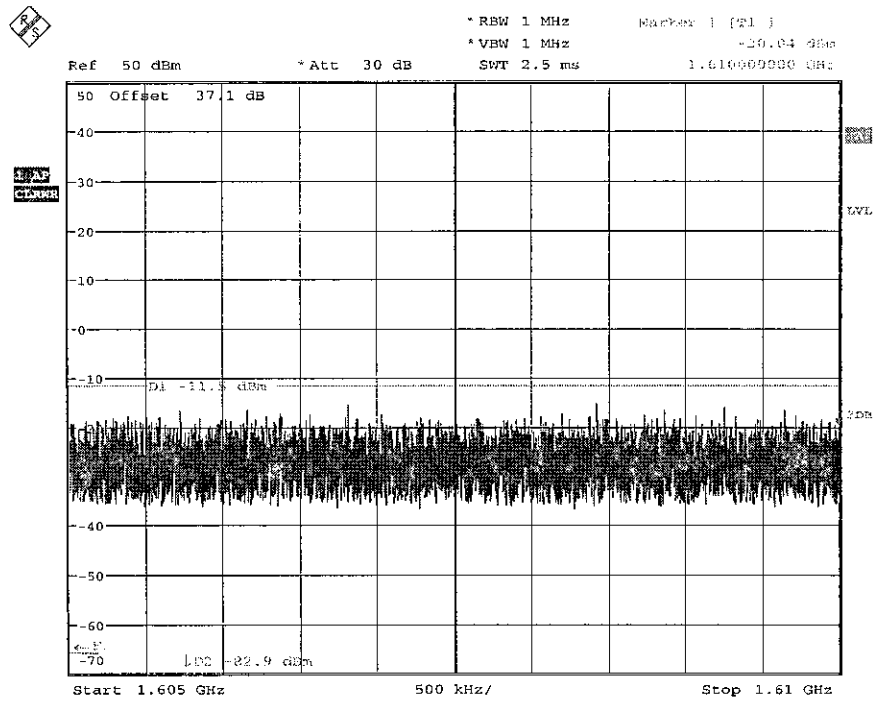
Date: 18.AUG.2008 12:54:26

5.3.4.6 1585 MHz to 1605 MHz



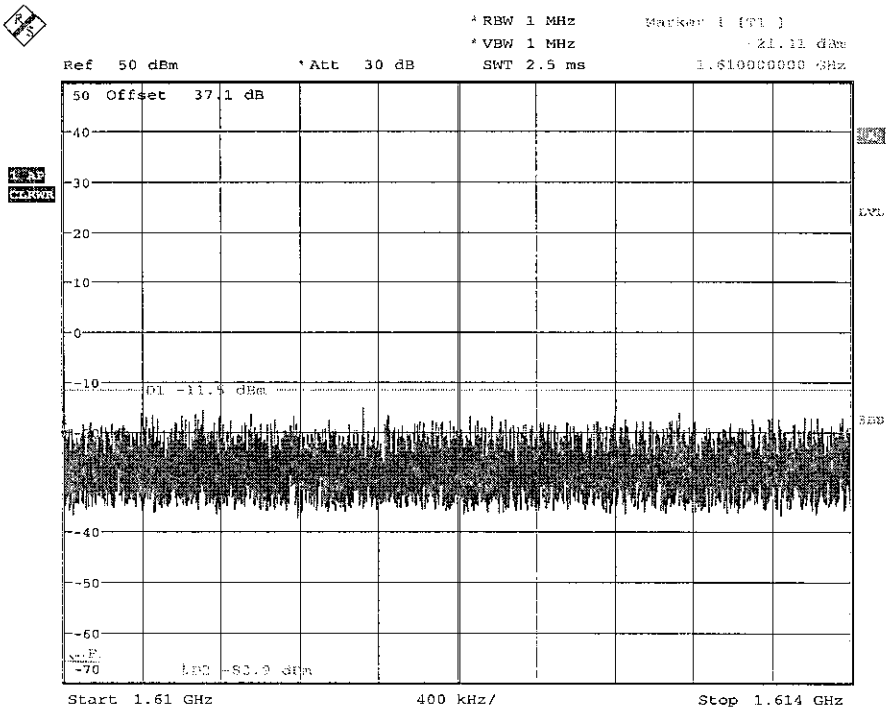
Date: 18.AUG.2008 12:56:18

5.3.4.7 1605 MHz to 1610 MHz



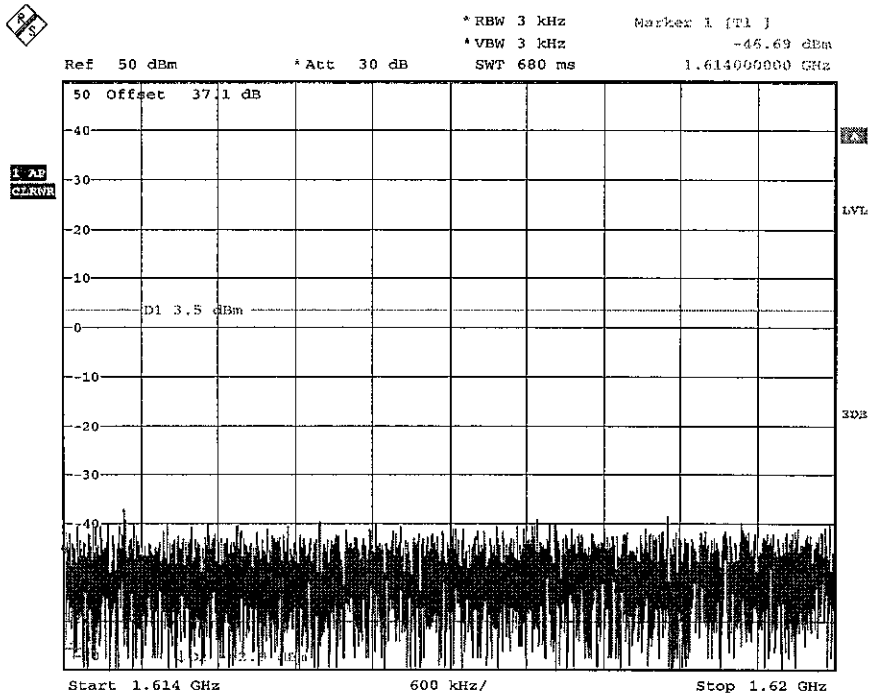
Date: 18.AUG.2008 14:00:07

5.3.4.8 1610 MHz to 1614 MHz



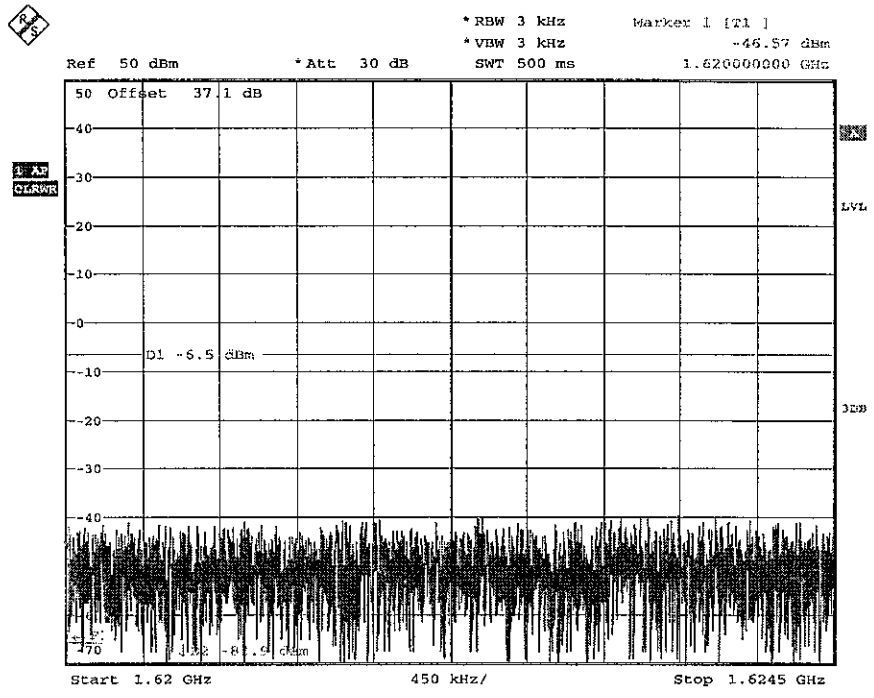
Date: 18.AUG.2008 14:01:39

5.3.4.9 1614 MHz to 1620 MHz



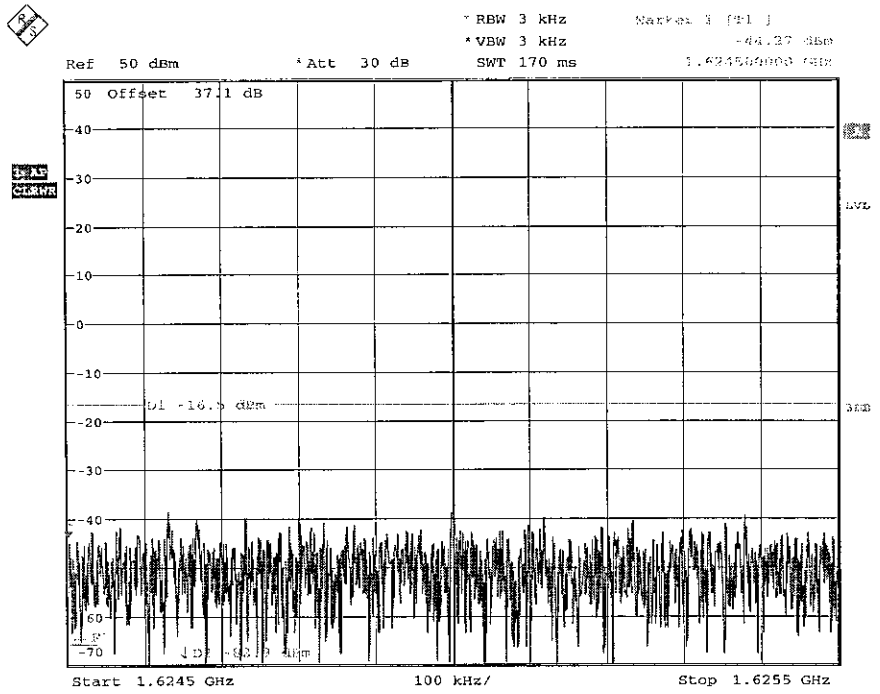
Date: 18.AUG.2008 14:03:56

5.3.4.10 1620 MHz to 1624.5 MHz



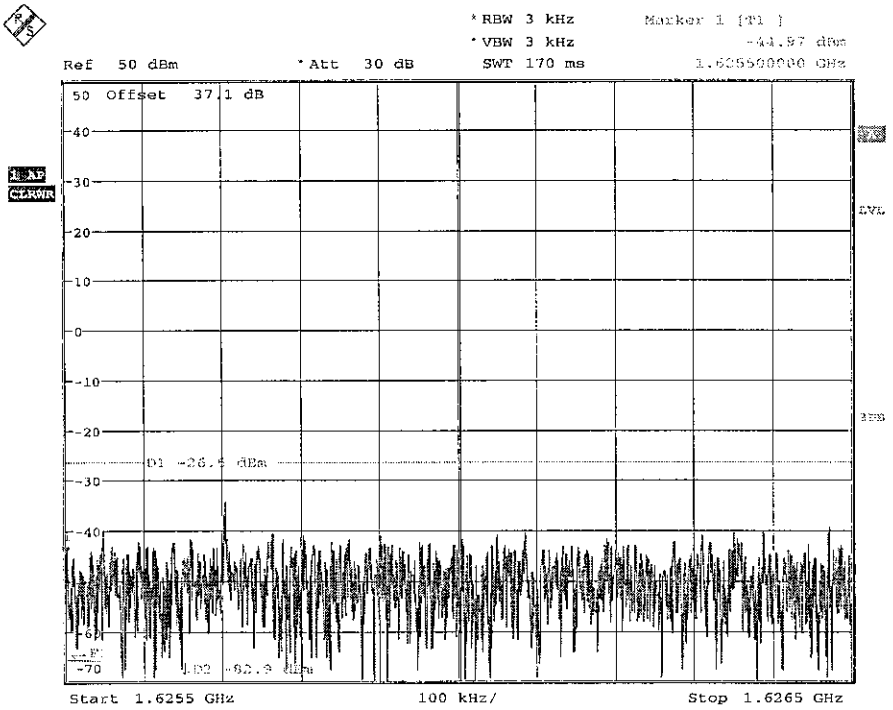
Date: 18.AUG.2008 14:05:06

5.3.4.11 1624.5 MHz to 1625.5 MHz



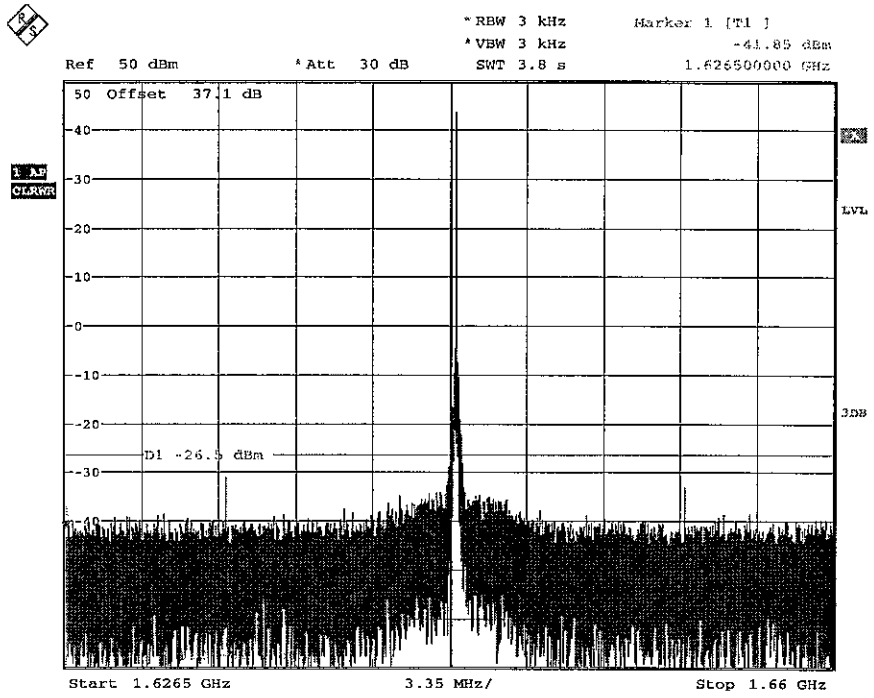
Date: 18.AUG.2008 14:06:34

5.3.4.12 1625.5 MHz to 1626.5 MHz



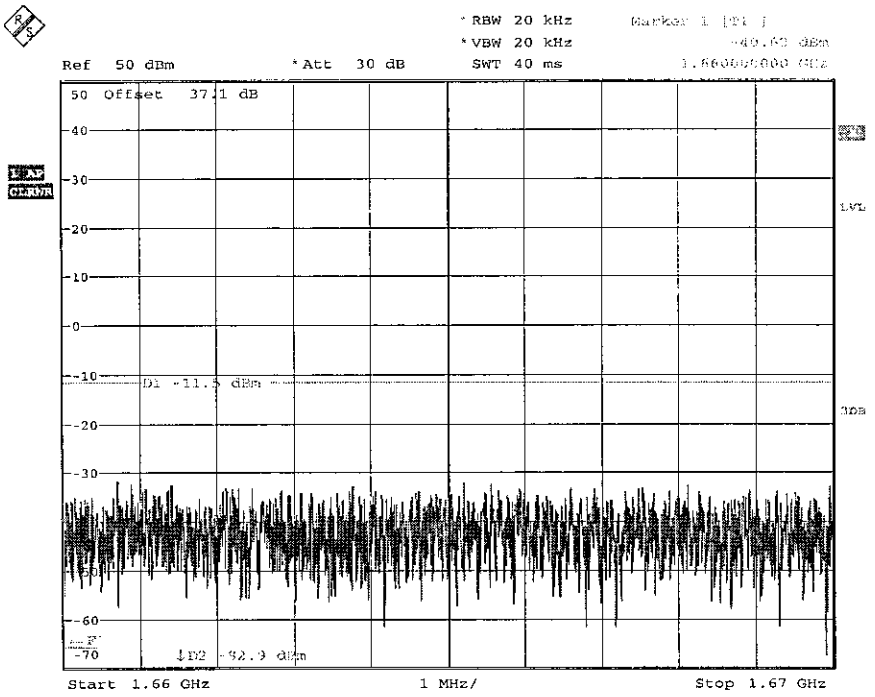
Date: 18.AUG.2008 14:07:44

5.3.4.13 1626.5 MHz to 1660 MHz



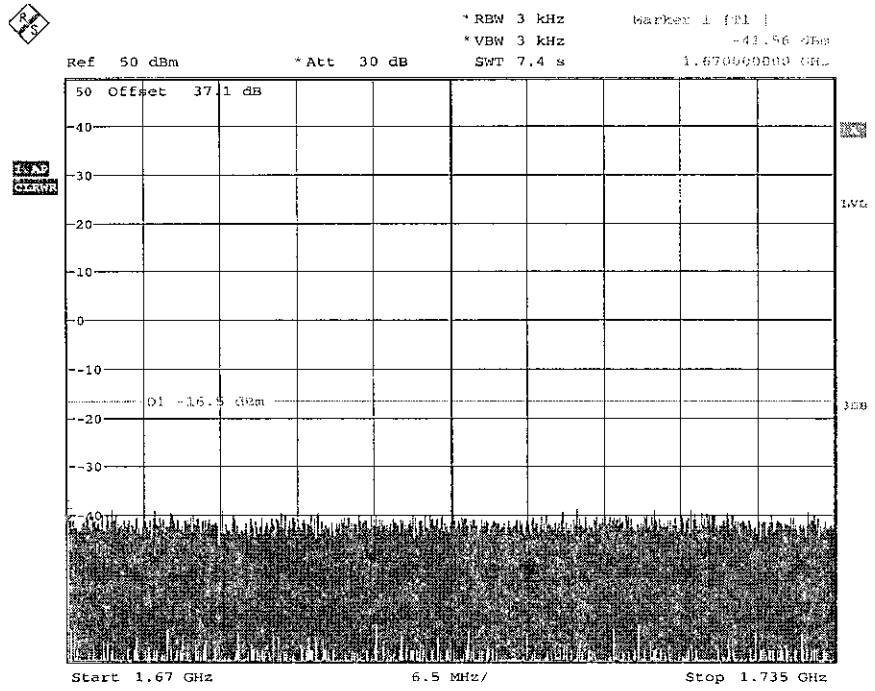
Date: 18.AUG.2008 14:08:46

5.3.4.14 1660 MHz to 1670 MHz



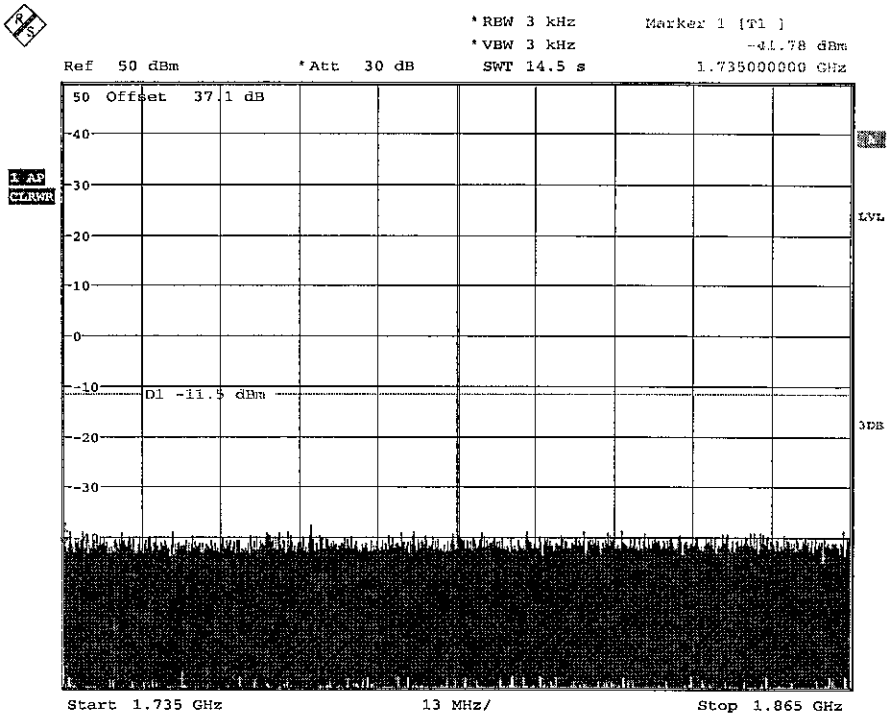
Date: 18.AUG.2008 14:10:03

5.3.4.15 1670 MHz to 1735 MHz



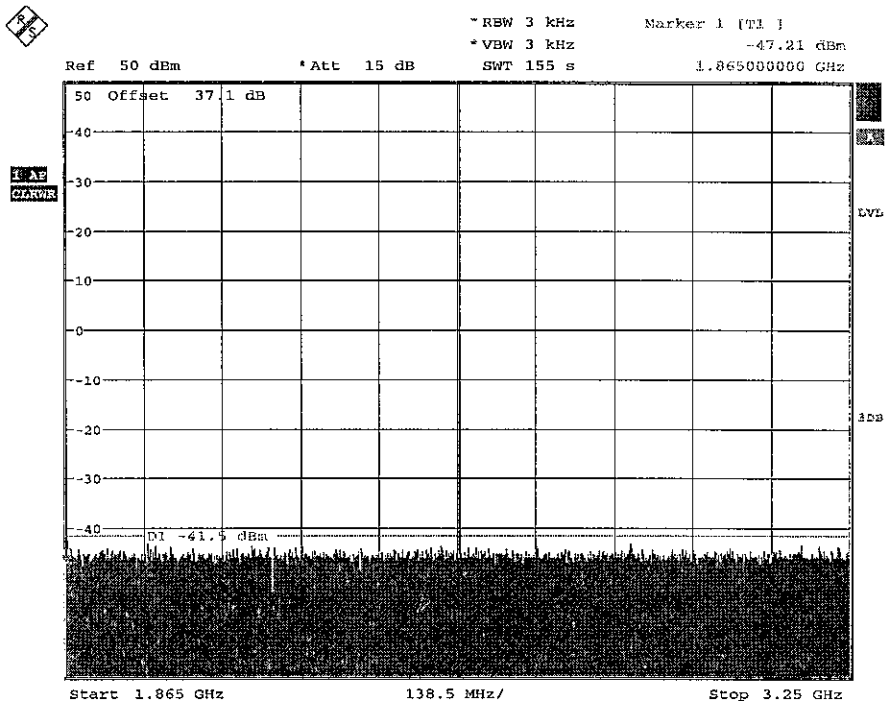
Date: 18.AUG.2008 14:11:22

5.3.4.16 1735 MHz to 1865 MHz



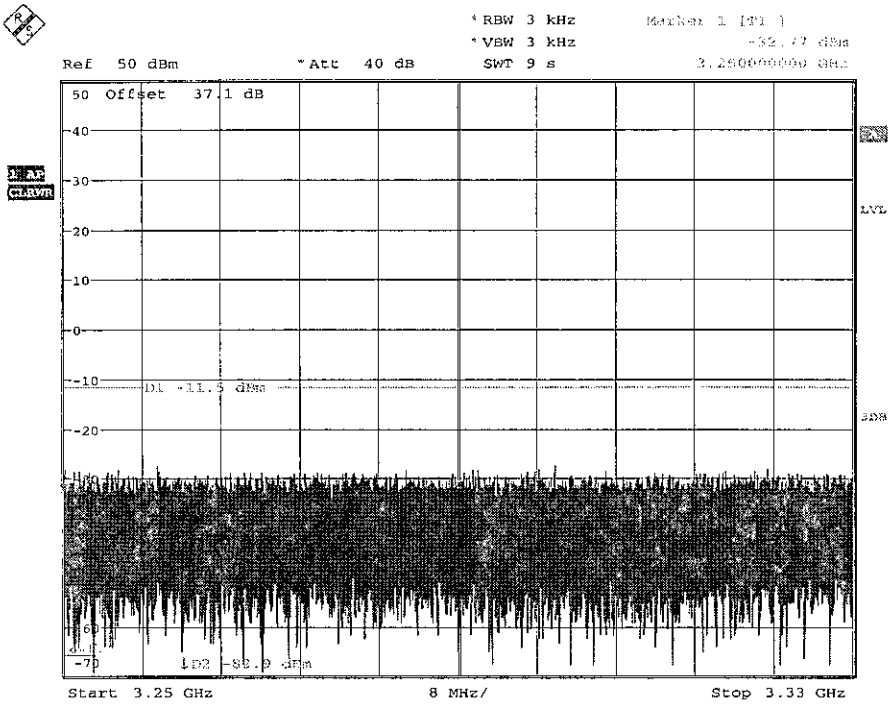
Date: 18.AUG.2008 14:12:32

5.3.4.17 1865 MHz to 3250 MHz



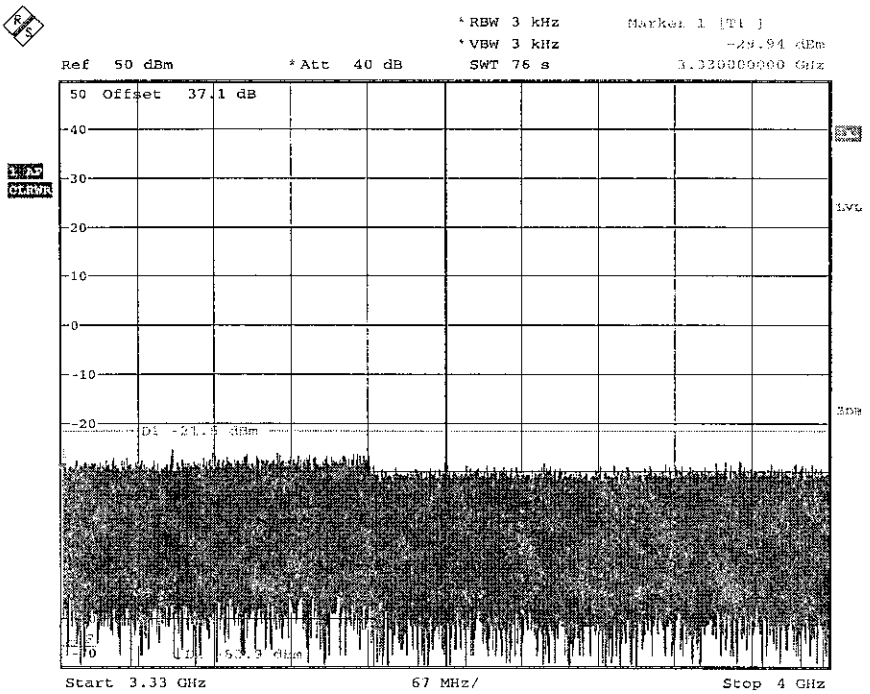
Date: 18.AUG.2008 14:16:43

5.3.4.18 3250 MHz to 3330 MHz



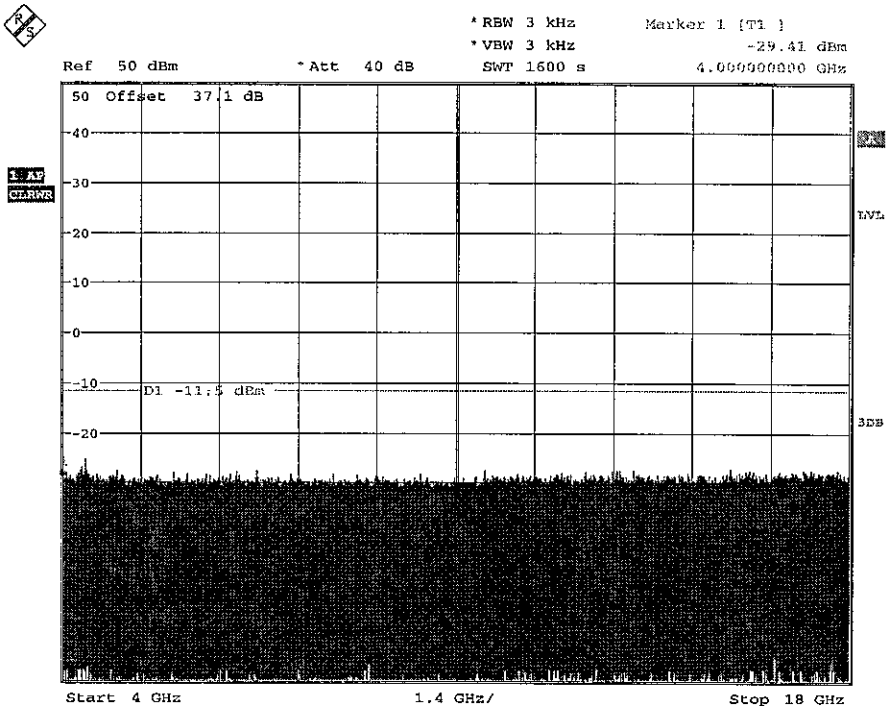
Date: 18.AUG.2008 14:18:06

5.3.4.19 3330 MHz to 4000 MHz



Date: 18.AUG.2008 14:46:26

5.3.4.20 4 GHz to 18 GHz



Date: 18.AUG.2008 15:15:09

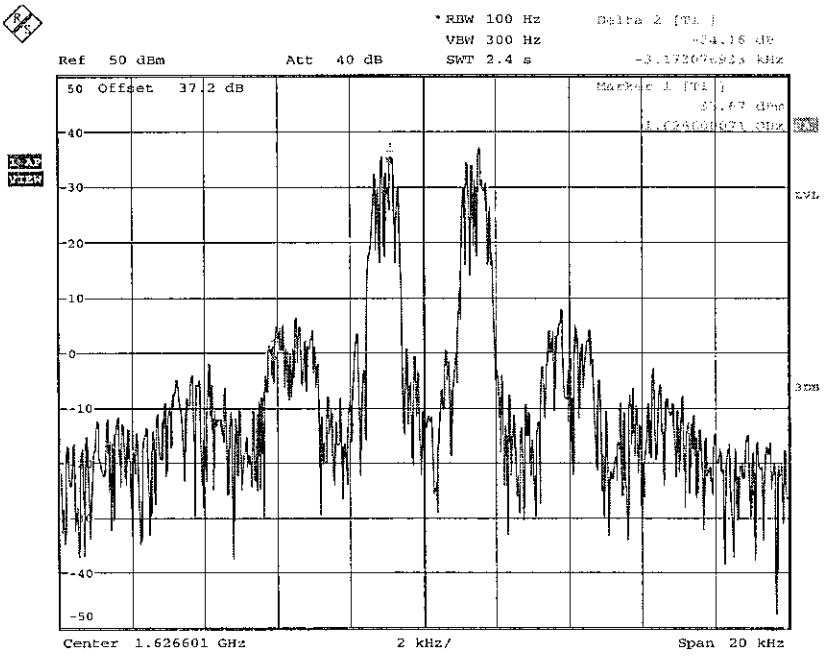
5.3.5 Radiated Emissions

5.3.5.1 For test results for radiated emissions see the Test House Test Report for the Thales Classic Aero SDU (ref. 1.4.5) sections 2.1 and 2.2

5.3.6 Intermodulation Products

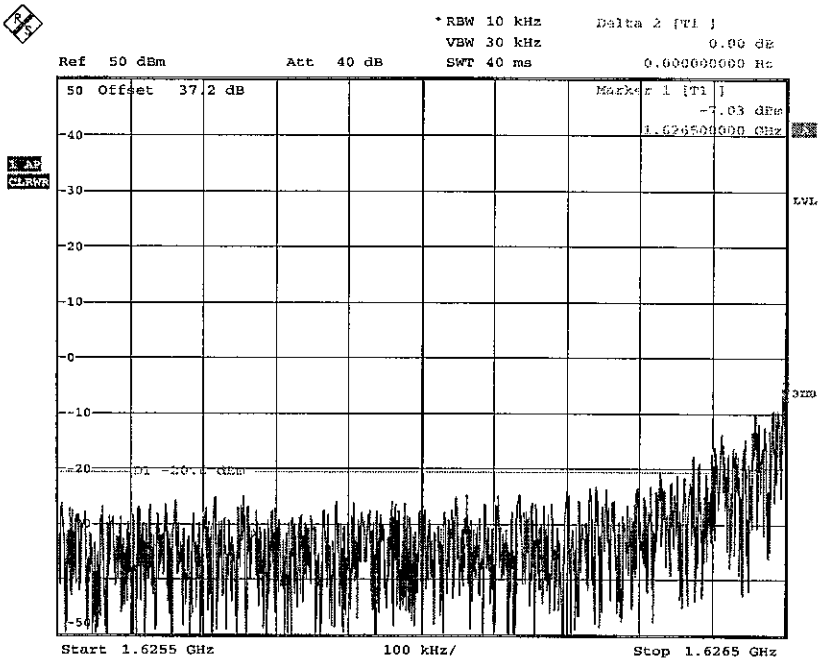
5.3.6.1 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1625.5MHz to 1660MHz with a combined signal level of the two modulated QPSK (600bps) carriers of 35 W. Both carriers are produced at close to the lower edge of the transmit band with 2.5KHz spacing.

5.3.6.1.1 Overview Image



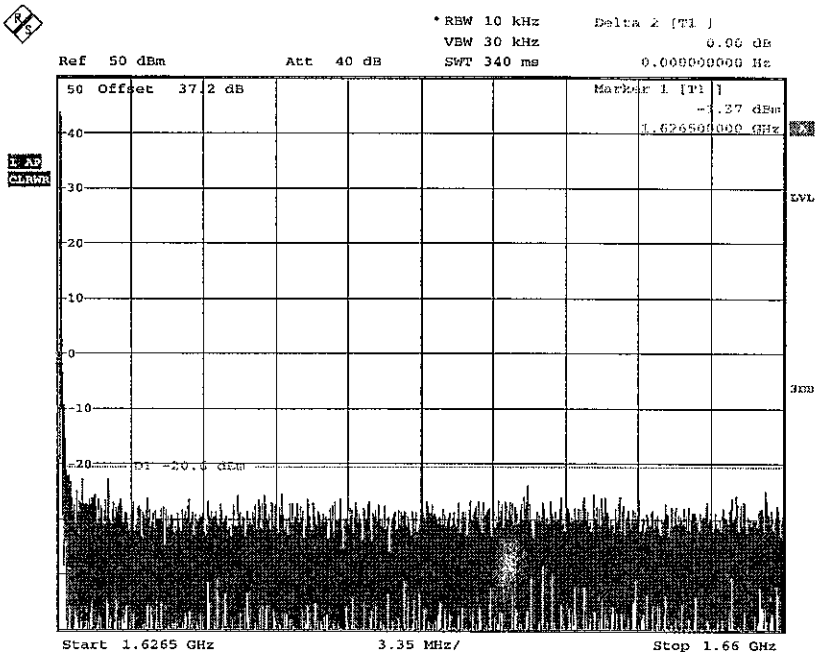
Date: 21.OCT.2008 12:17:42

5.3.6.1.2 1625.5 MHz to 1626.5 MHz



Date: 21.OCT.2008 12:20:03

5.3.6.1.3 1626.5 MHz to 1660 MHz

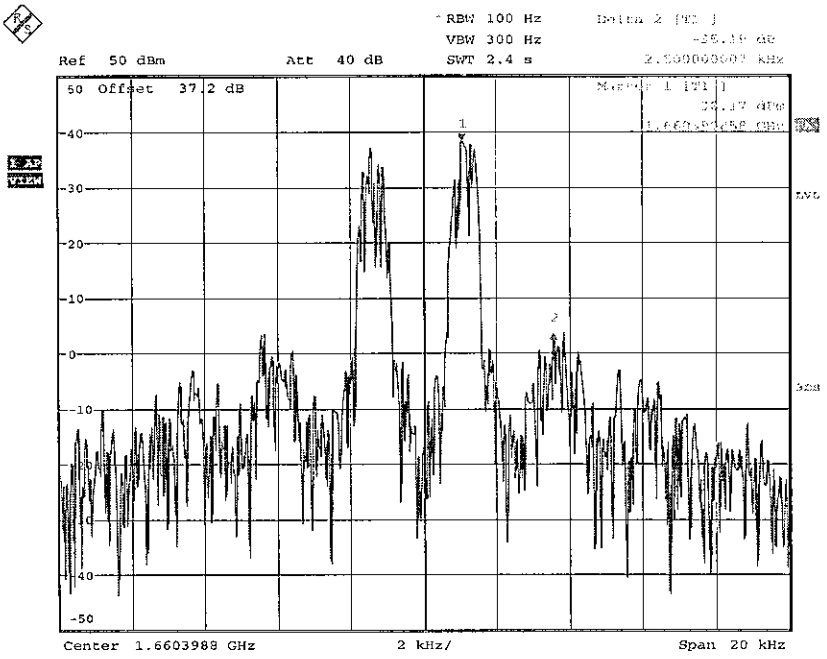


Date: 21.OCT.2008 12:20:50

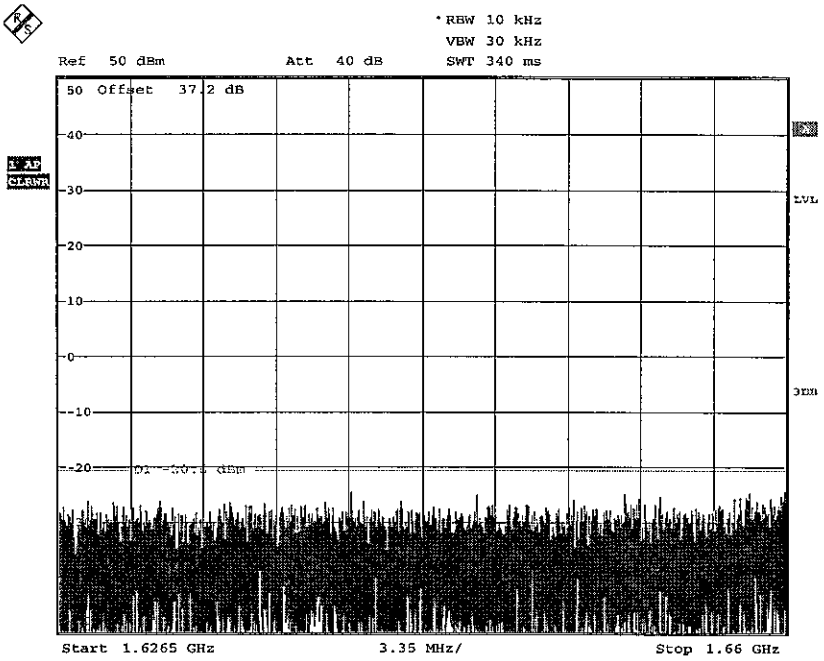
5.3.6.2 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1626.5MHz to 1670MHz with a combined

signal level of the two modulated QPSK (600bps) carriers of 35W. Both carriers are produced at close to the upper edge of the transmit band with 2.5KHz spacing.

5.3.6.2.1 Overview Image

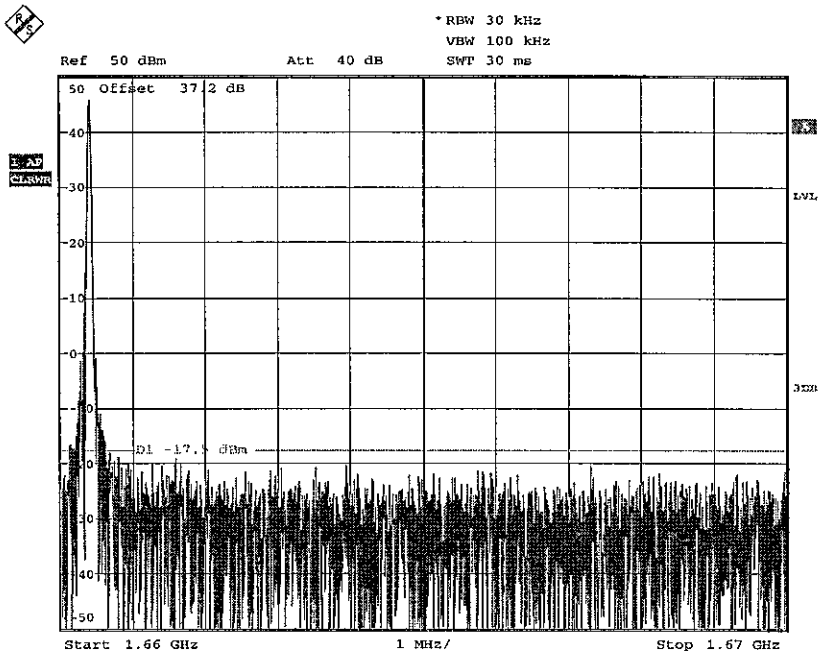


5.3.6.2.2 1626.5 MHz to 1660 MHz



Date: 21.OCT.2008 12:34:13

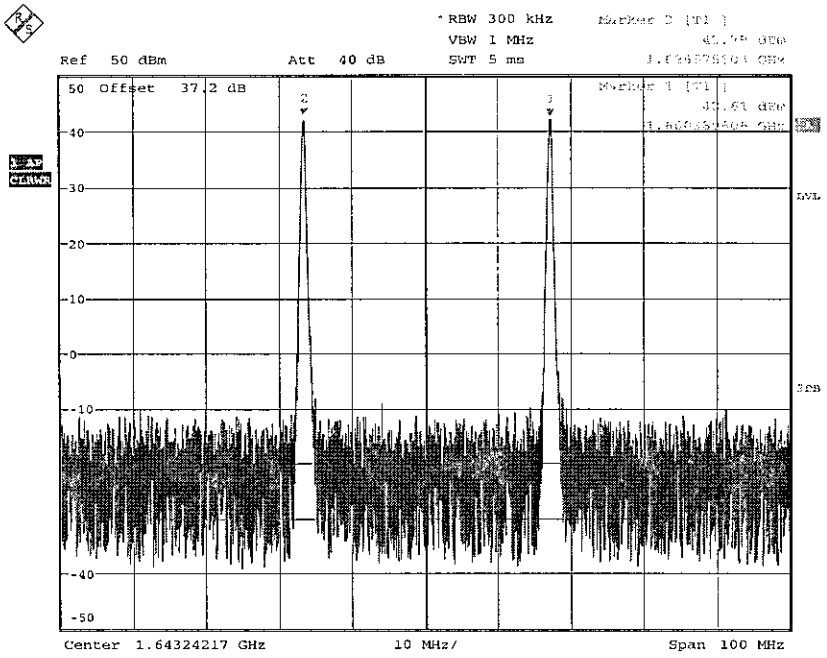
5.3.6.2.3 1660 MHz to 1670 MHz



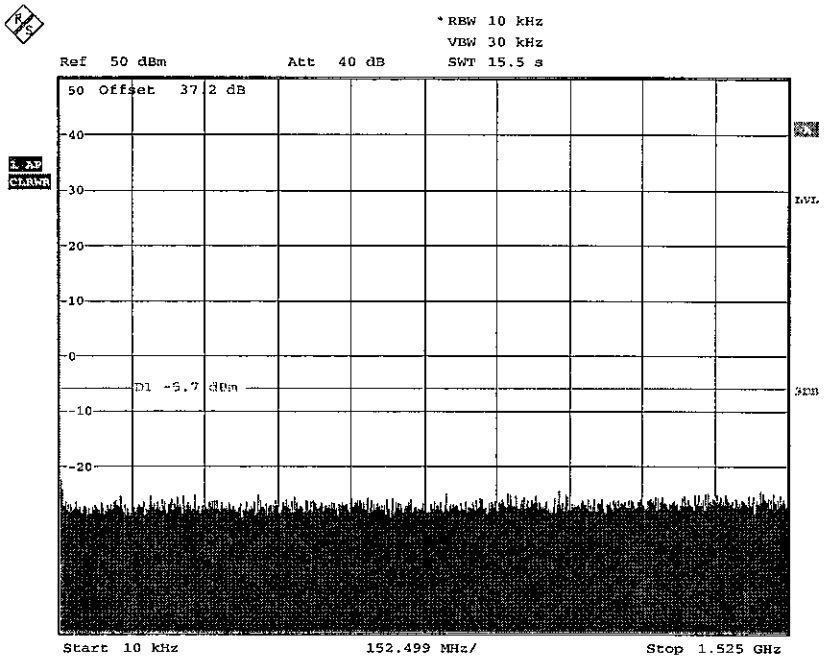
Date: 21.OCT.2008 12:32:27

5.3.6.3 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 10 KHz to 18 GHz with a combined signal level of the two modulated QPSK (600bps) carriers of 35 W. One carrier is produced at close to the lower edge of the transmit band and one carrier is produced at close to the upper edge of the transmit band.

5.3.6.3.1 Overview Image

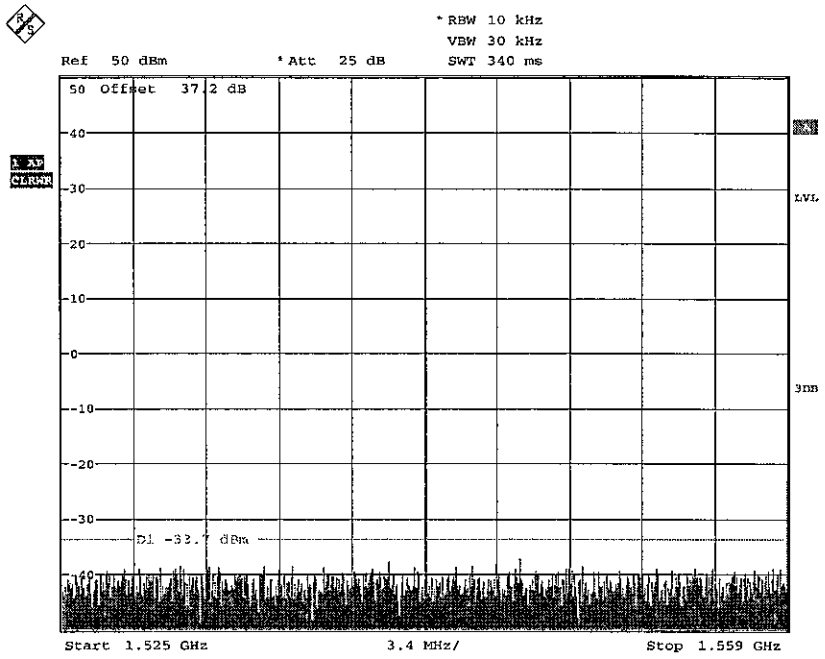


5.3.6.3.2 10 KHz to 1525 MHz



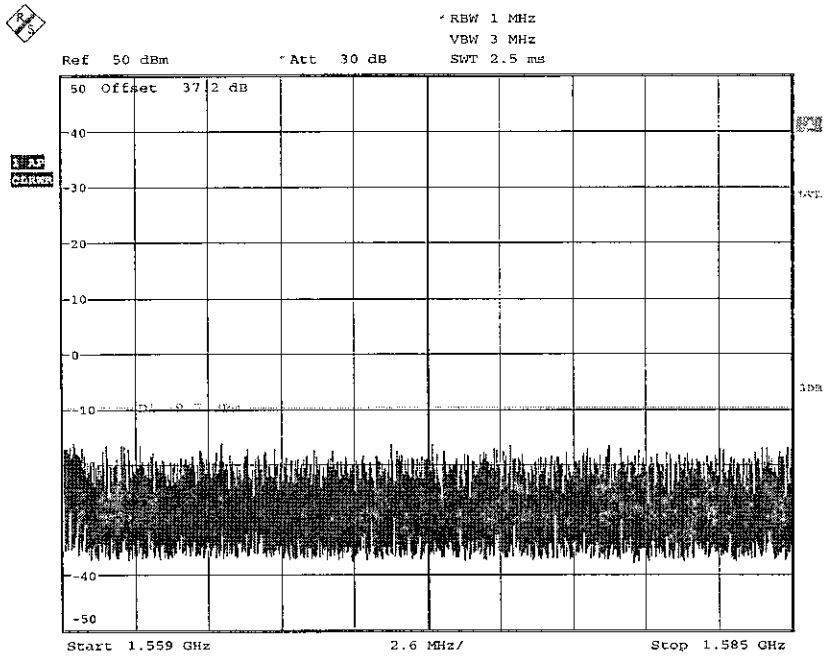
Date: 21.OCT.2008 12:42:27

5.3.6.3.3 1525 MHz to 1559 MHz



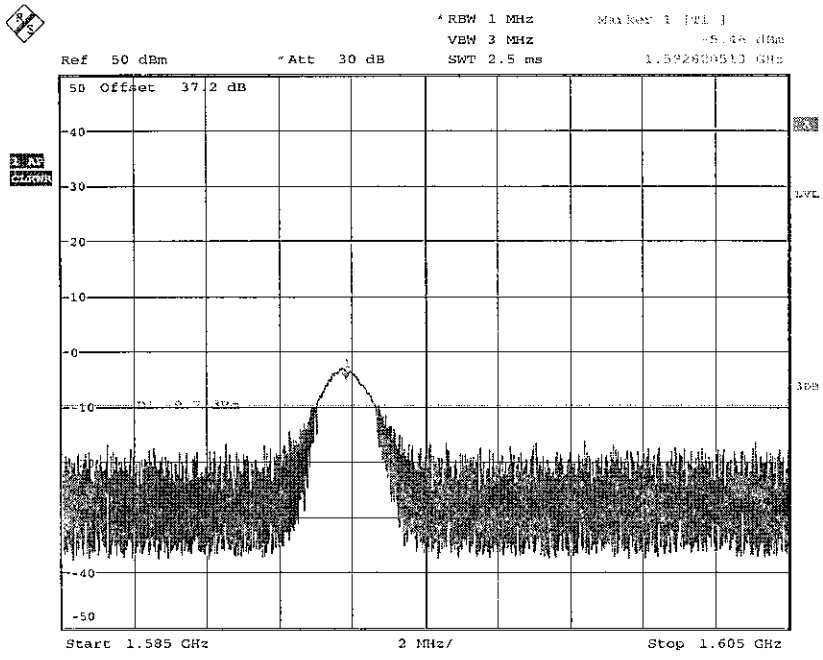
Date: 21.OCT.2008 12:45:55

5.3.6.3.4 1559 MHz to 1585 MHz



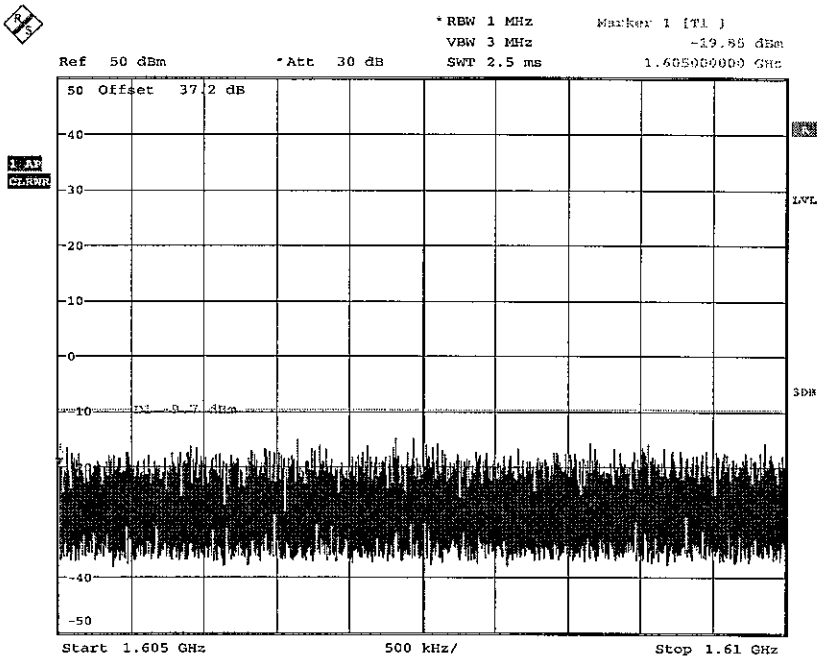
Date: 21.OCT.2008 12:48:52

5.3.6.3.5 1585 MHz to 1605 MHz



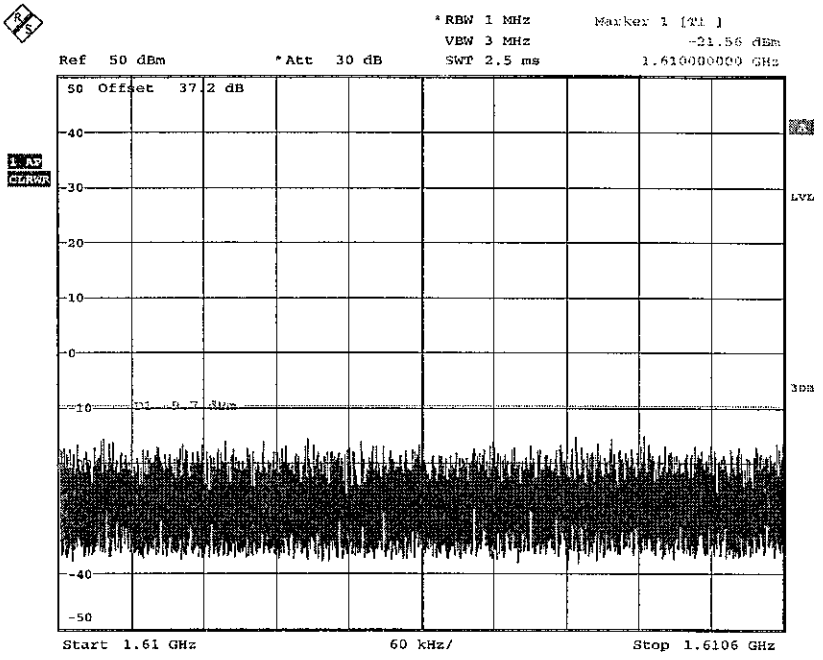
Date: 21.OCT.2008 12:49:43

5.3.6.3.6 1605 MHz to 1610 MHz



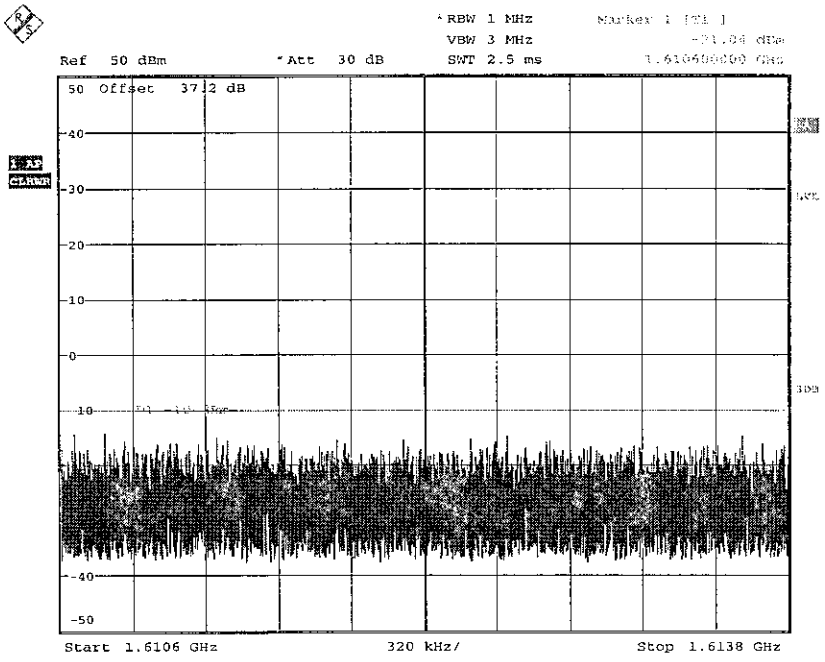
Date: 21.OCT.2008 12:50:40

5.3.6.3.7 1610 MHz to 1610.6 MHz



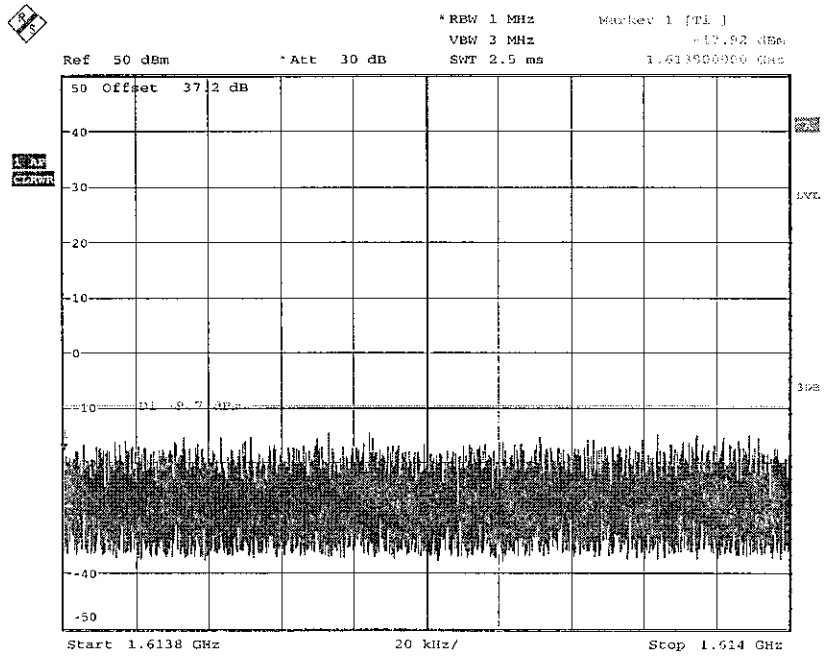
Date: 21.OCT.2008 12:51:18

5.3.6.3.8 1610.6 MHz to 1613.8 MHz



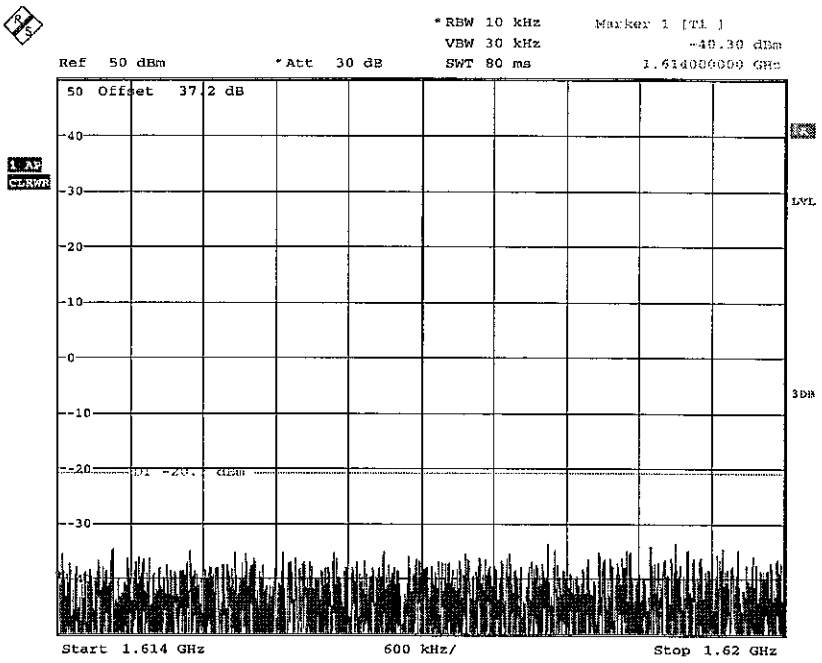
Date: 21.OCT.2008 12:52:29

5.3.6.3.9 1613.8 MHz to 1614 MHz



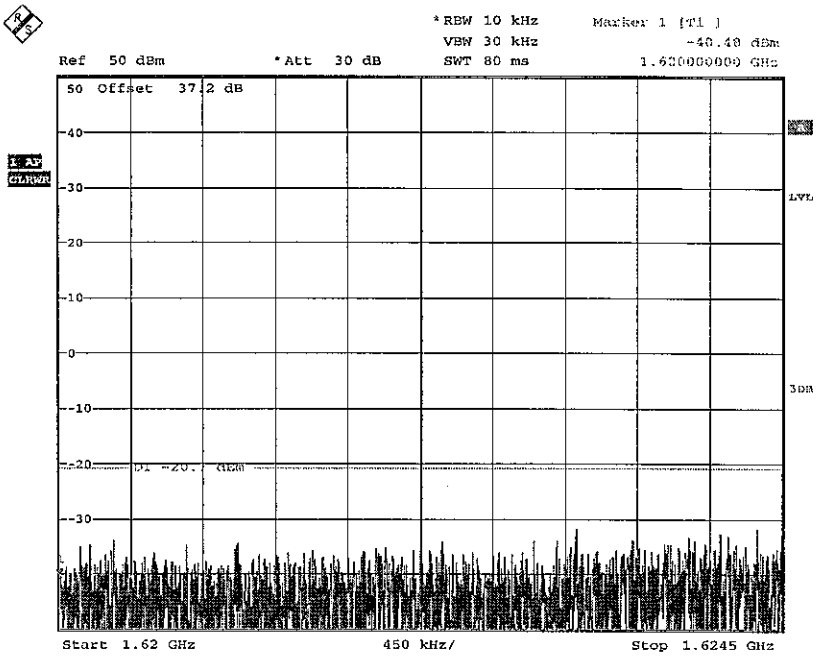
Date: 21.OCT.2008 12:53:45

5.3.6.3.10 1614 MHz to 1620 MHz



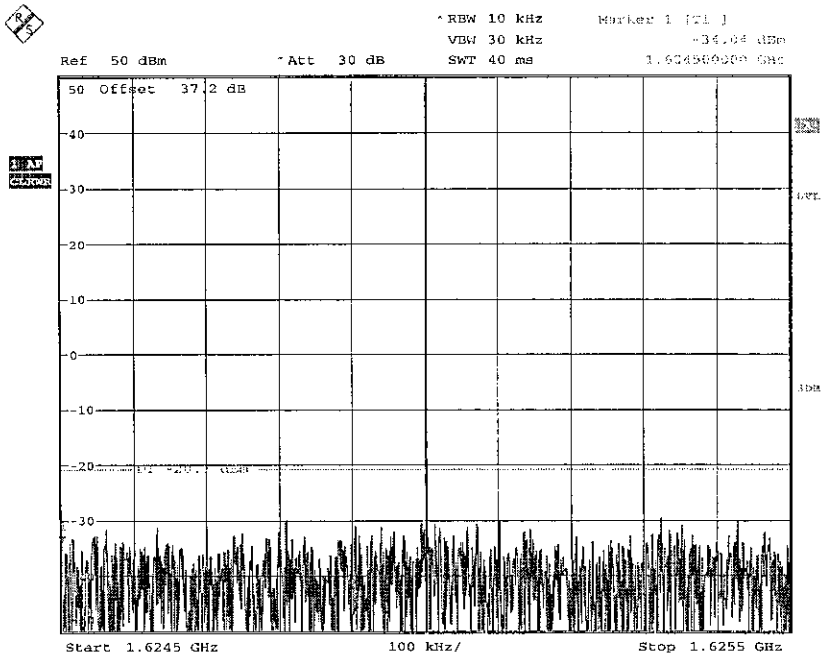
Date: 21.OCT.2008 12:55:18

5.3.6.3.11 1620 MHz to 1624.5 MHz



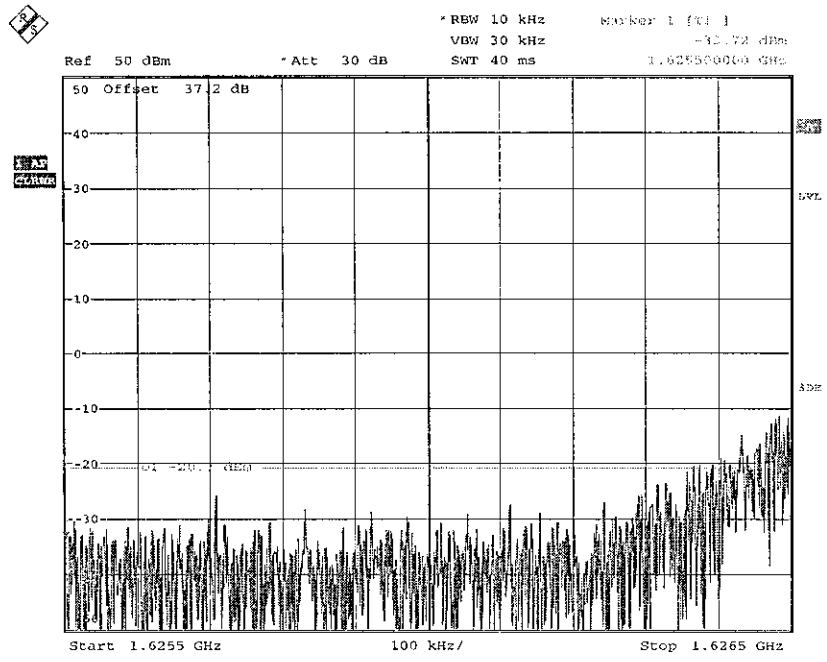
Date: 21.OCT.2008 12:56:14

5.3.6.3.12 1624.5 MHz to 1625.5 MHz



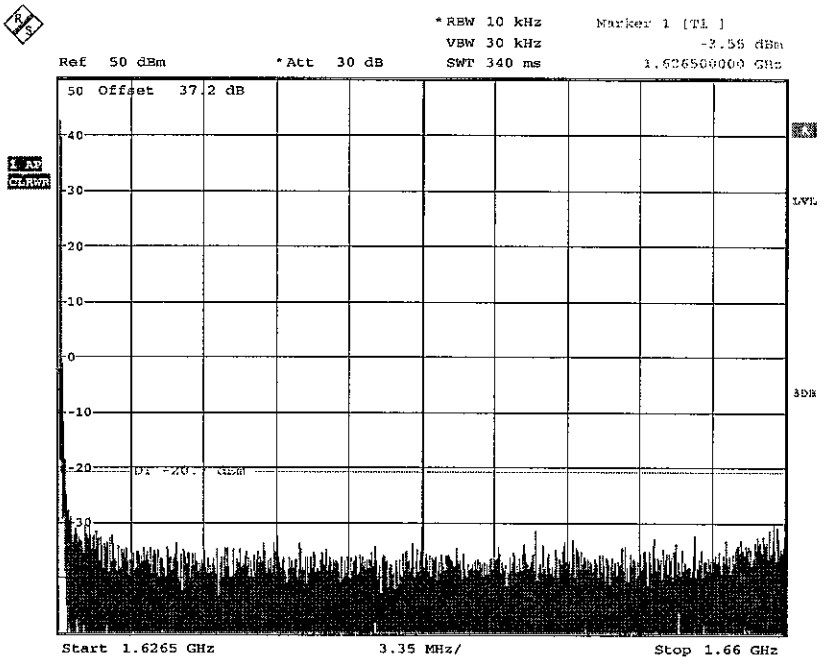
Date: 21.OCT.2008 12:58:13

5.3.6.3.13 1625.5 MHz to 1626.5 MHz



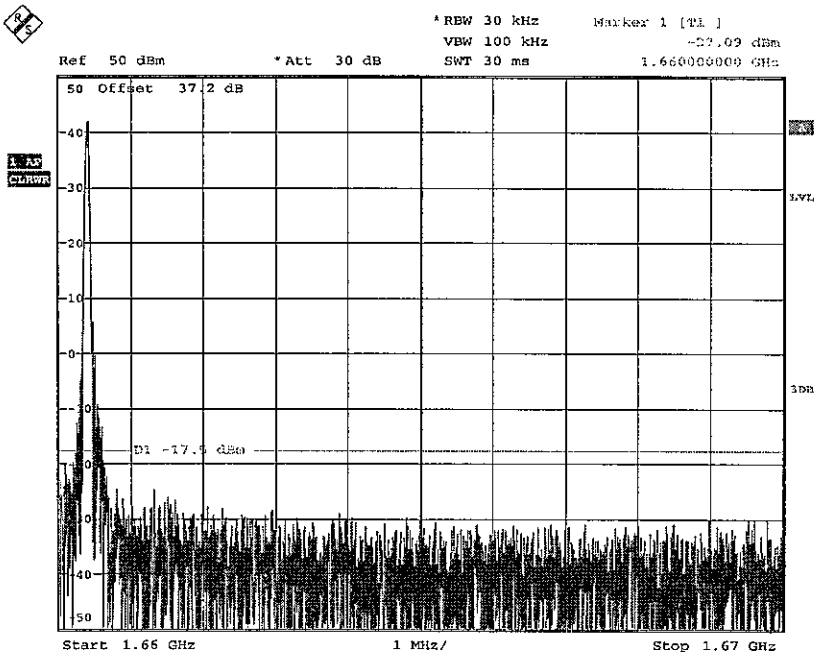
Date: 21.OCT.2008 12:58:38

5.3.6.3.14 1626.5 MHz to 1660 MHz



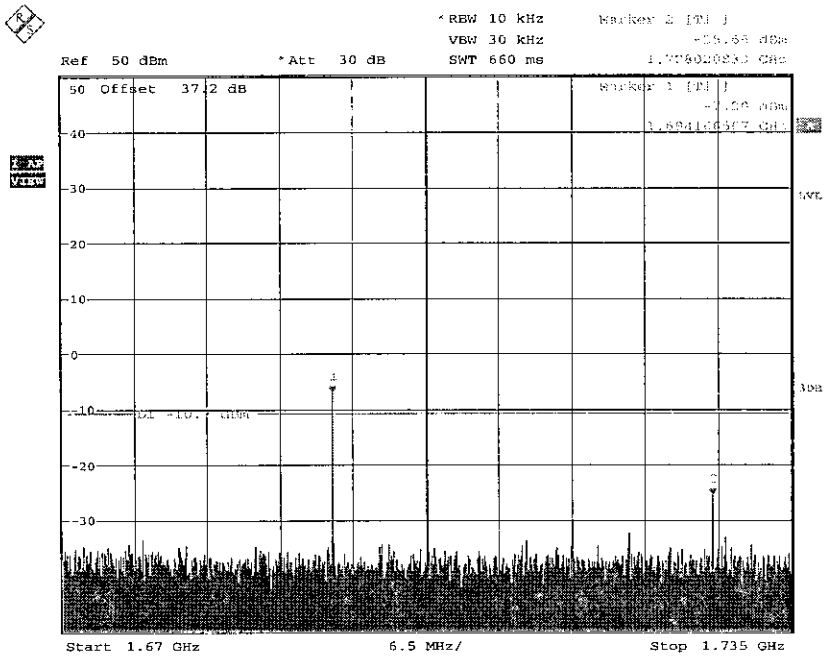
Date: 21.OCT.2008 12:59:20

5.3.6.3.15 1660 MHz to 1670 MHz



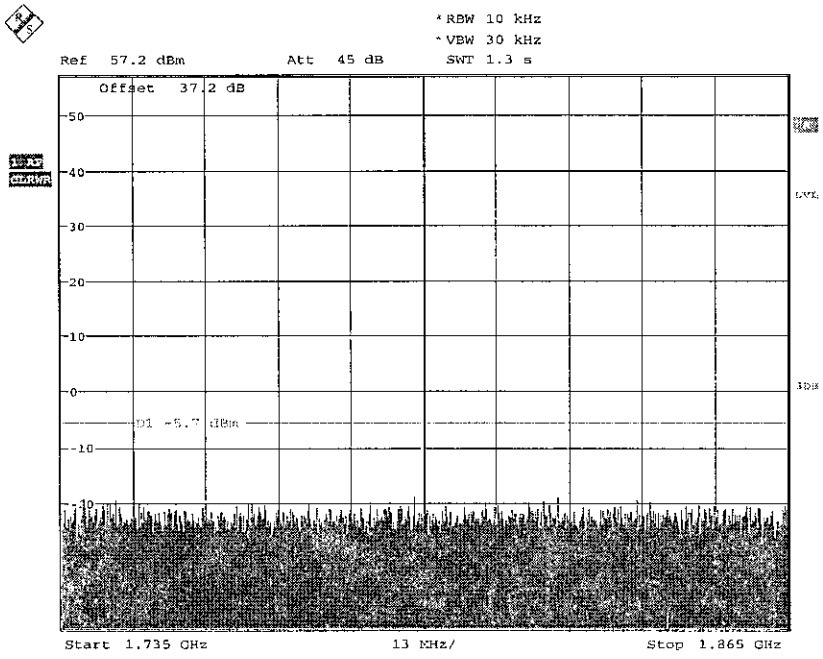
Date: 21.OCT.2008 13:00:58

5.3.6.3.16 1670 MHz to 1735 MHz



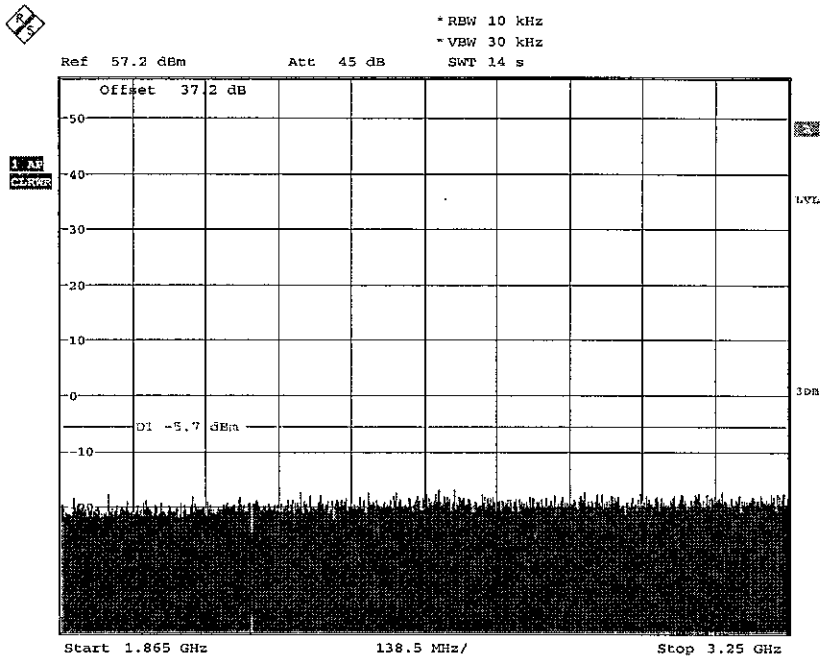
Date: 21.OCT.2008 13:02:52

5.3.6.3.17 1735 MHz to 1865 MHz



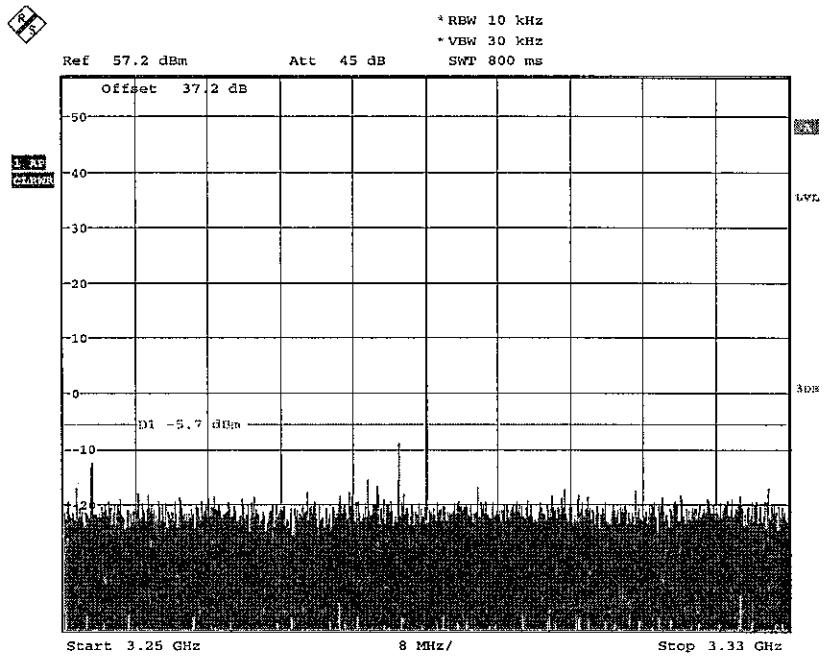
Date: 21.OCT.2008 13:55:35

5.3.6.3.18 1865 MHz to 3250 MHz



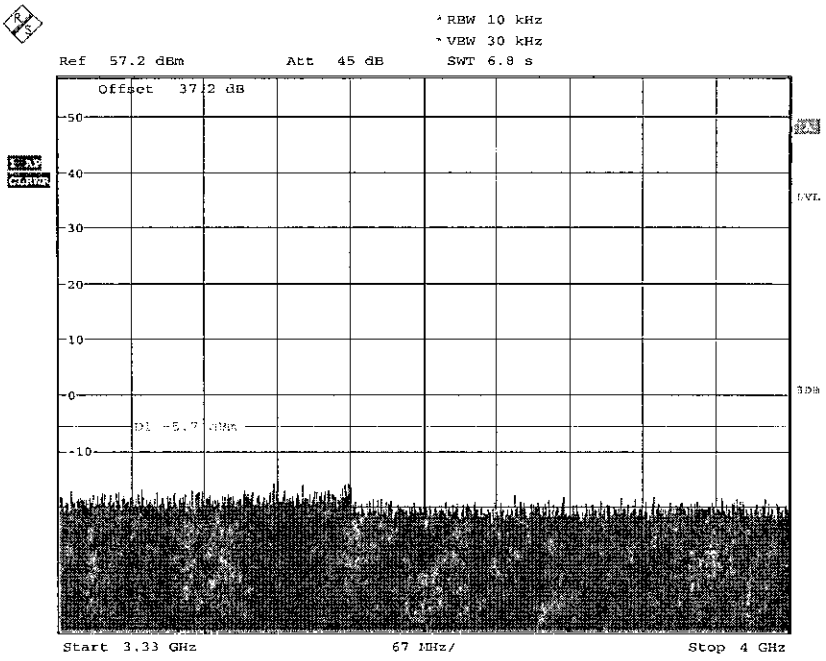
Date: 21.OCT.2008 13:57:22

5.3.6.3.19 3250 MHz to 3330 MHz



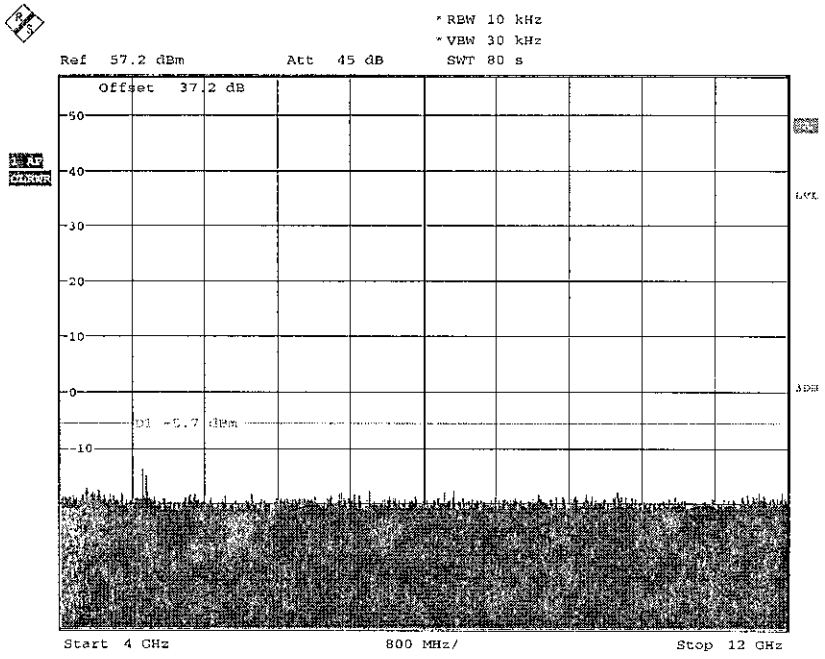
Date: 21.OCT.2008 13:56:47

5.3.6.3.20 3330 MHz to 4000 MHz



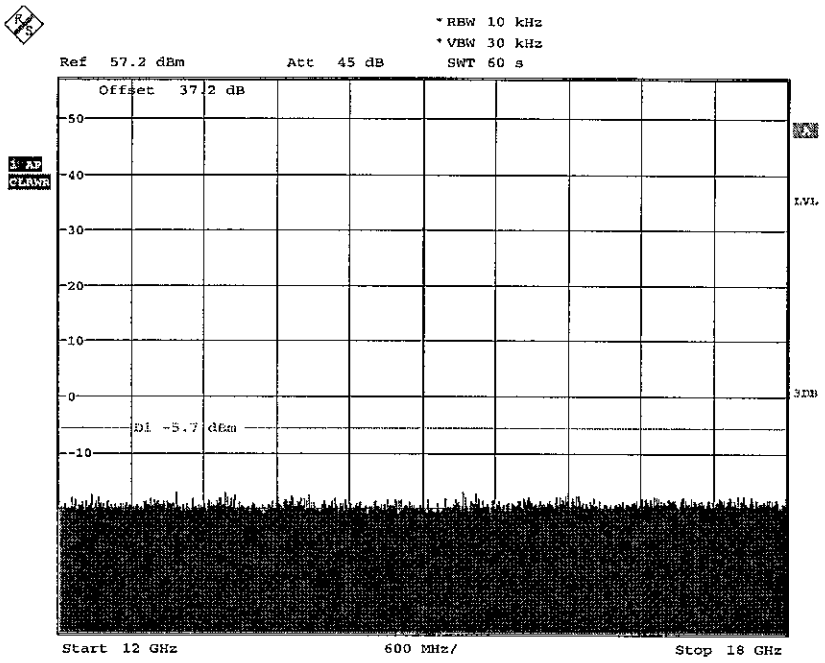
Date: 21.OCT.2008 13:57:44

5.3.6.3.21 4 GHz to 12 GHz



Date: 21.OCT.2008 13:59:23

5.3.6.3.22 12 GHz to 18 GHz



Date: 21.OCT.2008 14:01:16

6 Conclusions, Deviations and Waiver Requests.

6.1 General

6.1.1 Test Results were presented for the three modes of operation:

- Class 6 with internal HPA – see section 5.1,
- Class 6 with external HPA - see section 5.2,
- Classic with external HPA - see section 5.3.

The combined conclusions for all three modes for each FCC requirement is presented in the following sections.

6.1.2 The external HPA used with the SDU is a Thales product and application for FCC certification, using the FCC ID: KV6TFS-HPA82166A will be made and linked to this application for the SDU.

6.2 RF Output Power

6.2.1 The Thales SDU, FCC ID: KVSTFS-SDU82155D, in all three modes of operation described above, meets the requirements of FCC 47 CFR Parts 2.1046 and 87.131 for RF Output Power.

6.3 Occupied Bandwidth

6.3.1 The Thales SDU, FCC ID: KVSTFS-SDU82155D, in all three modes of operation described above, meets the requirements of FCC 47 CFR Parts 2.1049 and 87.135 for RF Occupied Bandwidth.

6.3.2 Inmarsat Class 6 mode includes QAM channels, which are non approved FCC emission types, Thales are therefore requesting a waiver to permit certification of these channel types – exhibit 13d.

6.4 Frequency Stability

6.4.1 The Thales SDU, FCC ID: KVSTFS-SDU82155D, in all three modes of operation described above, meets the requirements of FCC 47 CFR Parts 2.1055 and 87.133 for Frequency Stability.

6.5 Conducted Spurious Emissions

6.5.1 Thales tested the SDU using an alternative method. Sections 4.2.4.4 to 4.2.4.8 provide the justification for the use of this alternative method.

6.5.2 Thales have concluded that using this alternative method SDU FCC ID KV6TFS-SDU82155D does meet the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions.

6.5.3 Thales are therefore requesting a waiver against the test method used for the measurement of the SDU FCC ID: KVSTFS-SDU82155D (for all three modes of operation described above), for Conducted Spurious Emissions – exhibit 13c. This waiver in test method was approved previously for the submission for KVS-TFS-SDU82155A.

6.6 Radiated Emissions

6.6.1 The Thales SDU, FCC ID: KV6TFS-SDU82155D, in all three modes of operation described above, meets the requirements of FCC 47 CFR Part 15.209 for radiated emissions.

6.7 Intermods

6.7.1 The Thales SDU, FCC ID: KV6TFS-SDU82155D, in all three modes of operation described above, meets the anticipated FCC requirements for Intermods. The requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions were used to create the limits and conditions for which Intermodulation Products were measured against. No formal requirement set exists from the FCC regarding IM Products, however Thales have sought feedback on this through the FCC. The FCC stated the following (assuming measurement at the Antenna):

- Test all modulation types [TDMA, CDMA, and FM (covers GSM and F1D)]
- At maximum drive level, for each modulation: one test with three tones, or two tests (high-band, low-band and edge) with two tones
- Limit usually is -13dBm conducted.
- Combination of modulation types not needed.
- Use RBW 300 Hz or 1% RBW. The spectral shape of the output should look similar to input for all modulations.
- Power on Form 731 should be clearly understood as either composite of multi-channels or per carrier. If power is composite include in comments field: "Power output listed is composite for multi-channel operation."
- Check that the input drive level is at maximum input rating and maximum gain setting for all tests.
- Meets power limits of 90.219 for Part 90 booster operations.

6.7.2 Thales note that there are spurious results which exceed the conducted suprious limit masks applied at wide-spacing of approximately 34MHz. In this instance the 3rd and 5th order intermodulation products appear outside of the nominal Inmarsat frequency band. The worst case 3rd order product is shown in Class 6 with External FMHPA of 0.69dBm (ref: 5.2.2.3.5). therefore producing 10.69dBm EIRP (not including DLNA rejection). Including 95dB DLNA rejection at this frequency would result in approximately –84dBm EIRP of this Intermodulation Product. This would result in –126.4dBc/MHz and the Conducted Spruious Limit stated by the FCC at this Frequency is –143dBc/MHz.

6.7.3 Comparing this to the –13dBm conducted limit stated in the FCC communication above Thales conclude that Intermodulation Product performance in Class 6 and Classic services with and without the FMHPA are satisfactory and fit for purpose.

7 Testimonial and Statement of Certification

The Thales Avionics Ltd Satellite Data Unit Type Number 82155D (FCC ID: KV6TFS-SDU82155D) 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 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 82155D. 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.

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Colin Appleyard
(Technical Consultant: Certifying Engineer)

.....

Richard Thorburn
(Systems Engineer)

.....

J. Livingstone
(TFS Satcom Systems Project Leader)

.....

B. Feehan
(TFS Satcom Product Design Authority)