TRANSMITTER CERTIFICATION
OF
FCC ID: KV6TFS- HPA82166A
THALES AVIONICS
(APPLICANT)
TOP FLIGHT SATCOM
FLANGE MOUNT HIGH POWER AMPLIFIER
TO
FEDERAL COMMUNICATIONS COMMISSION
RULE PART 87

TEST REPORT

(Exhibit 6a)

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ISSUE RECORD

	Date	By	Comments
A	17 October 2008	P. Gillick	Initial Draft
B	24 October 2008	R. Thorburn	Intermod Results Addition
C	28 October 2008	R. Thorburn	PMG / JEL / RT Comments / Updates Ready for RASS6060 Review
I	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) Flange Mount High Power Amplifier (FMHPA) FCC ID: KV6TFS- HPA82166A.

1.1.2 The FMHPA is intended for use with the TFS Satellite Data Unit (SDU) KV6TFS-SDU82155D, the application for FCC certification of the FMHPA will be linked to the SDU.

1.1.3 The test results include the SDU as the signal source. The SDU can operate in two modes: Inmarsat Classic and Class 6 (Swift BroadBand - SBB).

1.1.4 Inmarsat Class 7 and Class 6 have the same transmitted channel types and thus results are read across for the purposes of this application from Class 7 Test results (ref. 1.4.3). Otherwise Classic results are used as they represent the worst case, as Classic mode is about 2dB higher than Class 6.

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

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

Test	Test evidence	Comment
RF Power output	This report, section 5.1 (Classic SDU + FMHPA)	Use Classic + FMHPA results as they are the highest/worst power case
BW/Modulation	This report, section 5.2.3 (Classic SDU + FMHPA) and Class 7 TuV report reference 1.4.3, section 2.5	Both classic and SBB modulation types
Freq stability	Not applicable	No frequency conversion
Conducted spurious	This report, section 5.3 (Classic SDU + FMHPA)	Use Classic + FMHPA results as they are the highest/worse power case
Radiated (EMC)	Classic TuV report reference 1.4.4, sections 2.1, 2.2	Use Classic + FMHPA results as they are the highest/worse power case
Intermods	This report, section 5.5	Classic channel and Class 6 channel results

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
Classic, reference 1.4.4 exhibit 6c	2.1, 2.2	Radiated Emissions

Table 2 TuV Test Report summary

1.1.7 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 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 Thales Topflight Satcom (TFS) Flange Mount High Power Amplifier (FMHPA) FCC ID: KV6TFS- HPA82166A.

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 the Thales Topflight Satcom (TFS) Flange Mount High Power Amplifier (FMHPA) FCC ID: KV6TFS-HPA82166A.

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[PG2].

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

1.4.5 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

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- HPA82166A

2.5 Model Number:

HPA 82166A

2.6 Type of Emission:

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

2.7 Frequency Range MHz:

Transmit: 1626.5 to 1660.5 MHz

2.8 Power Rating:

35W maximum

2.9 Voltages & Currents in all Final RF Stages:

Three final parallel output stages each 28VDC and 2.5A 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 EUT 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.1.4.5)

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 and 1.4.4).

3.3 FMHPA Part Record

3.3.1 Details of the FMHPA (FCC ID: KV6TFS-HPA82166A) used for some of the testing is given in Table 3.

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

Table 3: FMHPA Part Record

3.4 SDU Configuration

3.4.1 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 4 SDU Configuration

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

3.5 Hardware and Software Configuration Changes

3.5.1 The same FMHPA 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 Procedure

4.2.1 RF Power Output Testing

4.2.1.1 The FMHPA was tested for RF Carrier Output Power as 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 Thales Avionics Ltd. with a SDU configured for Inmarsat Classic operation connected to the FMHPA.

4.2.1.3 The power output of a FMHPA/SDU combination operating in Classic Aero mode is 2dB higher than in Class 6 mode. Thales considers that for the purposes of assessing RF Carrier Output Power, the Classic Aero testing provides the worst case for the requirements of this submission.

4.2.1.4 Figure 1 shows the test configuration used for testing RF Carrier Output Power.

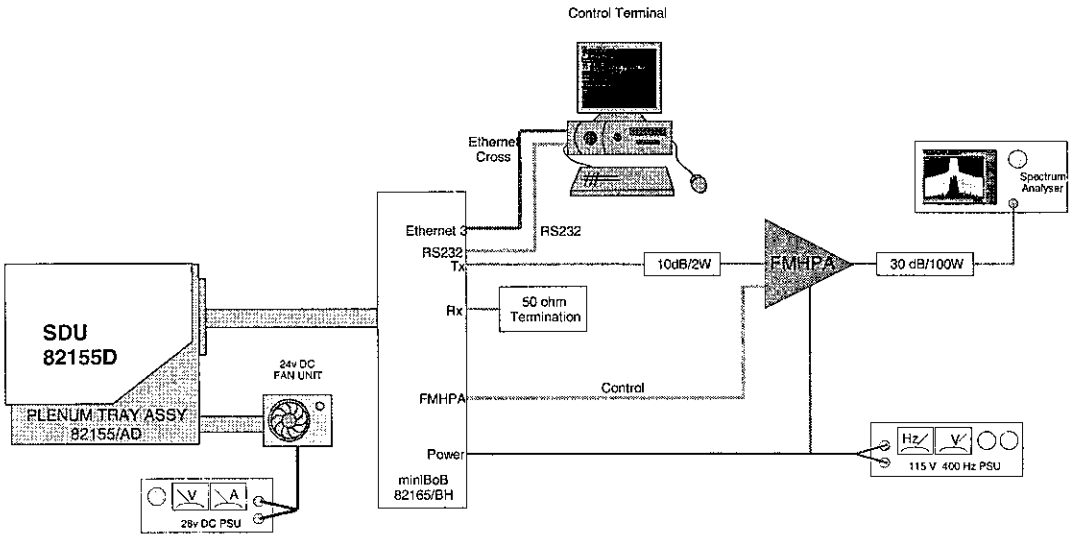


Figure 1 RF Power, Occupied Bandwidth and Conducted Emissions Test Configuration

4.2.2 Occupied Bandwidth

4.2.2.1 The FMHPA was tested with a SDU, 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 split into two parts:

- Classic channels: 840HG1D, 1K68G1D, 8K40G1D, 10K5G1D performed at Thales Avionics Ltd.,
- SBB channels: 25K0G7W, 50K0G7W, 100KG7W, 200KG7W, 50K0D7W, 100KD7W, 200KD7W performed at the authorised test house.

4.2.2.3 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.

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

4.2.2.5 Figure 1 shows the test configuration used for testing Occupied Bandwidth for Classic channels, whilst Figure 2 shows the test configuration used for testing Occupied Bandwidth for SBB channels.

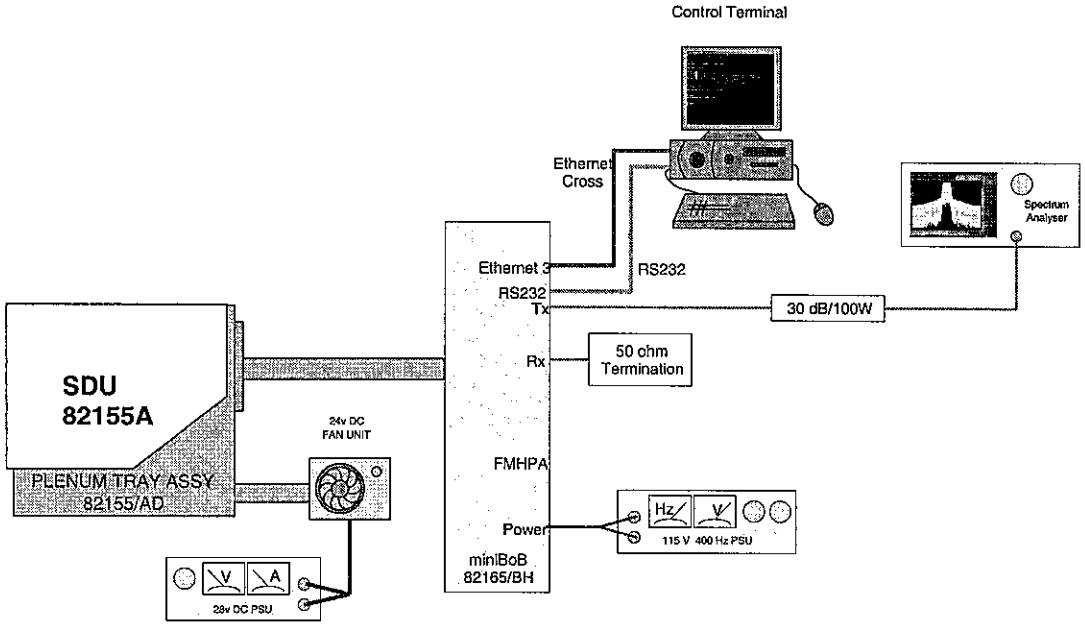


Figure 2 Occupied Bandwidth for SBB channels Test Configuration

4.2.3 Conducted Spurious Emissions

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

4.2.3.2 The Conducted Emissions testing was performed at the authorised test house, with a SDU configured for Inmarsat Classic Aero operation (see section 4.3.3.2). The power output of a FMHPA/SDU combination operating in Classic Aero mode is 2 dB higher than in Class 6 mode. Because the power output in Classic Aero mode is higher, the spurious emissions can be expected to be equal to or worse than in SBB Class 6. Thales considers that for the purposes of assessing Conducted Emissions, the Classic Aero testing provides the worst case measurements to satisfy the requirements of this submission.

4.2.3.3 Thales tested the FMHPA/SDU combination 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 (with internal HPA) designed for operation as an Inmarsat Class 3A SDU. The following paragraphs outline the justification for the use of this alternative method.

4.2.3.4 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.

4.2.3.5 Thales concluded that the only practical way to measure conducted spurious 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 DLNA.

4.2.3.6 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 781.

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

4.2.3.8 Thales are therefore requesting a waiver against the test method used for the measurement of the FMHPA FCC ID: KVSTFS-HPA82166A for Conducted Spurious Emissions. This waiver in test method was approved for our KVS-TFS-SDU82155A submission.

4.2.3.9 Figure 1 shows the configuration used for testing Conducted Emissions.

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 (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

4.2.4 Radiated Spurious Emissions

4.2.4.1 The FMHPA was tested for Radiated Emissions as per FCC 47 CFR Part 15.209 (ref.1.4.1) with the SDU providing a Classic mode signal as this is the highest signal power mode.

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

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

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

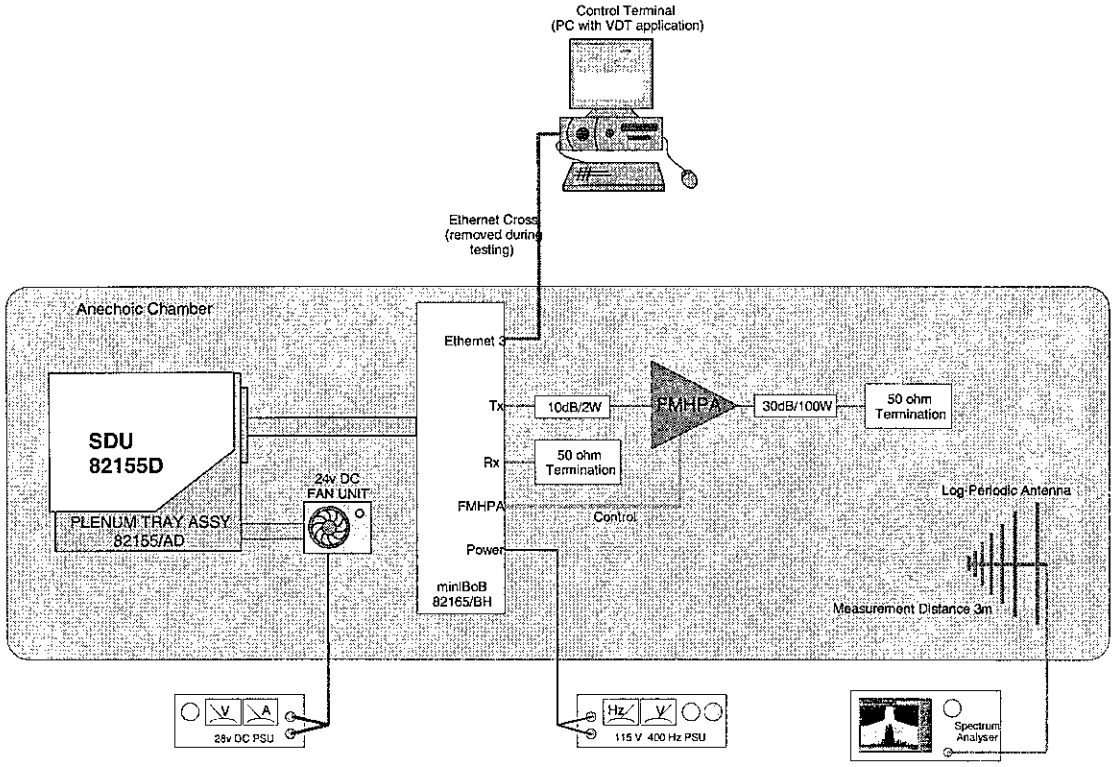


Figure 3 Radiated Emissions Test Configuration

4.2.5 Intermodulation Products

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

4.2.5.2 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.

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

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

4.2.5.5 Multiple tests have been conducted with carrier at both minimum and maximum carrier frequency separations. The SDU in Classic or Class 6 mode is capable of both QPSK and 16-QAM modulations, over a range of symbol rates and both of these cases have been presented to show all modulation types as requested by the FCC.

4.2.5.5.1 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.

4.2.5.5.2 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.

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

4.2.5.6 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.

4.2.5.7 As in the Conducted spurious emissions testing (section 4.2.3), 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.

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

4.2.5.9 Figure 1 shows the configuration used for testing Intermodulation Products.

5 Results.

5.1 RF Output Power

5.1.1 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.

5.2 Occupied Bandwidth

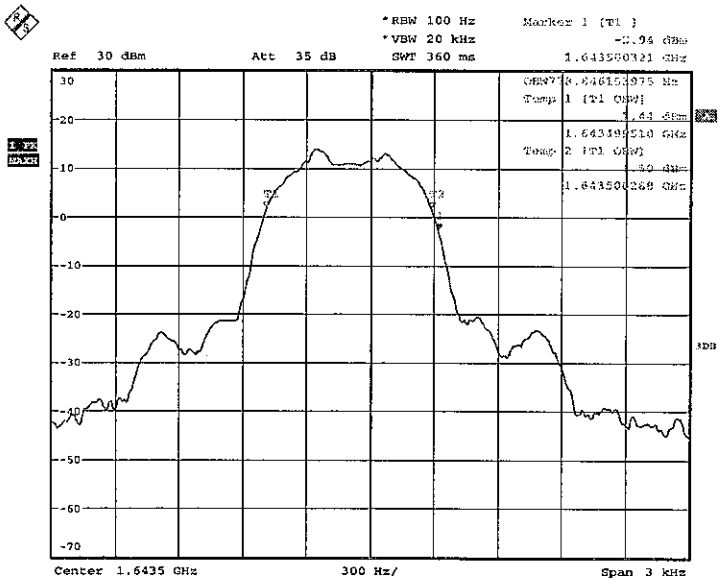
5.2.1 Class 6

5.2.2 Measurements of Occupied bandwidth are provided in (ref: 1.4.3) section 2.5.

5.2.3 Classic

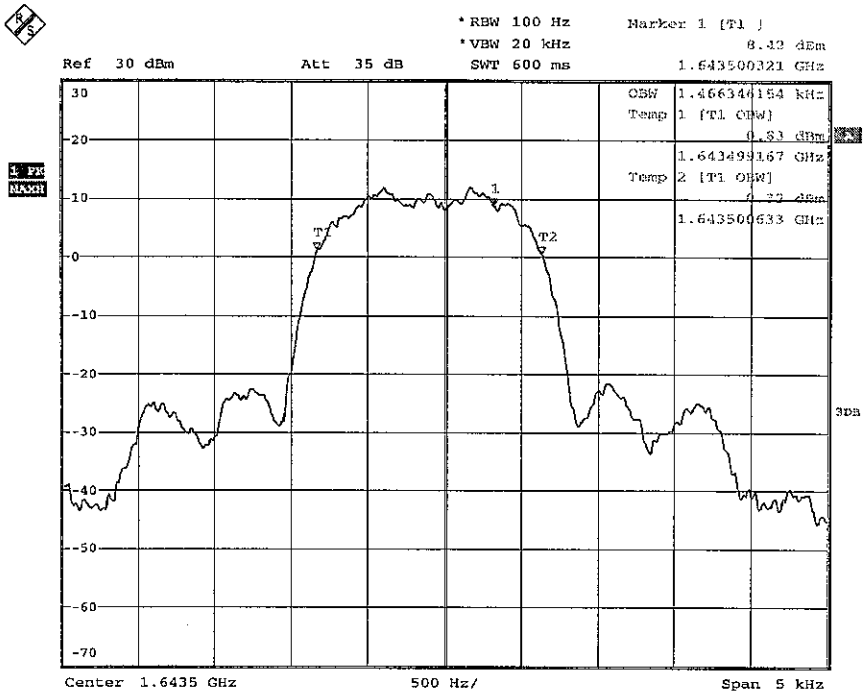
5.2.3.1 Measurements of Occupied bandwidth are provided below as spectrum plots at each data rate at the middle RF carrier frequency.

5.2.3.2 600 bps BPSK



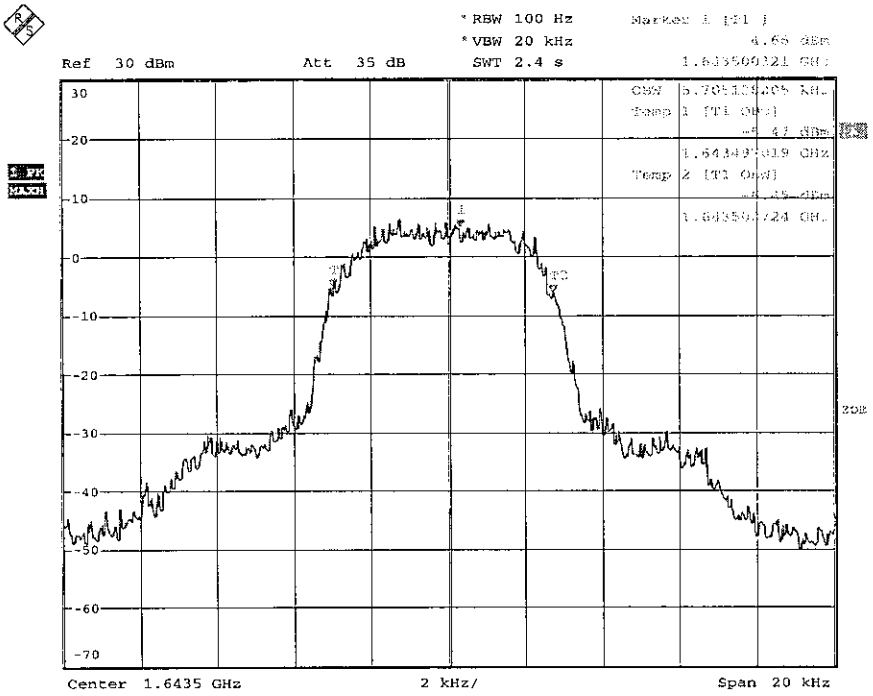
Date: 9.SEP.2008 17:56:24

5.2.3.3 1200 bps BPSK



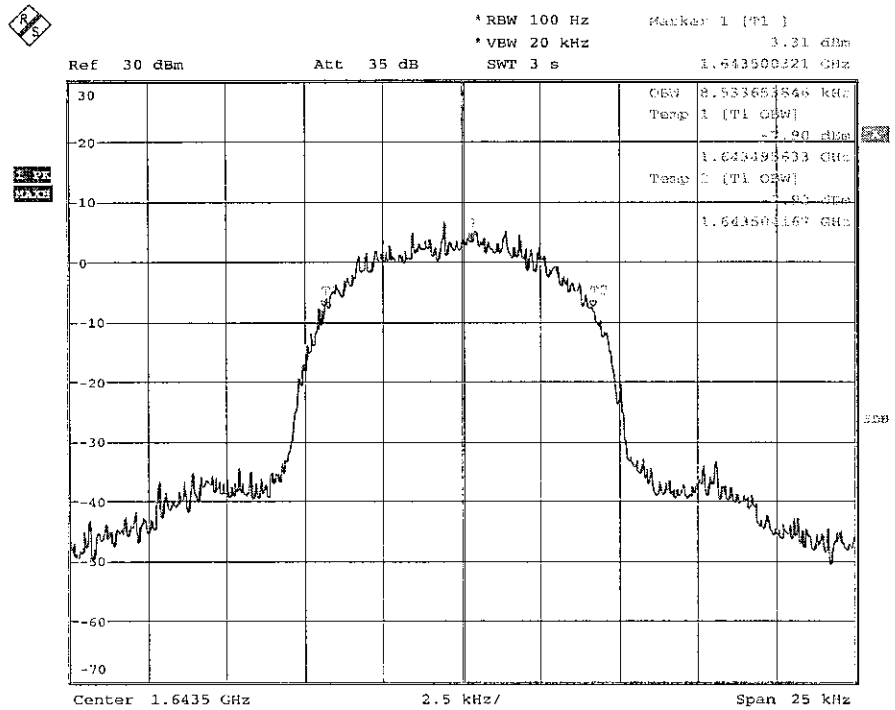
Date: 9.SEP.2008 17:55:27

5.2.3.4 8400 bps OQPSK, 1643.5 MHz



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

5.2.3.5 10500 bps OQPSK, 1643.5 MHz



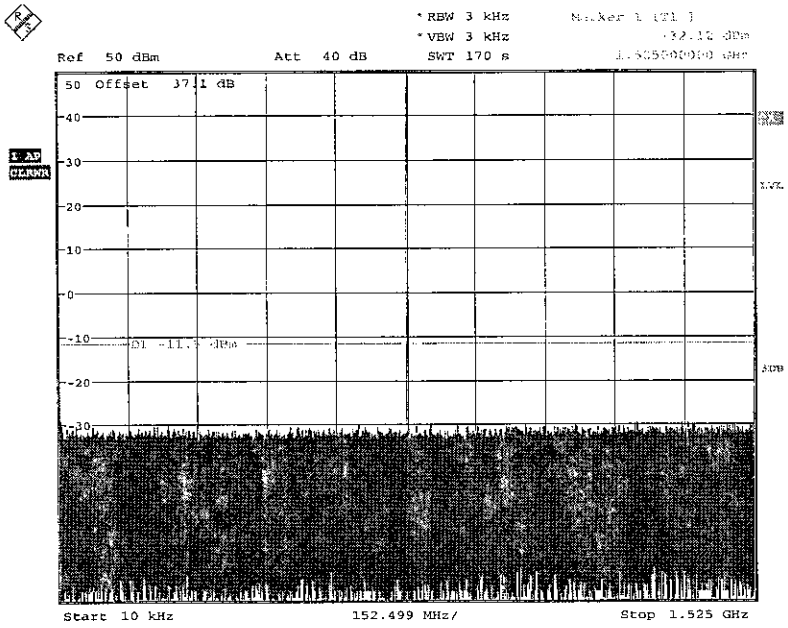
Date: 9.SEP.2008 17:53:47

5.3 Conducted Spurious Emissions

5.3.1 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).

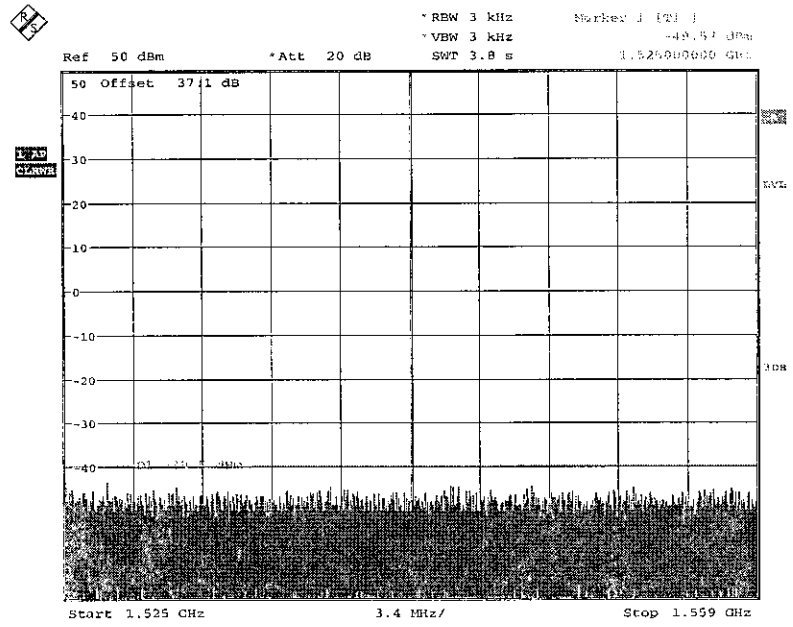
5.3.2 In the following plots, the Limit line level is set to the levels in Table 5, that is Limit line level = Carrier level – Limit at HPA output (to 0.5 dB). For example, for Frequency band 0.01 to 1525 MHz, then for Carrier level of 44.8 dBm and limit of – 56.2 dBc, then the Limit line level is –11.5 dBc (to 0.5 dB) as in plot in section 5.3.3.

5.3.3 10 KHz to 1525 MHz



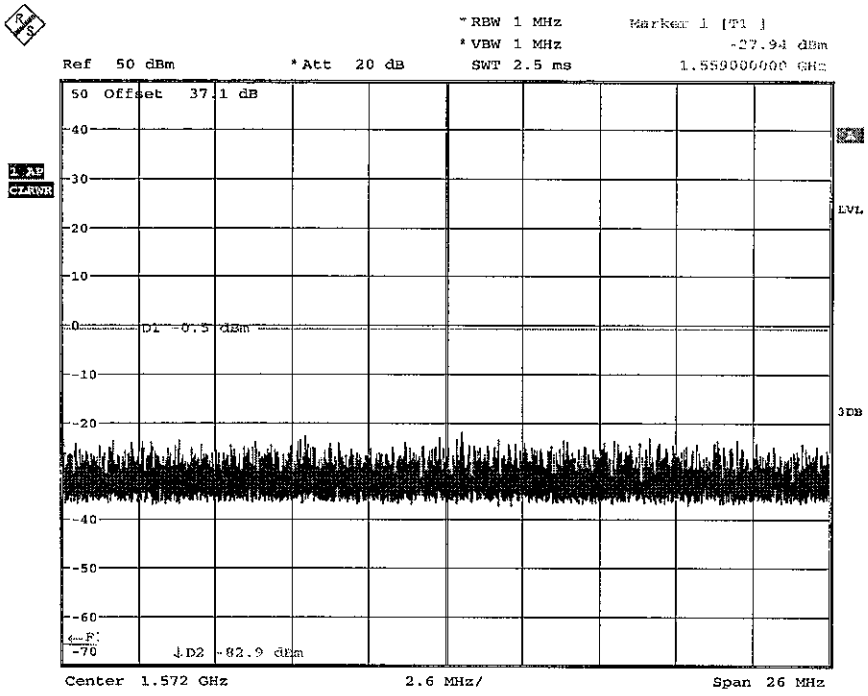
Date: 18.AUG.2008 12:37:08

5.3.4 1525 MHz to 1559 MHz



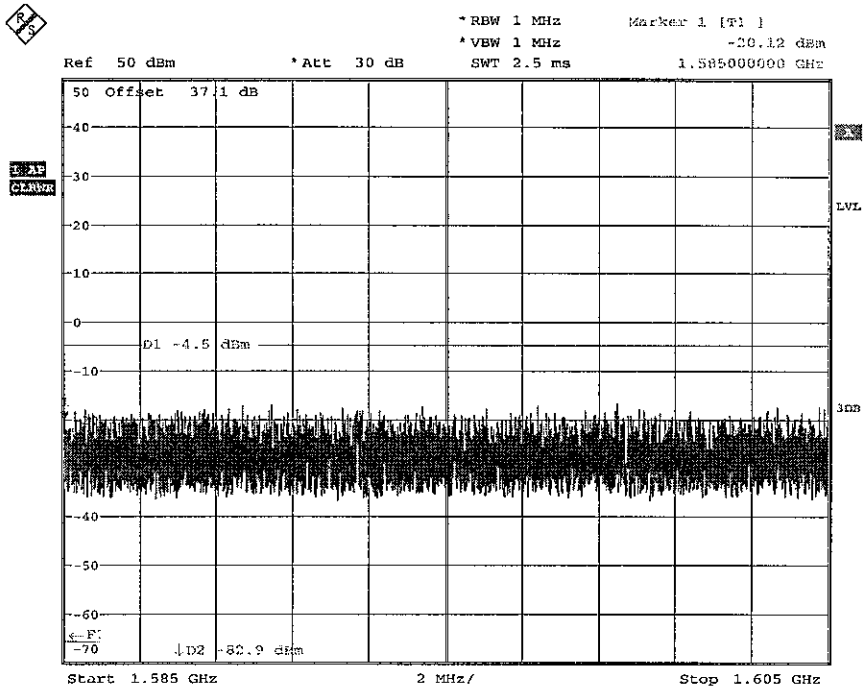
Date: 18.AUG.2008 12:41:41

5.3.5 1559 MHz to 1585 MHz



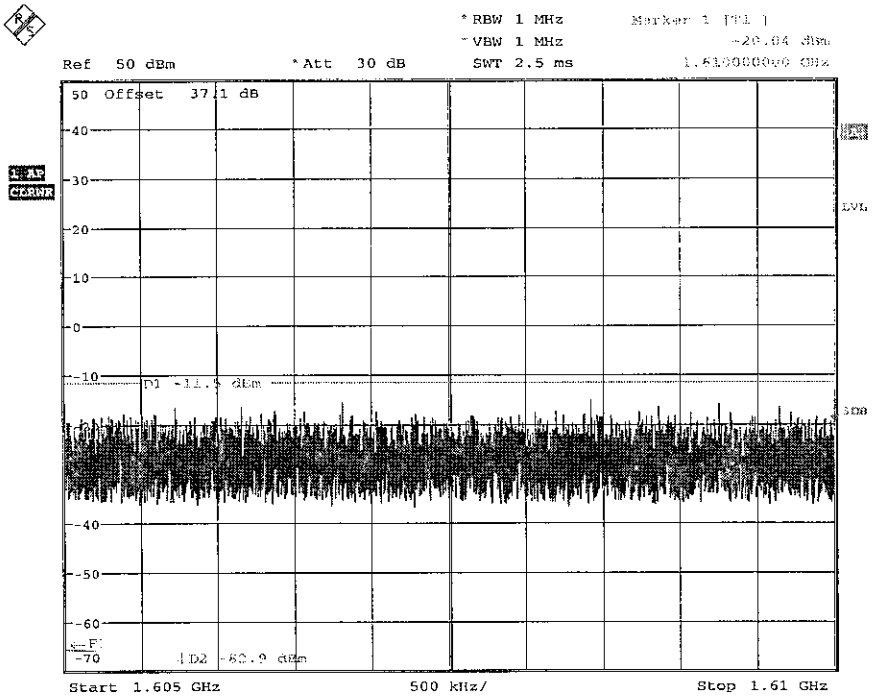
Date: 18.AUG.2008 12:54:26

5.3.6 1585 MHz to 1605 MHz



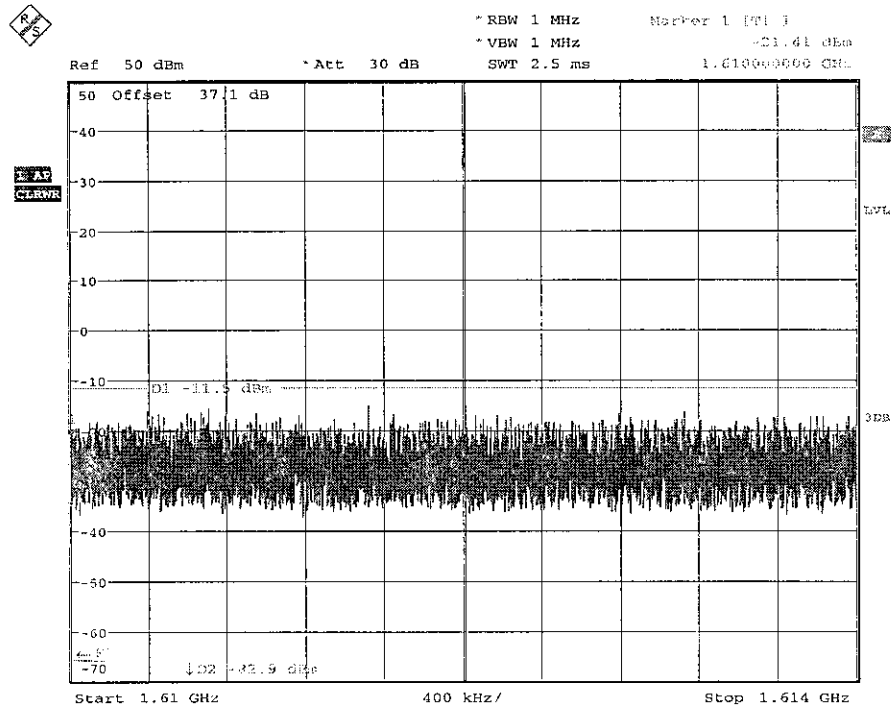
Date: 18.AUG.2008 12:56:18

5.3.7 1605 MHz to 1610 MHz



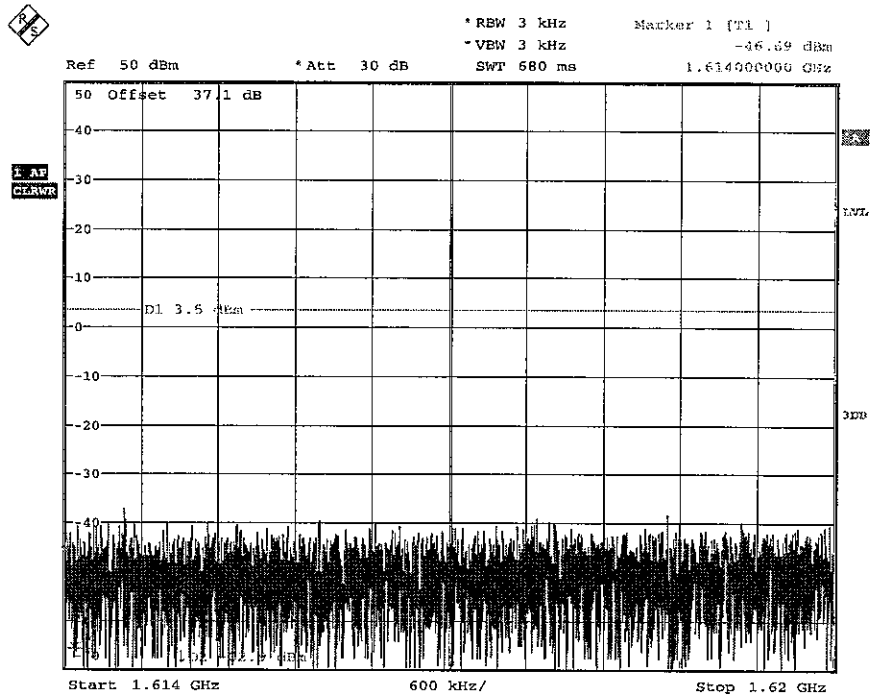
Date: 18.AUG.2008 14:00:07

5.3.8 1610 MHz to 1614 MHz



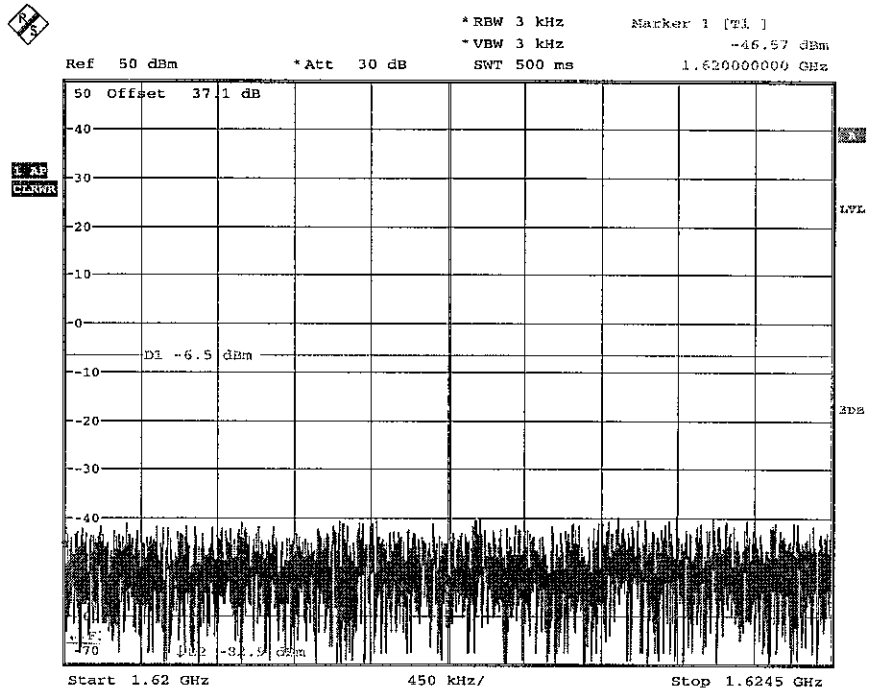
Date: 18.AUG.2008 14:01:39

5.3.9 1614 MHz to 1620 MHz



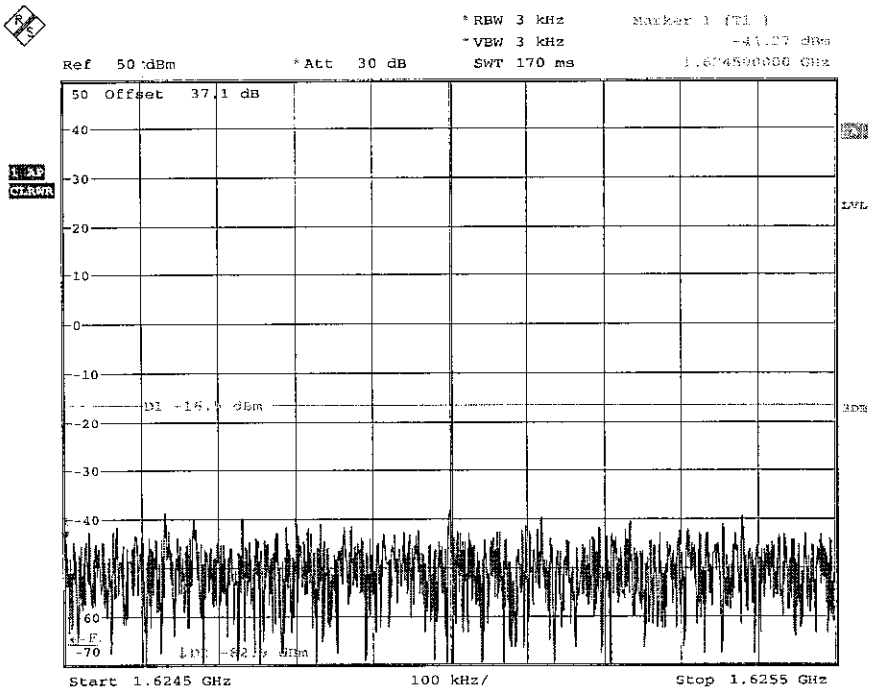
Date: 18.AUG.2008 14:03:56

5.3.10 1620 MHz to 1624.5 MHz



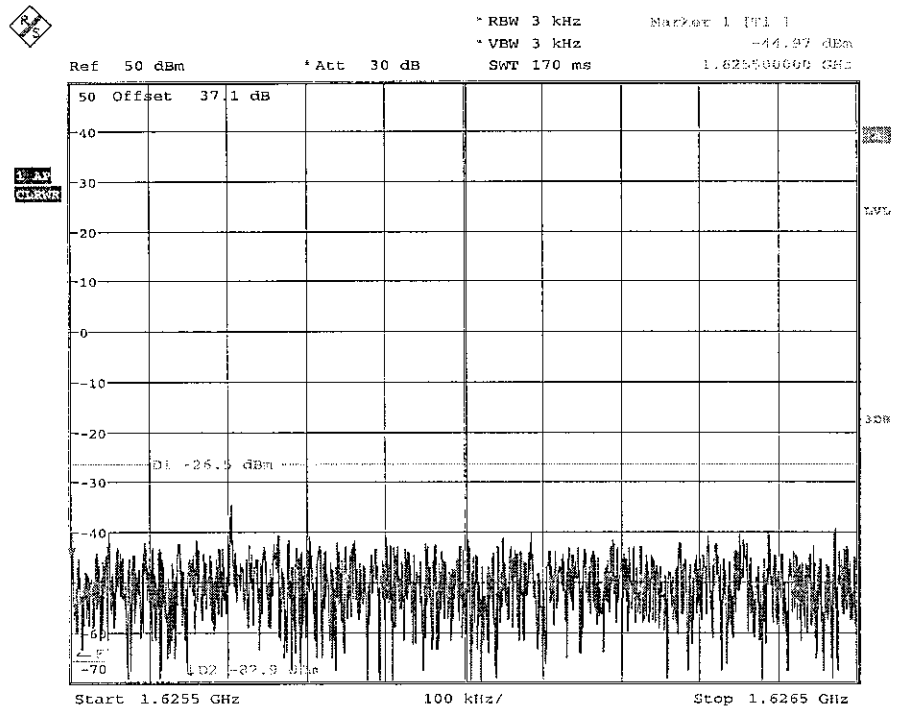
Date: 18.AUG.2008 14:05:06

5.3.11 1624.5 MHz to 1625.5 MHz



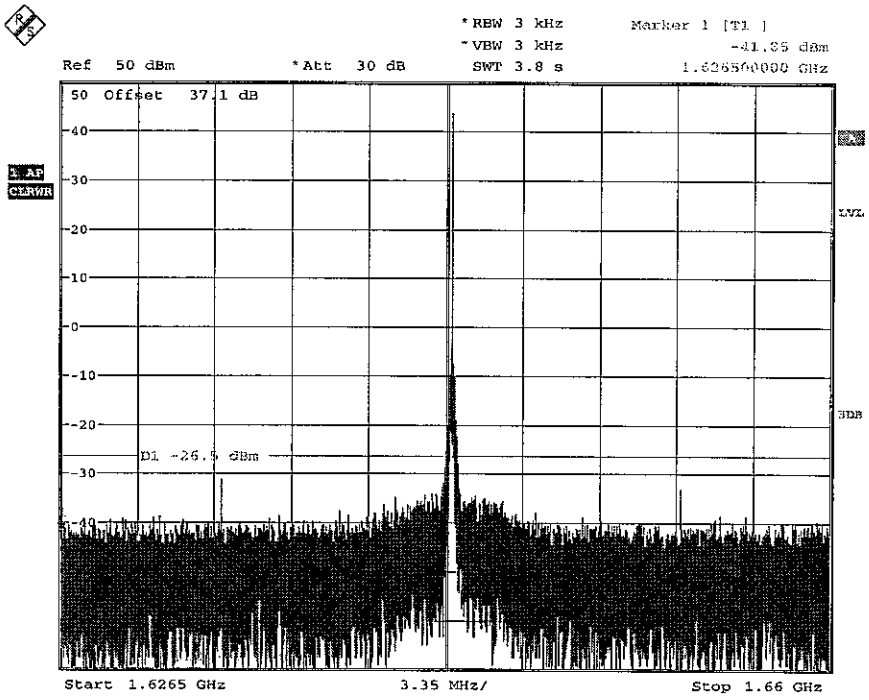
Date: 18.AUG.2008 14:06:34

5.3.12 1625.5 MHz to 1626.5 MHz



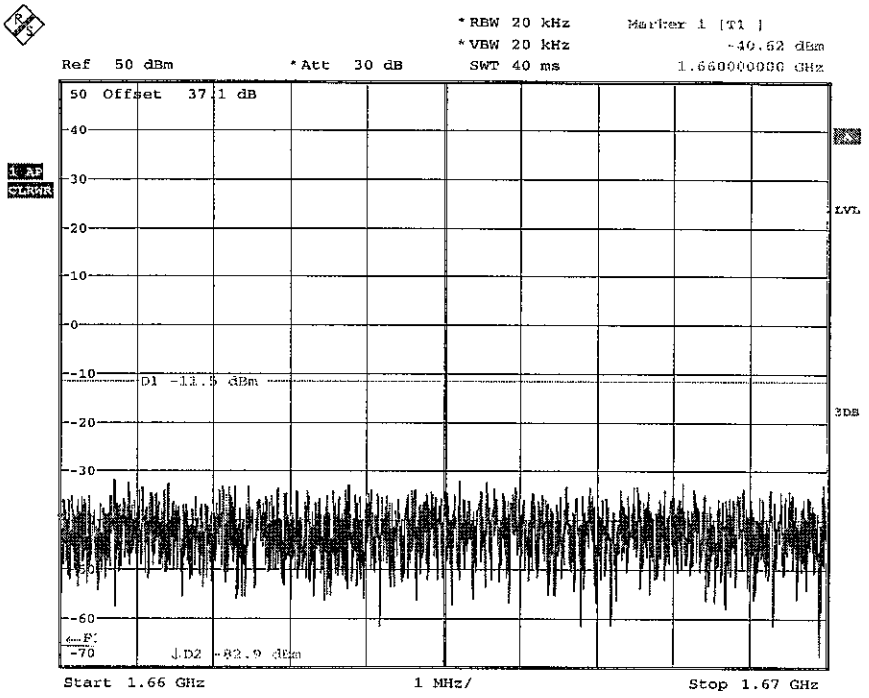
Date: 18.AUG.2008 14:07:44

5.3.13 1626.5 MHz to 1660 MHz



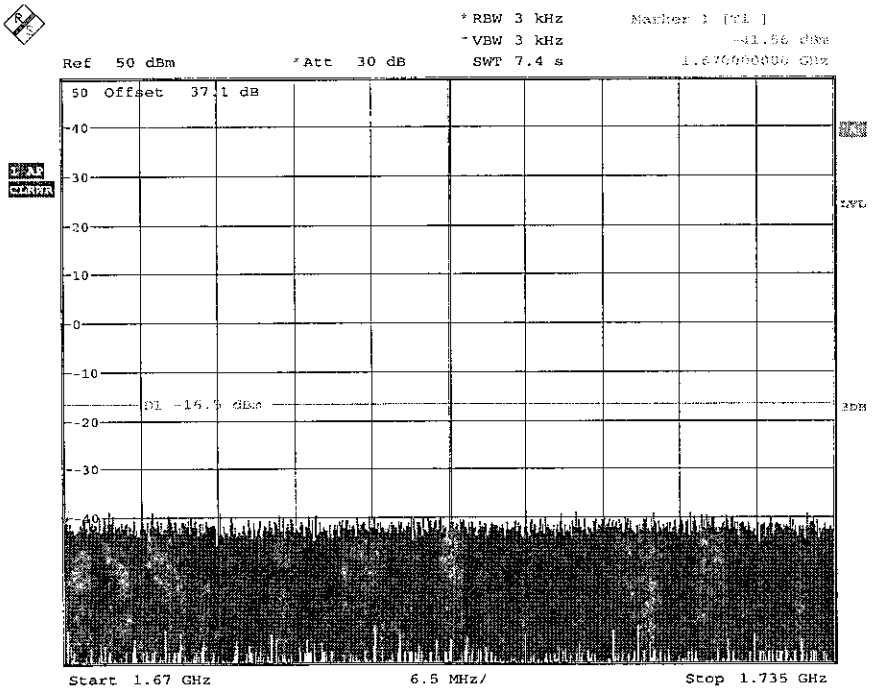
Date: 18.AUG.2008 14:08:46

5.3.14 1660 MHz to 1670 MHz



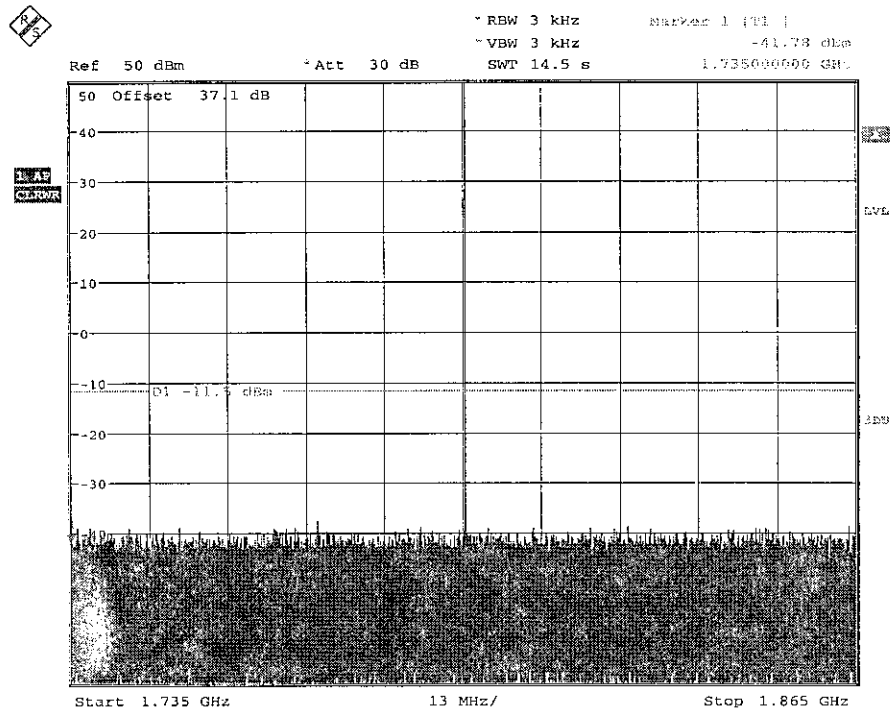
Date: 18.AUG.2008 14:10:03

5.3.15 1670 MHz to 1735 MHz



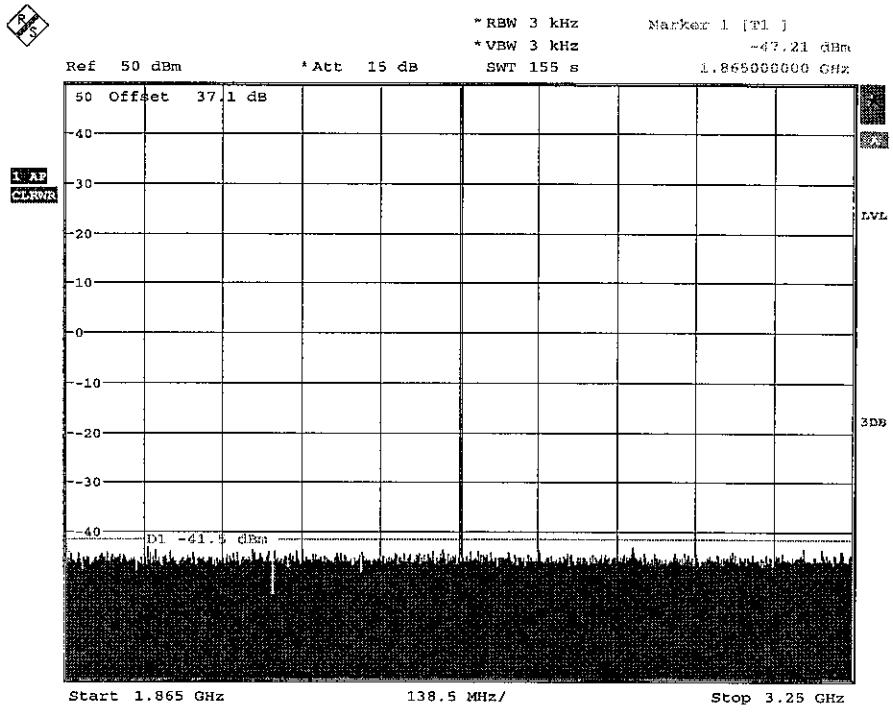
Date: 18.AUG.2008 14:11:22

5.3.16 1735 MHz to 1865 MHz



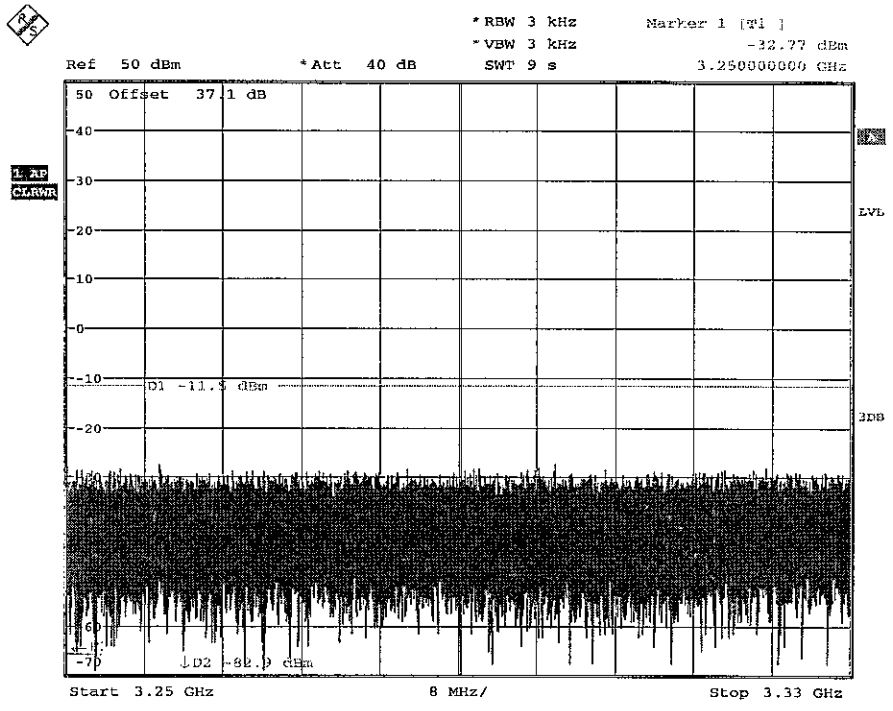
Date: 18.AUG.2008 14:12:32

5.3.17 1865 MHz to 3250 MHz



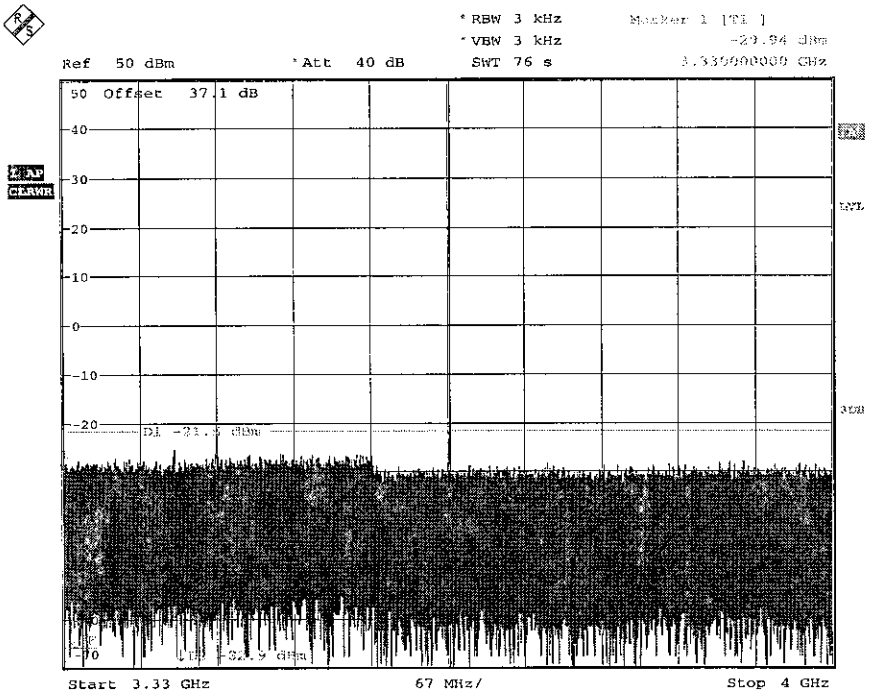
Date: 18.AUG.2008 14:16:43

5.3.18 3250 MHz to 3330 MHz



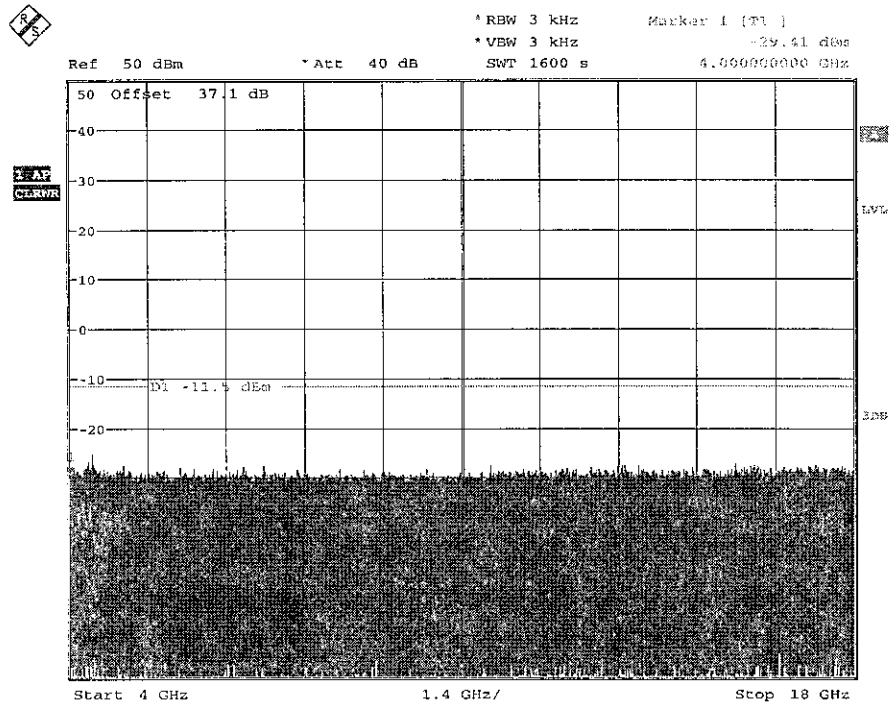
Date: 18.AUG.2008 14:18:06

5.3.19 3330 MHz to 4000 MHz



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

5.3.20 4 GHz to 18 GHz



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

5.4 Radiated Emissions

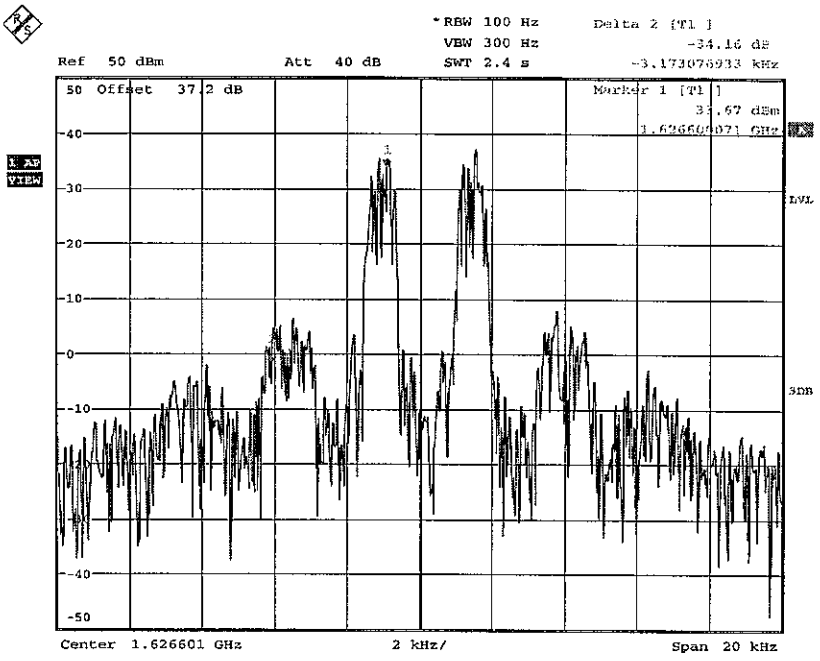
5.4.1 See Test House Test Report (ref. 1.4.4) sections 2.1 and 2.2.

5.5 Intermods

5.5.1 Intermodulation Products – Classic with FMHPA

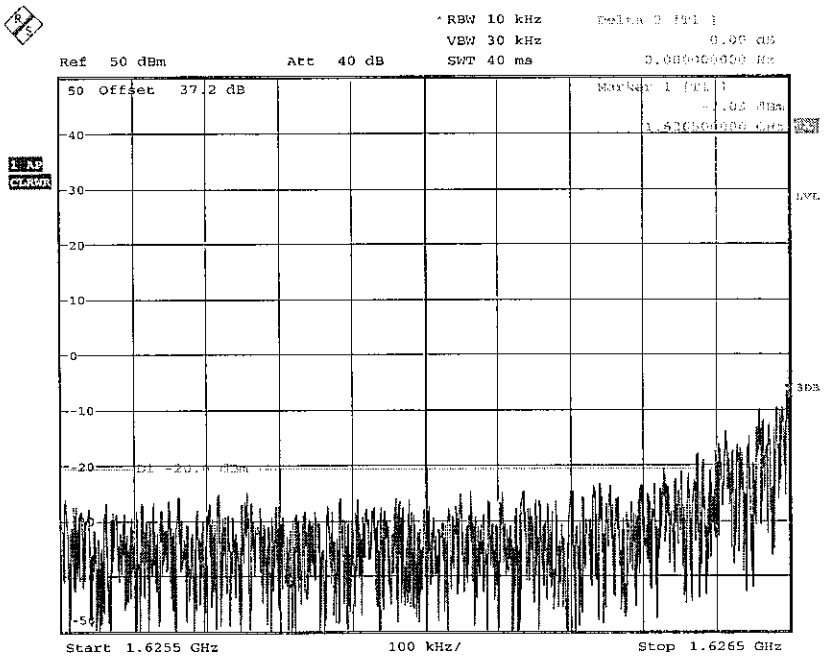
5.5.1.1 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1625.5MHz to 1660MHz with a combined signal level of the two modulated QPSK (600bps) carriers of 35 W. Both carriers are produced at close to the lower edge of the transmit band with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

5.5.1.1.1 Overview Image



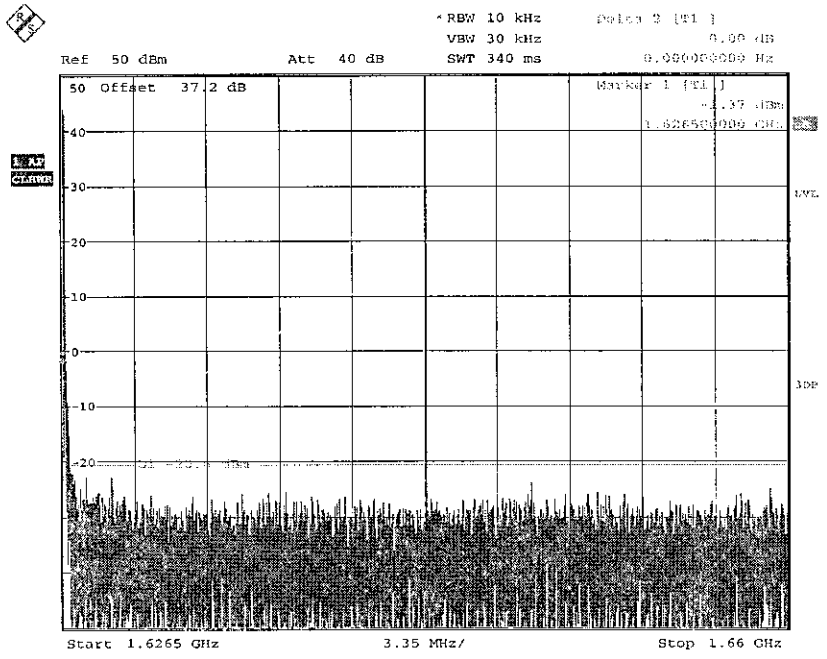
Date: 21.OCT.2008 12:17:42

5.5.1.1.2 1625.5 MHz to 1626.5 MHz



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

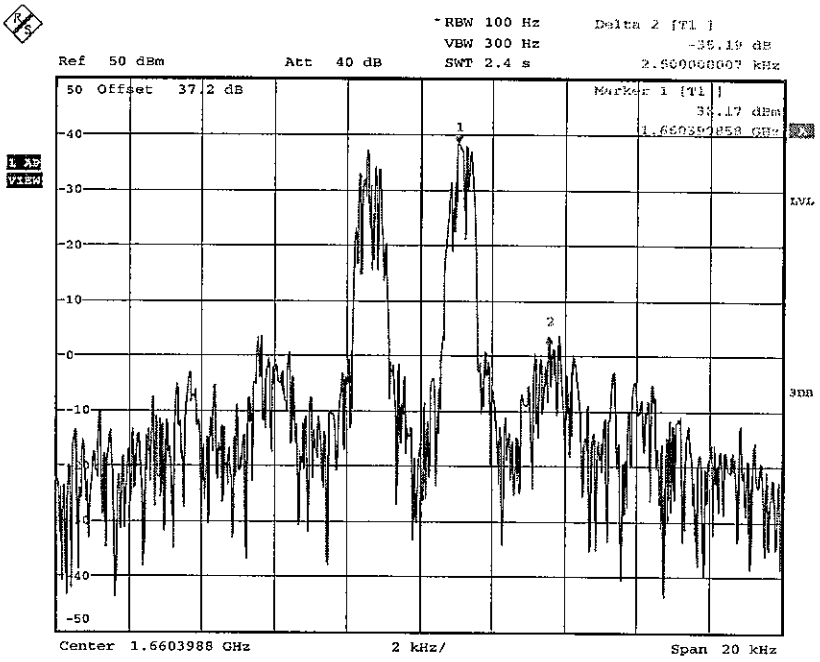
5.5.1.1.3 1626.5 MHz to 1660 MHz



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

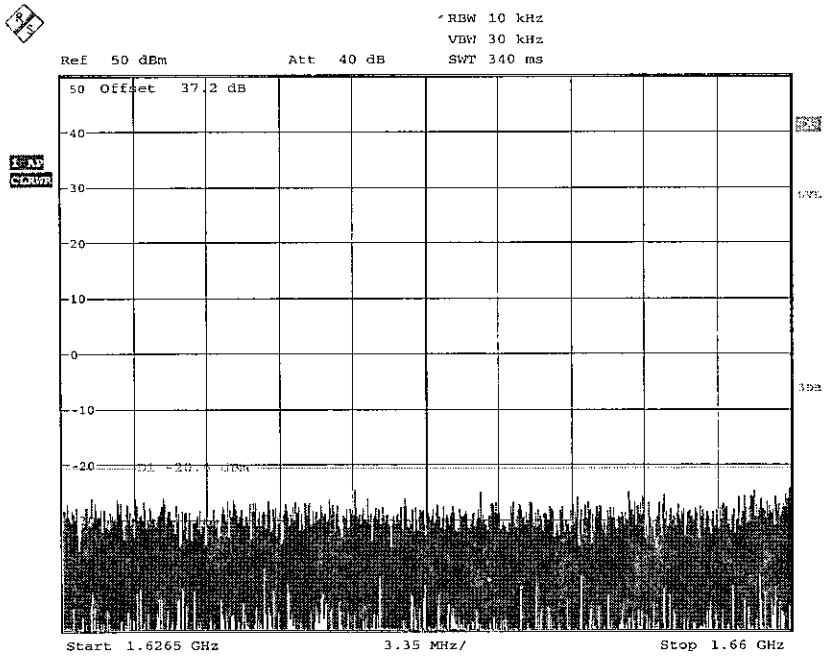
5.5.1.2 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1626.5MHz to 1670MHz with a combined signal level of the two modulated QPSK (600bps) carriers of 35W. Both carriers are produced at close to the upper edge of the transmit band with 2.5KHz spacing.

5.5.1.2.1 Overview Image



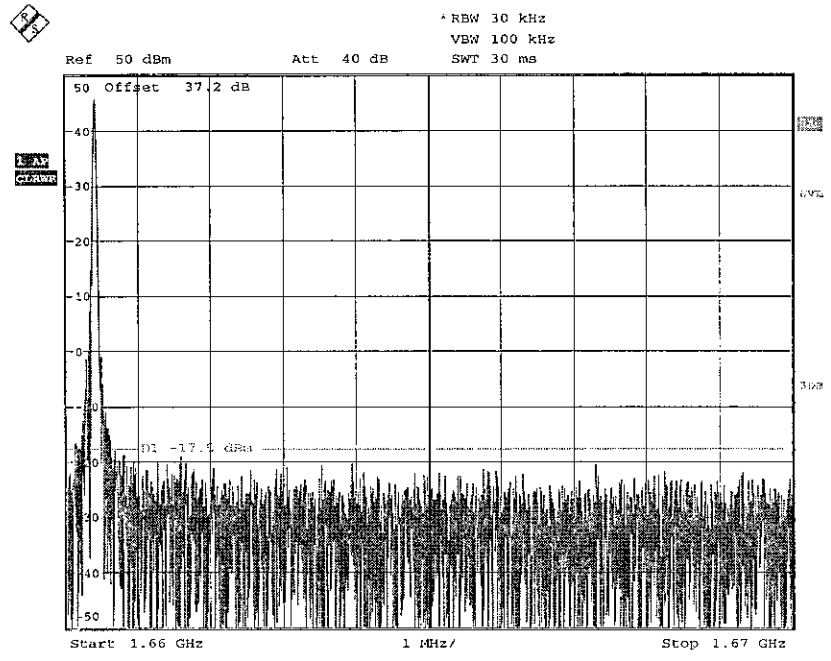
Date: 21.OCT.2008 12:29:55

5.5.1.2.2 1626.5 MHz to 1660 MHz



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

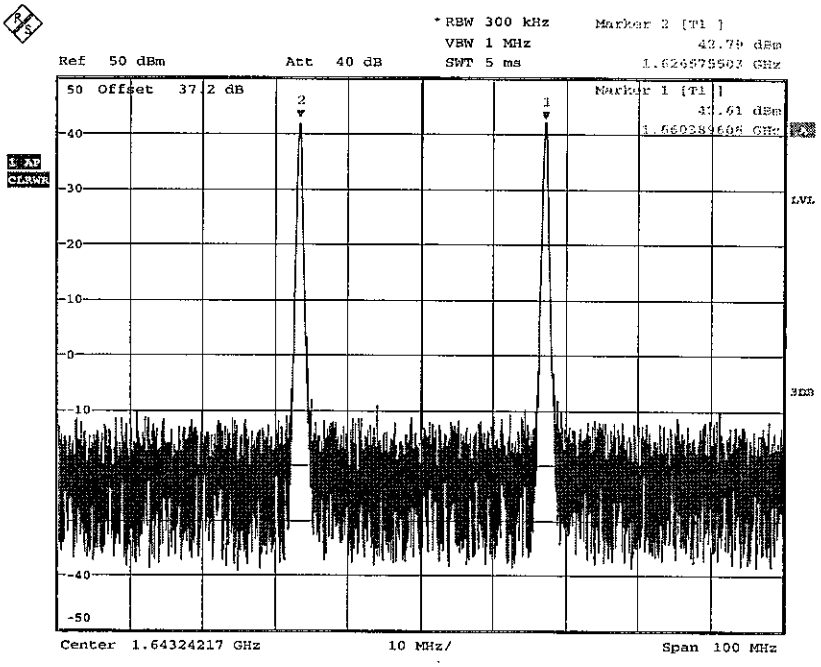
5.5.1.2.3 1660 MHz to 1670 MHz



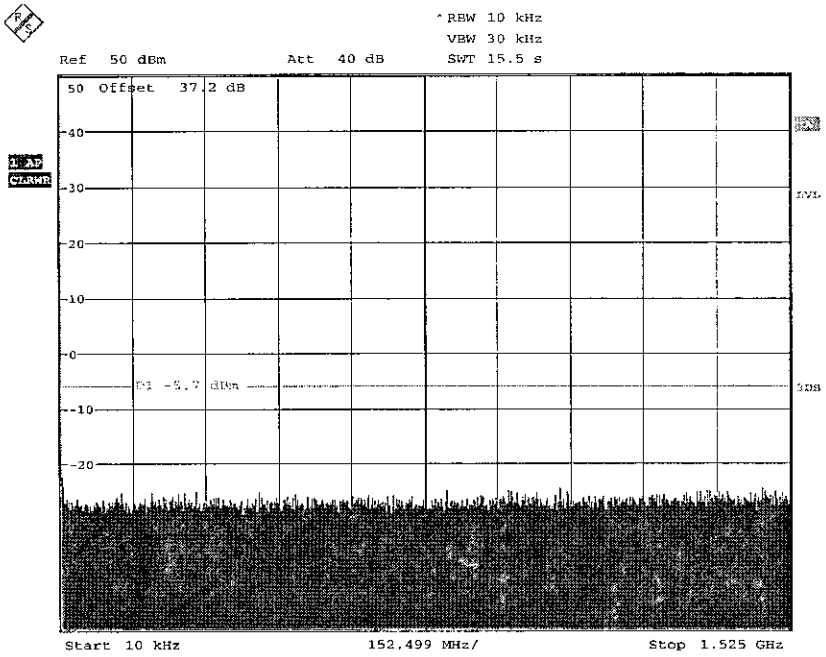
Date: 21.OCT.2008 12:32:27

5.5.1.3 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.

5.5.1.3.1 Overview Image

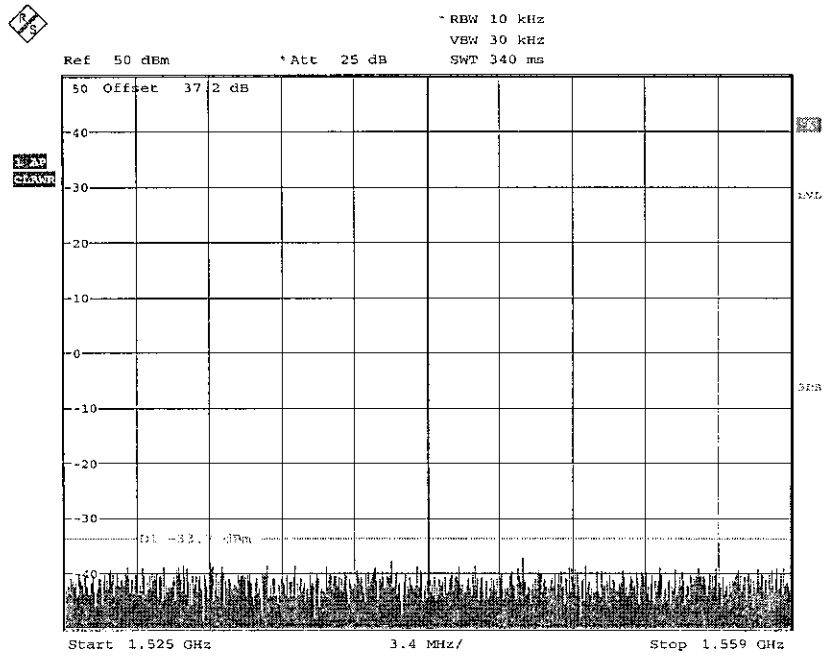


5.5.1.3.2 10 KHz to 1525 MHz



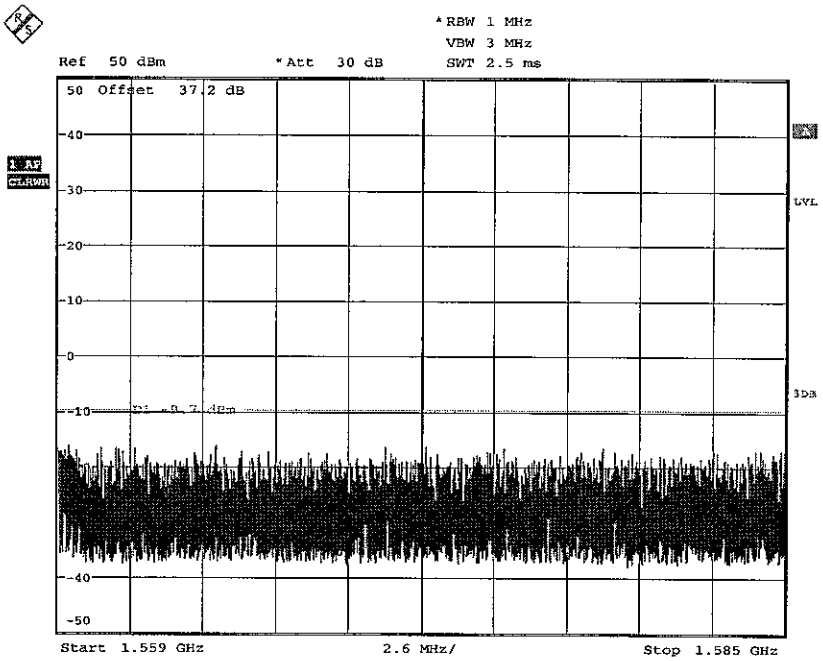
Date: 21.OCT.2008 12:42:27

5.5.1.3.3 1525 MHz to 1559 MHz



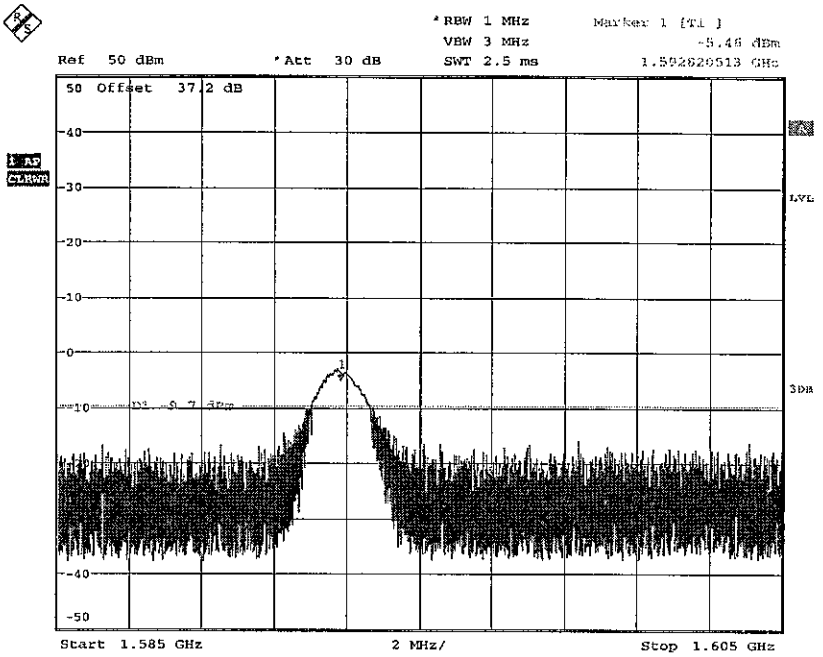
Date: 21.OCT.2008 12:45:55

5.5.1.3.4 1559 MHz to 1585 MHz



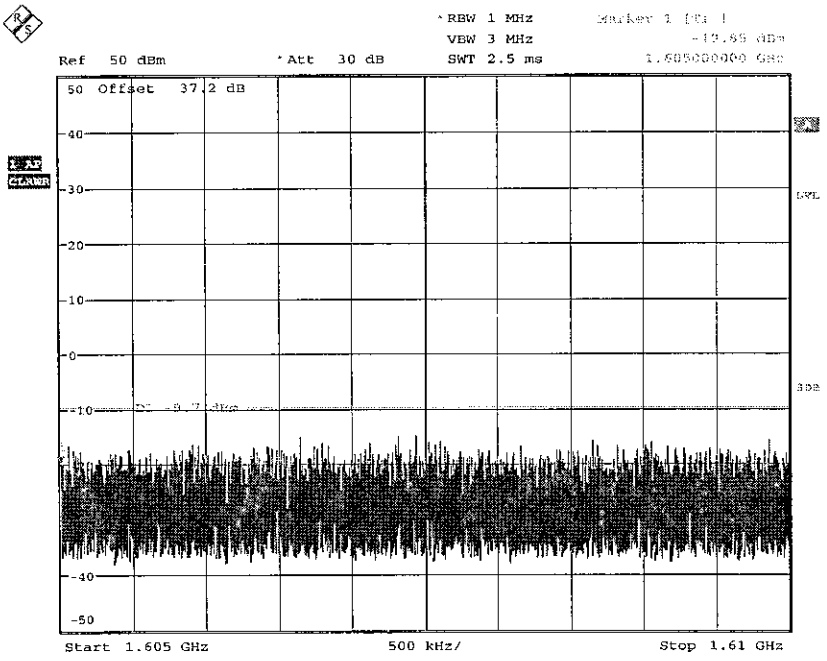
Date: 21.OCT.2008 12:48:52

5.5.1.3.5 1585 MHz to 1605 MHz



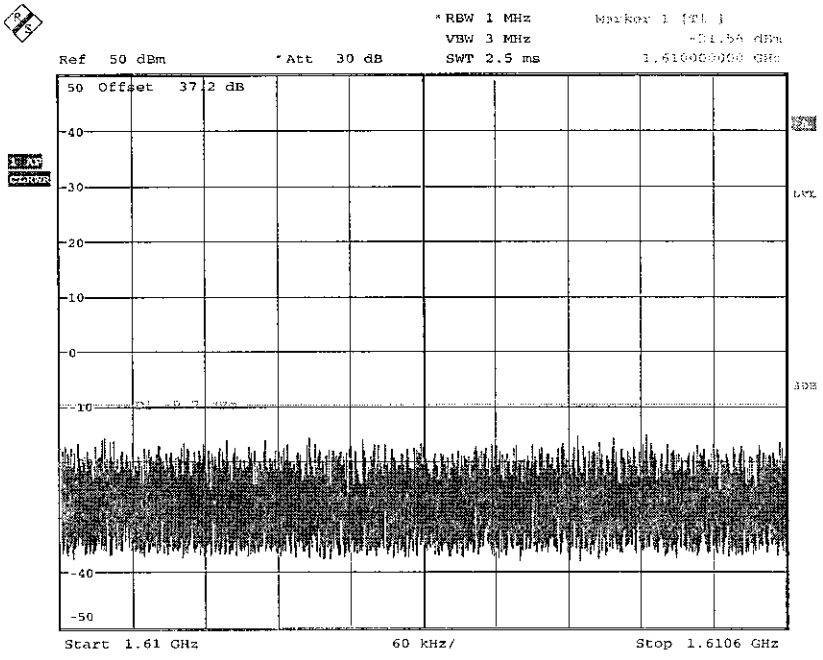
Date: 21.OCT.2008 12:49:43

5.5.1.3.6 1605 MHz to 1610 MHz



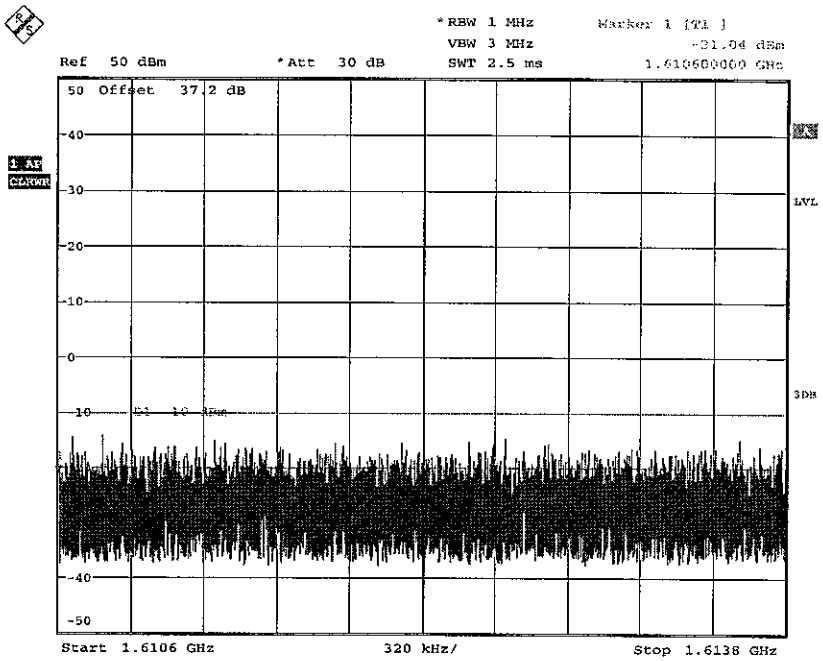
Date: 21.OCT.2008 12:50:40

5.5.1.3.7 1610 MHz to 1610.6 MHz



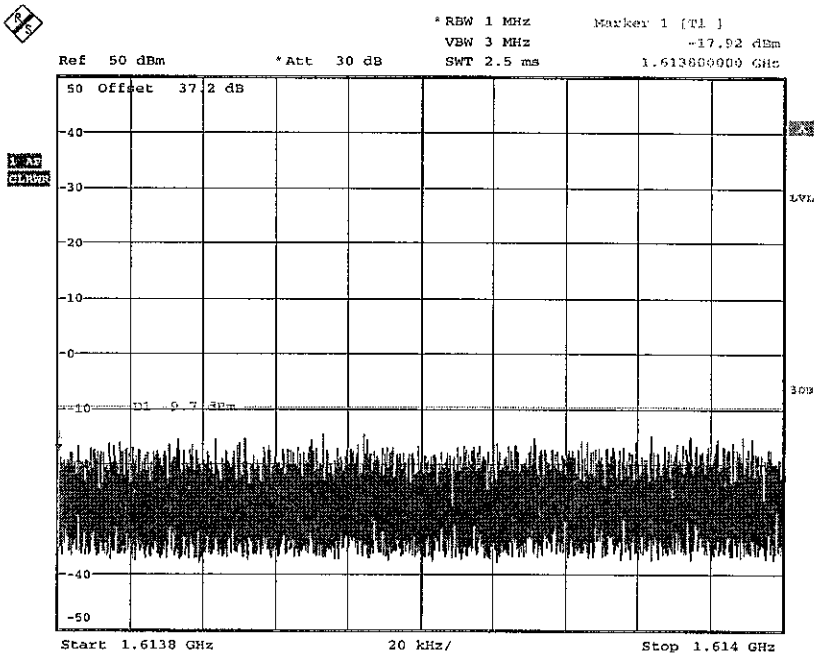
Date: 21.OCT.2008 12:51:18

5.5.1.3.8 1610.6 MHz to 1613.8 MHz



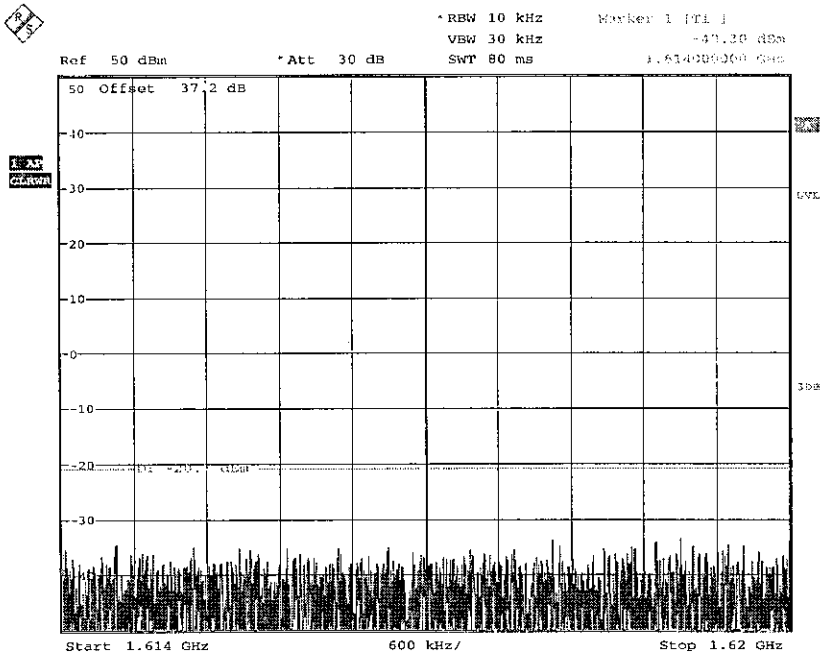
Date: 21.OCT.2008 12:52:29

5.5.1.3.9 1613.8 MHz to 1614 MHz



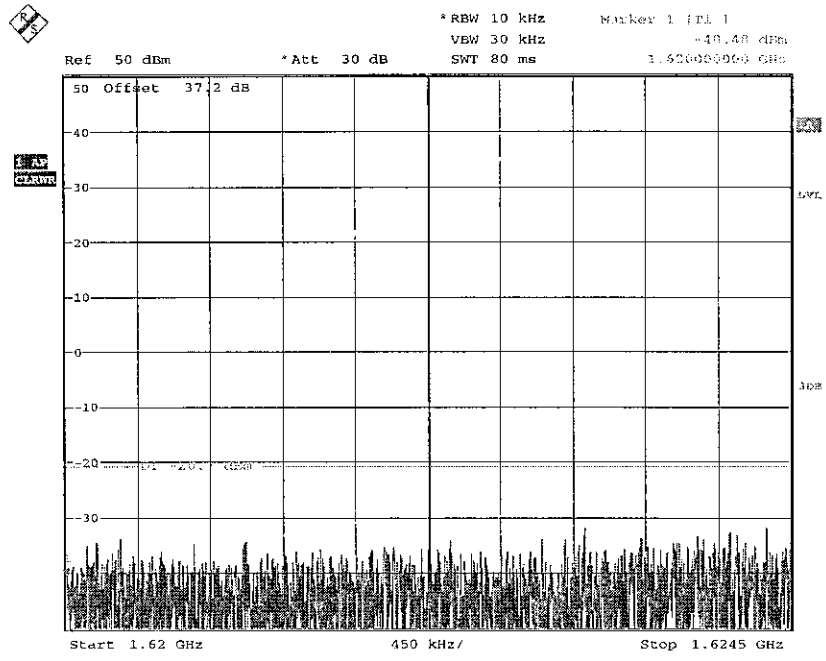
Date: 21.OCT.2008 12:53:45

5.5.1.3.10 1614 MHz to 1620 MHz



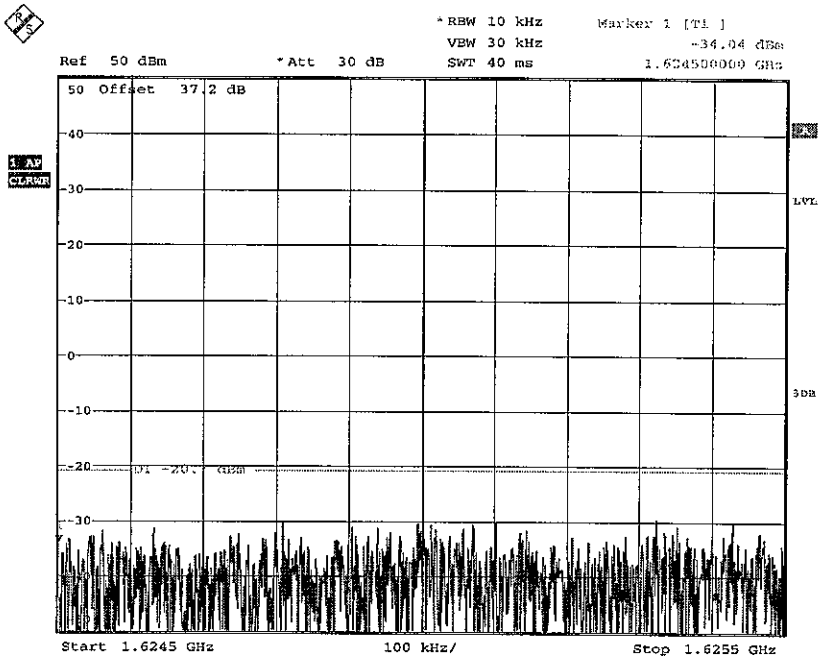
Date: 21.OCT.2008 12:55:18

5.5.1.3.11 1620 MHz to 1624.5 MHz



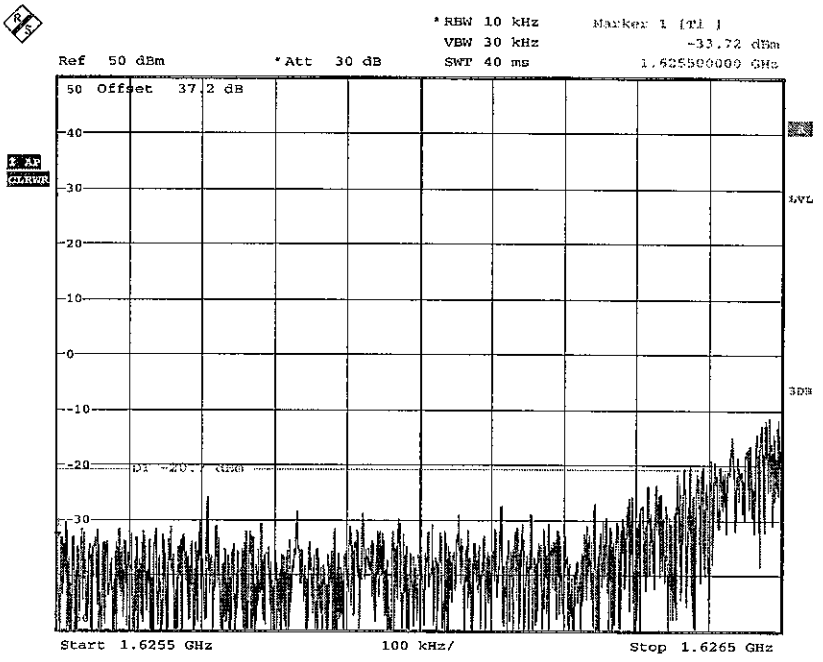
Date: 21.OCT.2008 12:56:14

5.5.1.3.12 1624.5 MHz to 1625.5 MHz



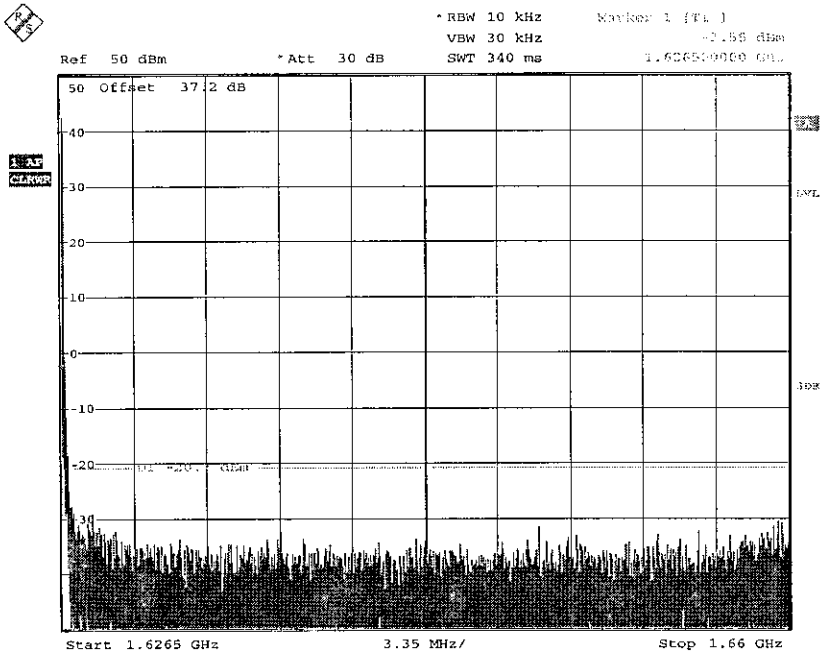
Date: 21.OCT.2008 12:58:13

5.5.1.3.13 1625.5 MHz to 1626.5 MHz



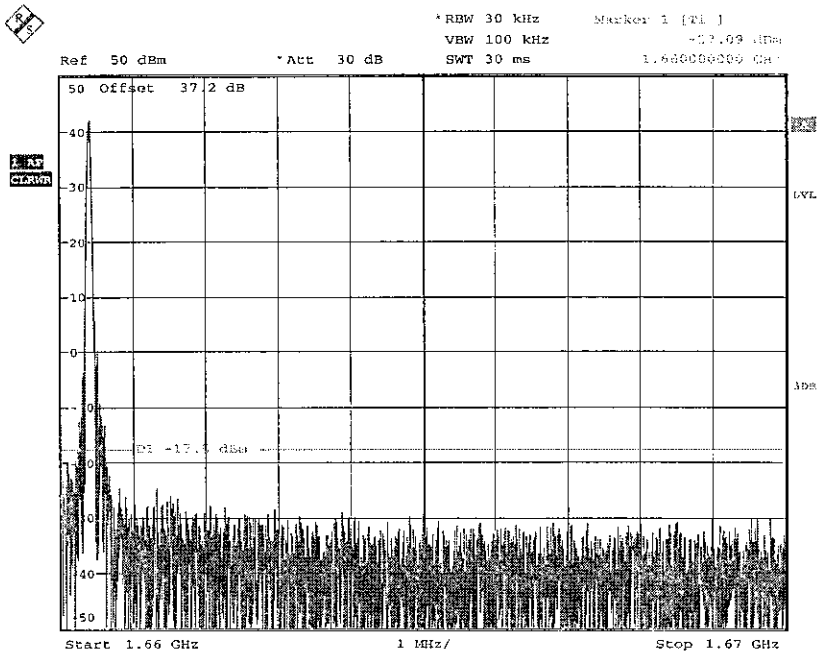
Date: 21.OCT.2008 12:58:38

5.5.1.3.14 1626.5 MHz to 1660 MHz



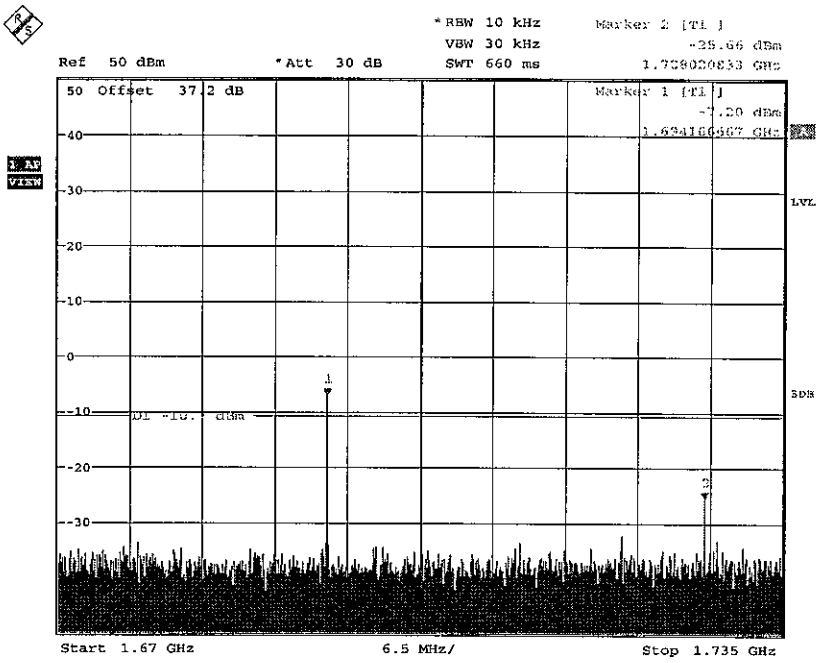
Date: 21.OCT.2008 12:59:20

5.5.1.3.15 1660 MHz to 1670 MHz



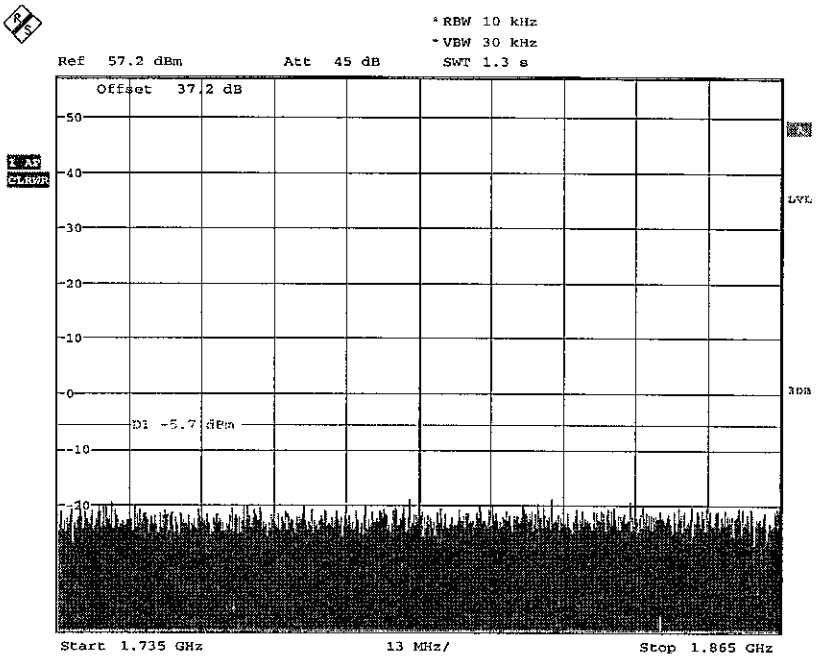
Date: 21.OCT.2008 13:00:58

5.5.1.3.16 1670 MHz to 1735 MHz



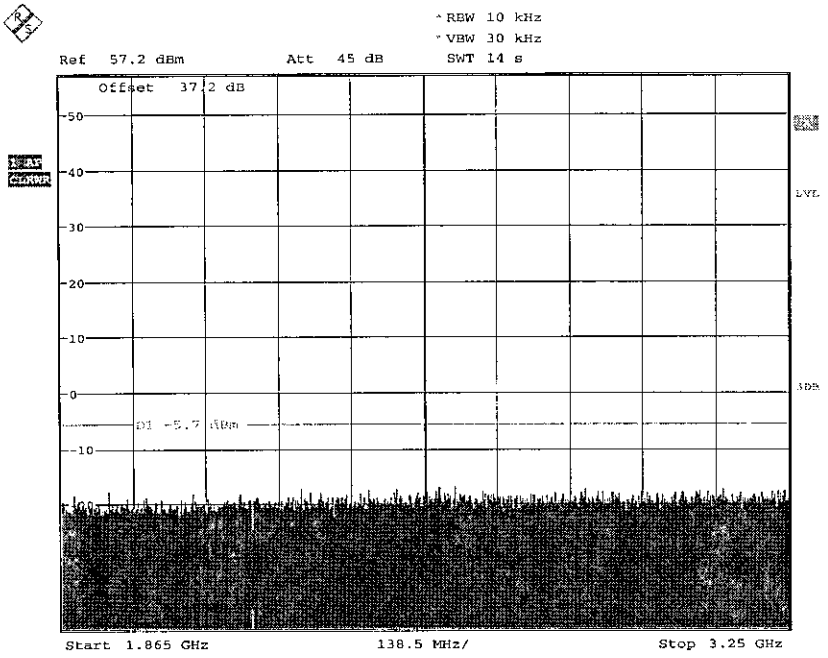
Date: 21.OCT.2008 13:02:52

5.5.1.3.17 1735 MHz to 1865 MHz



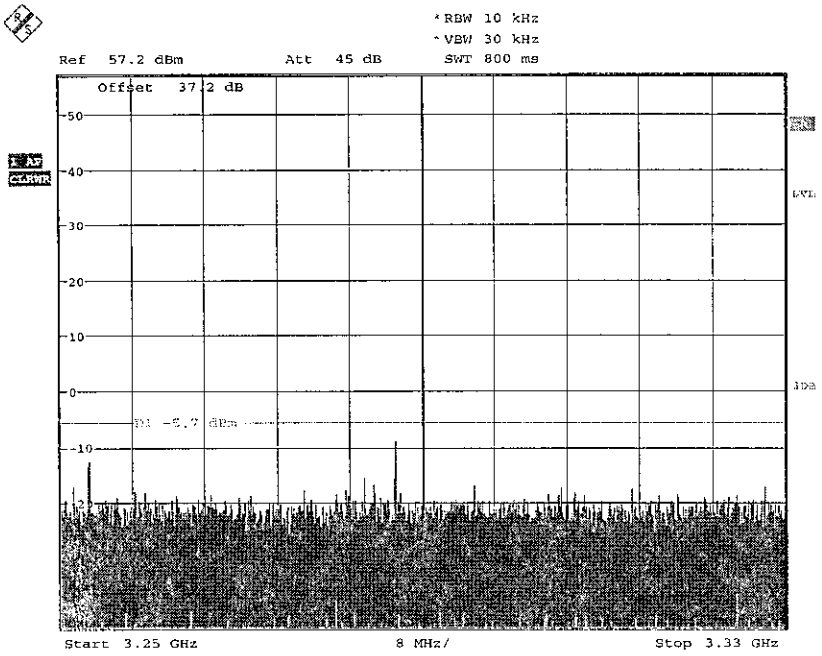
Date: 21.OCT.2008 13:55:35

5.5.1.3.18 1865 MHz to 3250 MHz



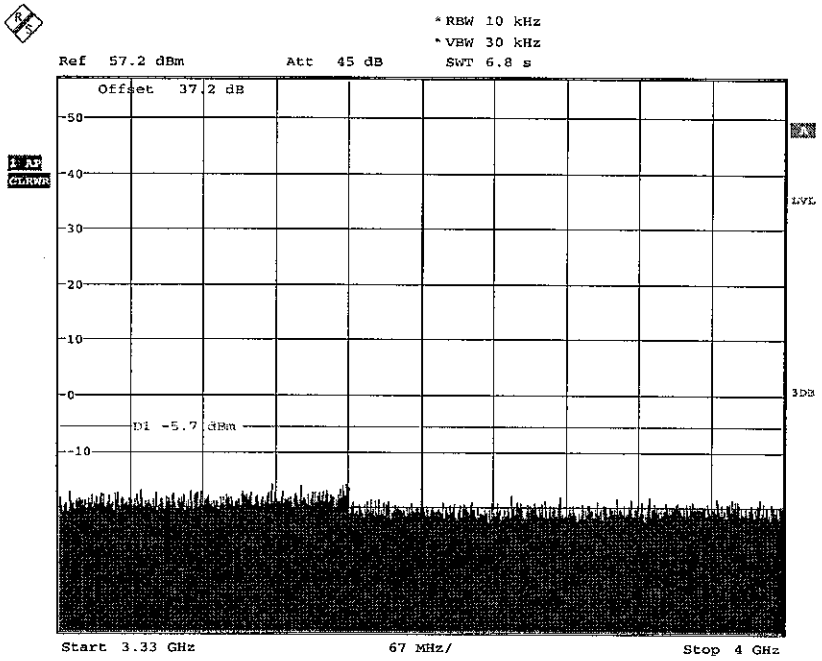
Date: 21.OCT.2008 13:57:22

5.5.1.3.19 3250 MHz to 3330 MHz



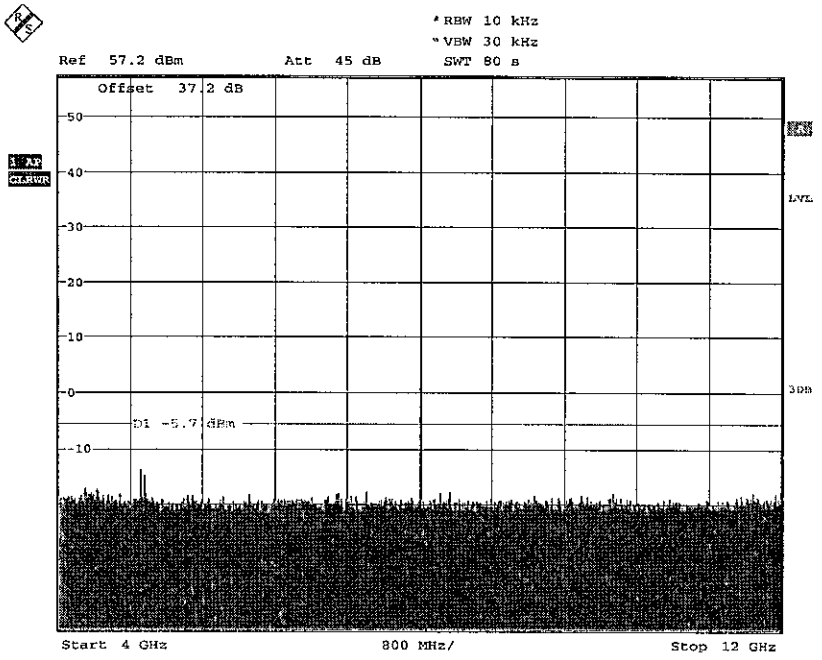
Date: 21.OCT.2008 13:56:47

5.5.1.3.20 3330 MHz to 4000 MHz



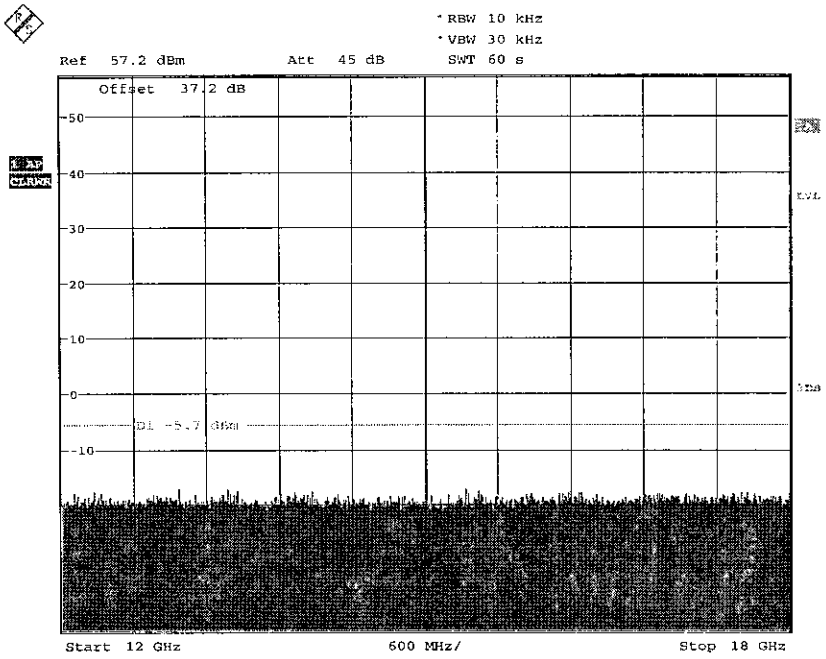
Date: 21.OCT.2008 13:57:44

5.5.1.3.21 4 GHz to 12 GHz



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

5.5.1.3.22 12 GHz to 18 GHz

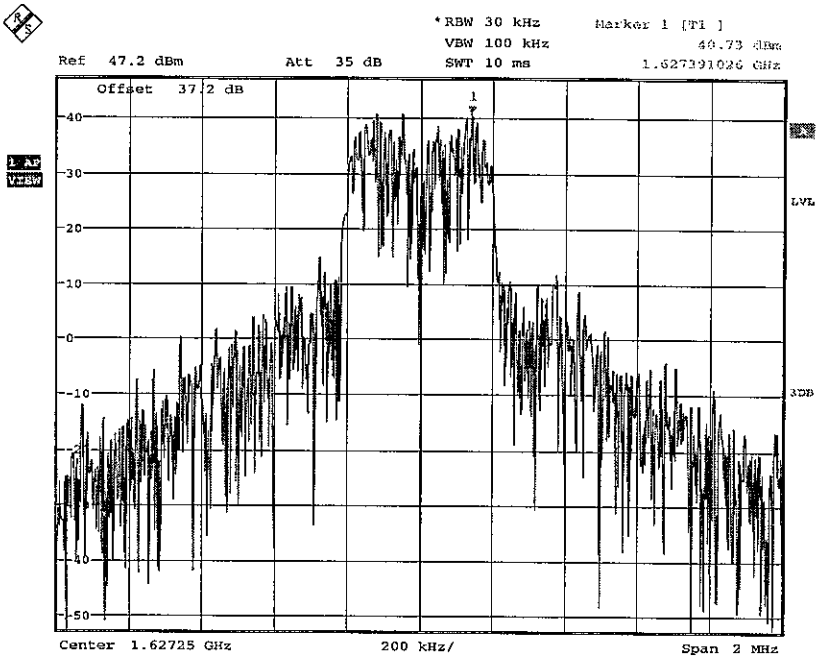


Date: 21.OCT.2008 14:01:16

5.5.2 Intermodulation Products – Class 6 (SBB) with FMHPA

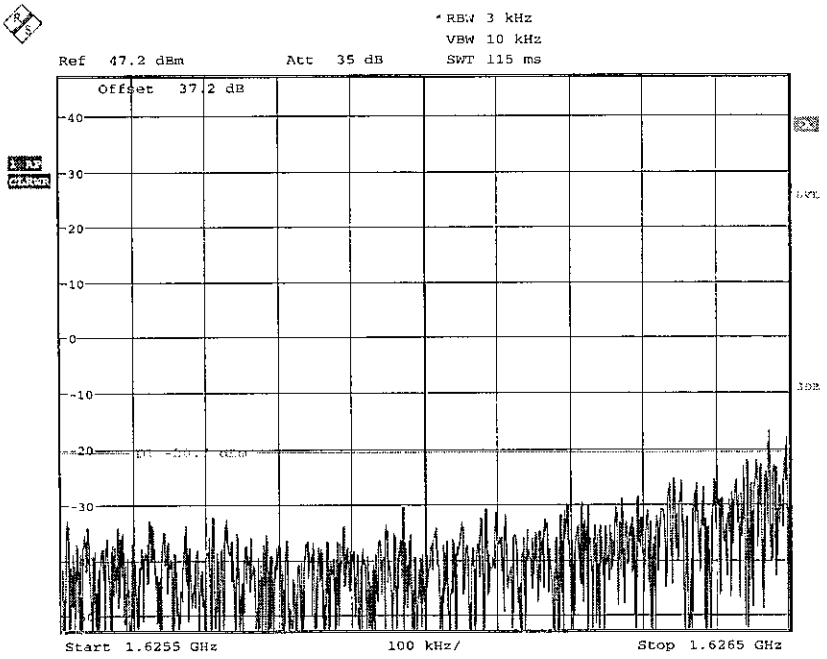
5.5.2.1 Measurements of Intermodulation Products are provided below, in screen plots covering the frequency range from 1625.5MHz to 1660MHz with a combined signal level of the two modulated 16QAM (151.2kbps) carriers of 35 W. Both carriers are produced at close to the lower edge of the transmit band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

5.5.2.1.1 Overview Image



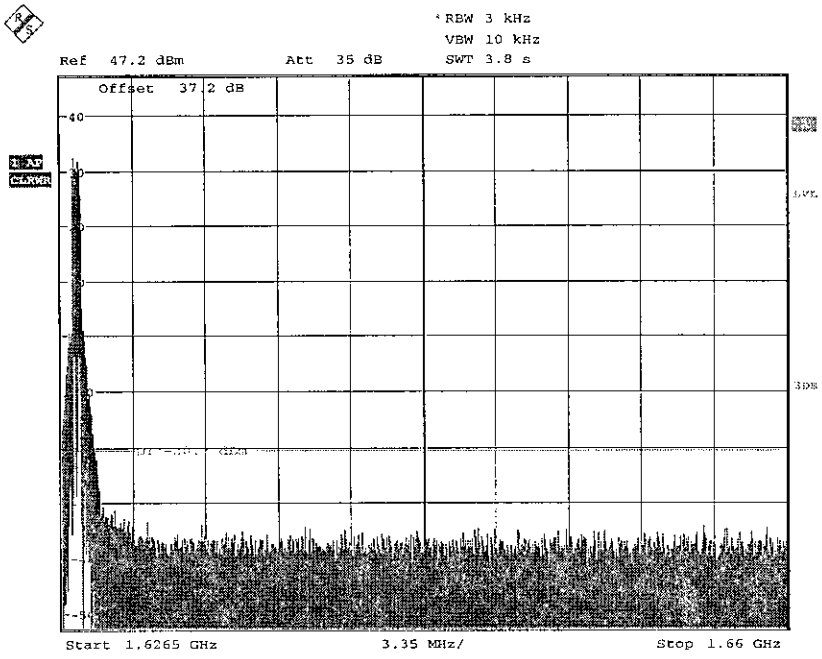
Date: 21.OCT.2008 16:06:38

5.5.2.1.2 1625.5 MHz to 1626.5 MHz



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

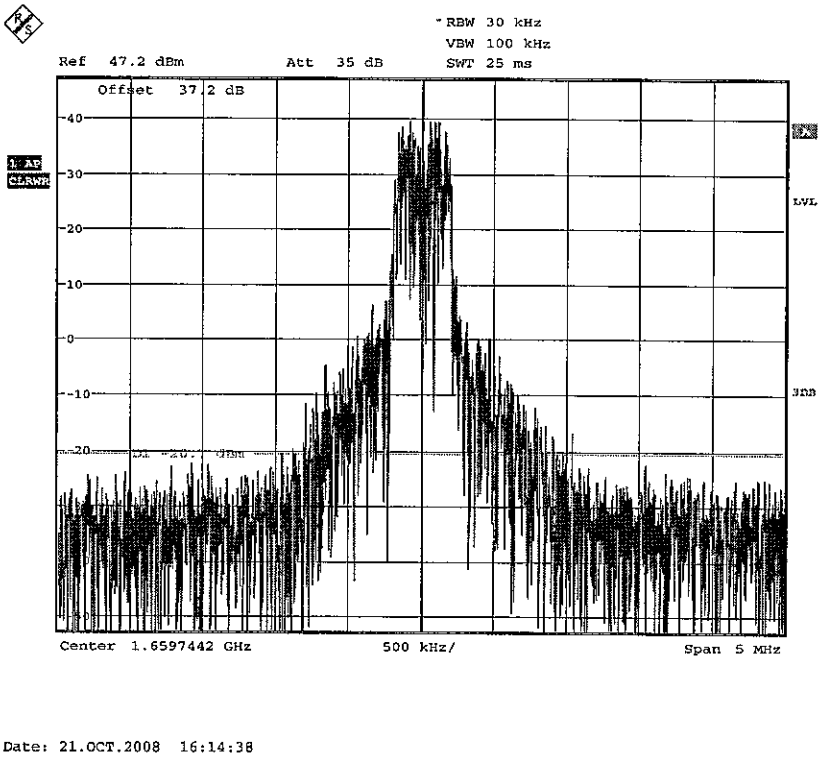
5.5.2.1.3 1626.5 MHz to 1660 MHz



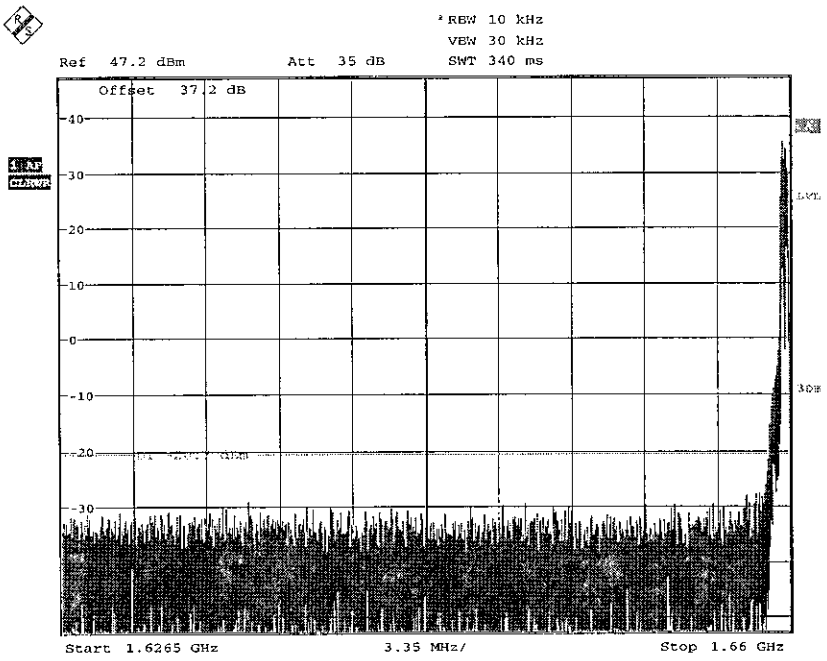
Date: 21.OCT.2008 16:11:41

5.5.2.2 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.

5.5.2.2.1 Overview Image



5.5.2.2.2 1626.5 MHz to 1660 MHz



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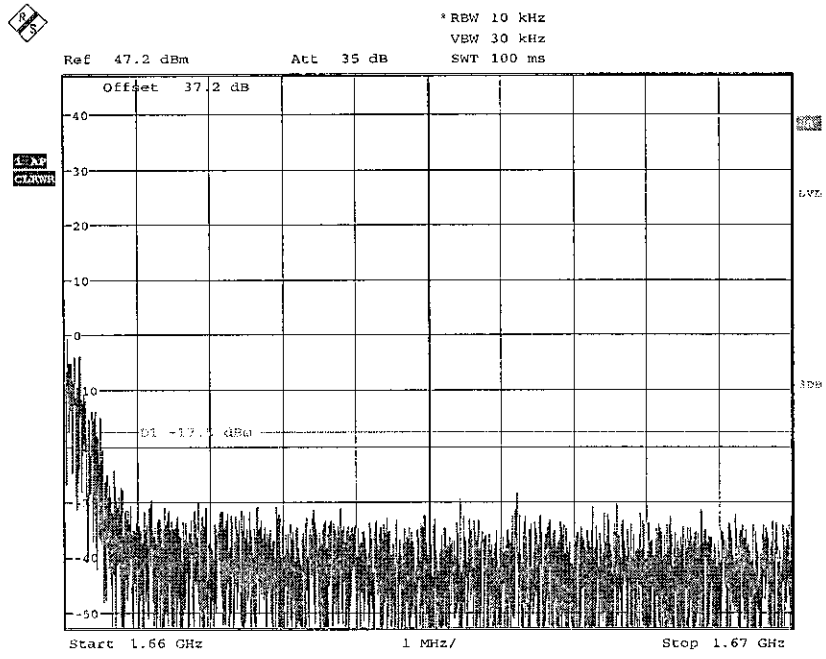
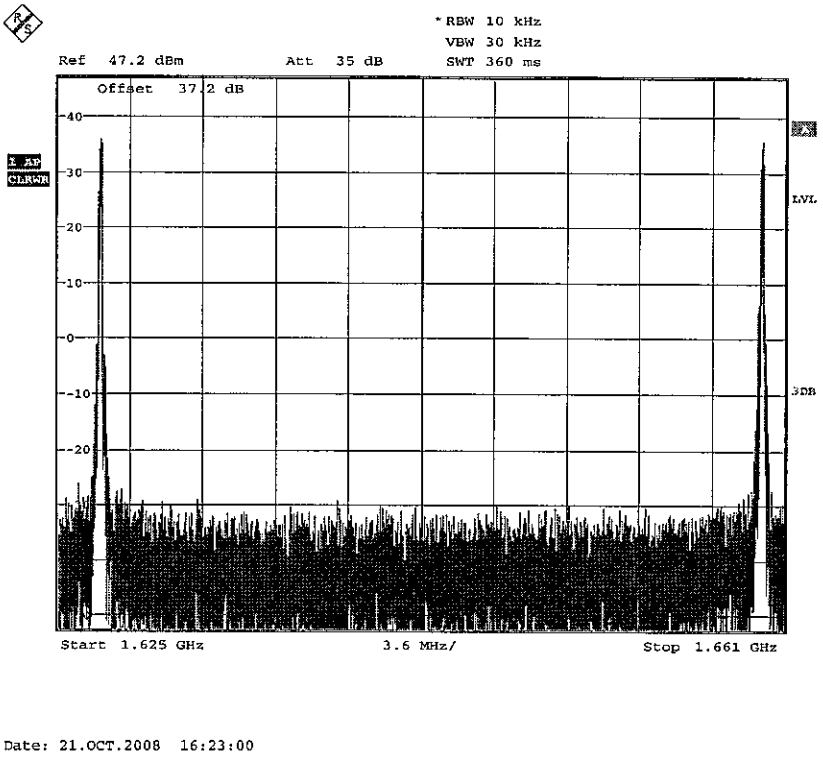
5.5.2.2.3 1660 MHz to 1670 MHz



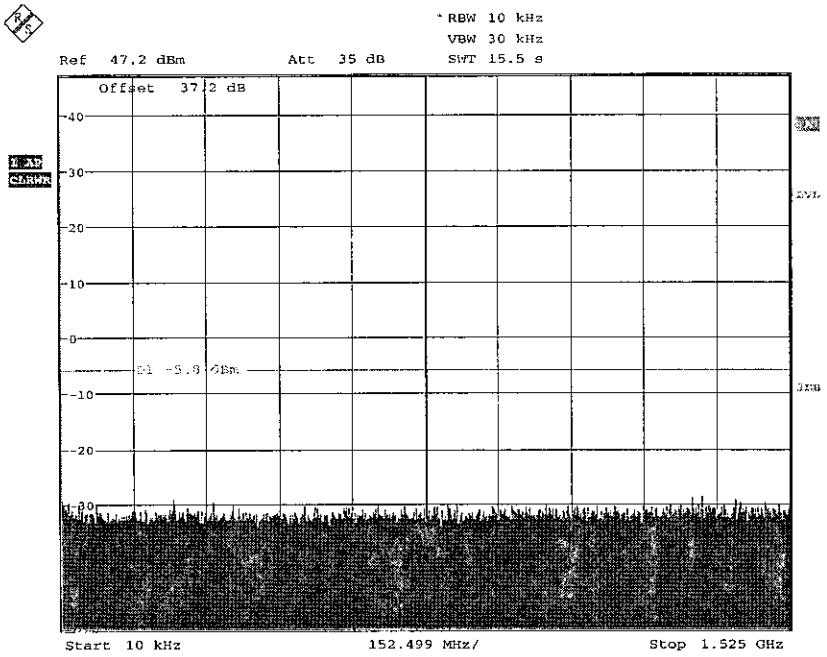
Date: 21.OCT.2008 16:18:00

5.5.2.3 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.

5.5.2.3.1 Overview Image



5.5.2.3.2 10 KHz to 1525 MHz



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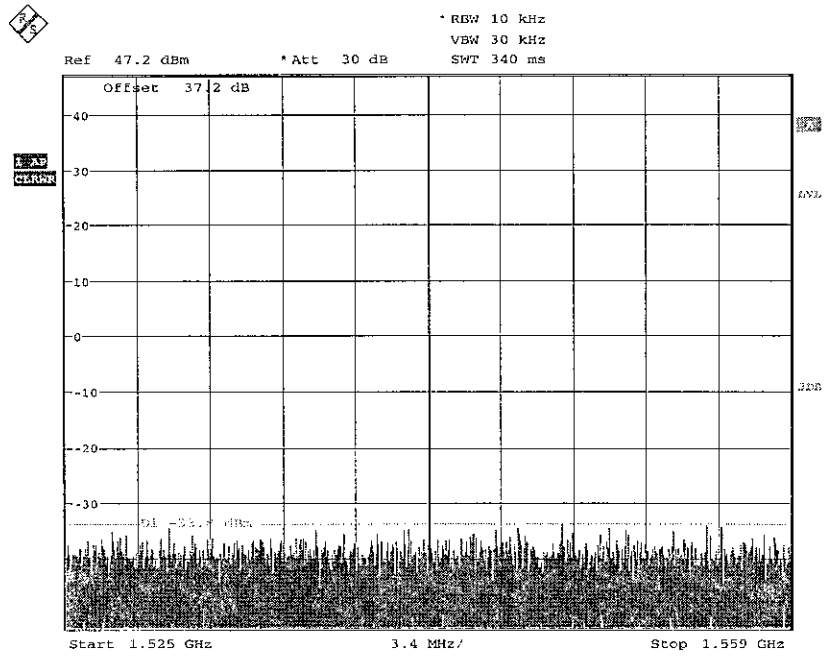
5.5.2.3.3 1525 MHz to 1559 MHz



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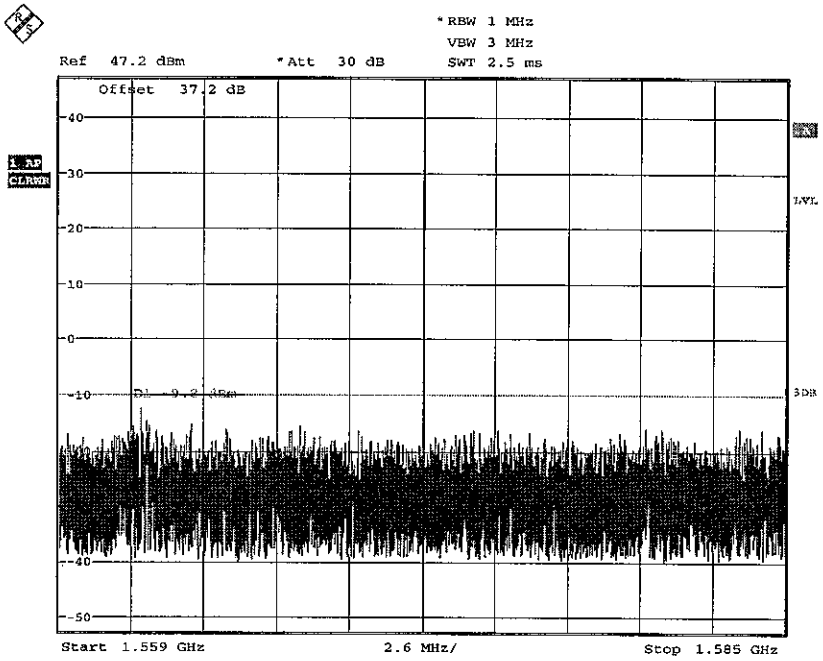
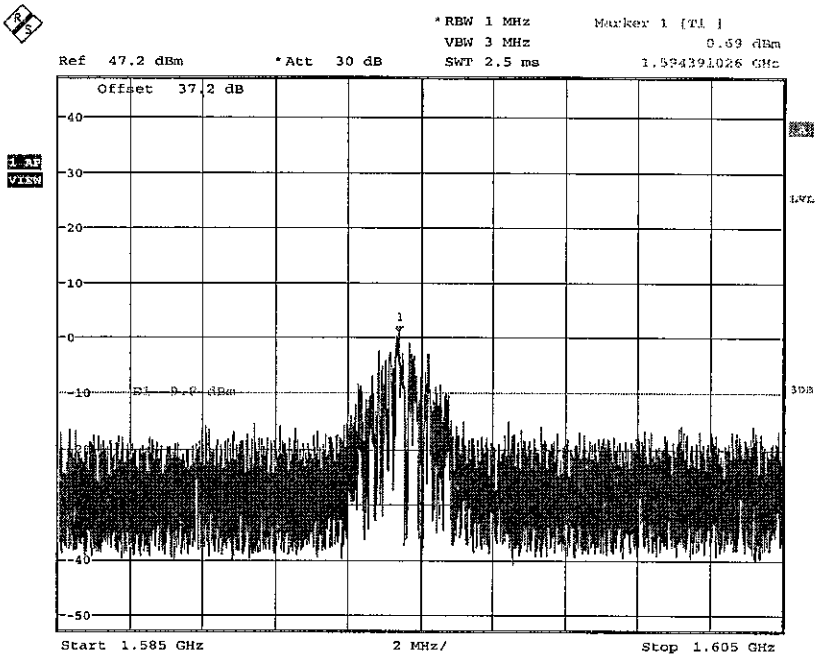
5.5.2.3.4 1559 MHz to 1585 MHz



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

5.5.2.3.5 1585 MHz to 1605 MHz



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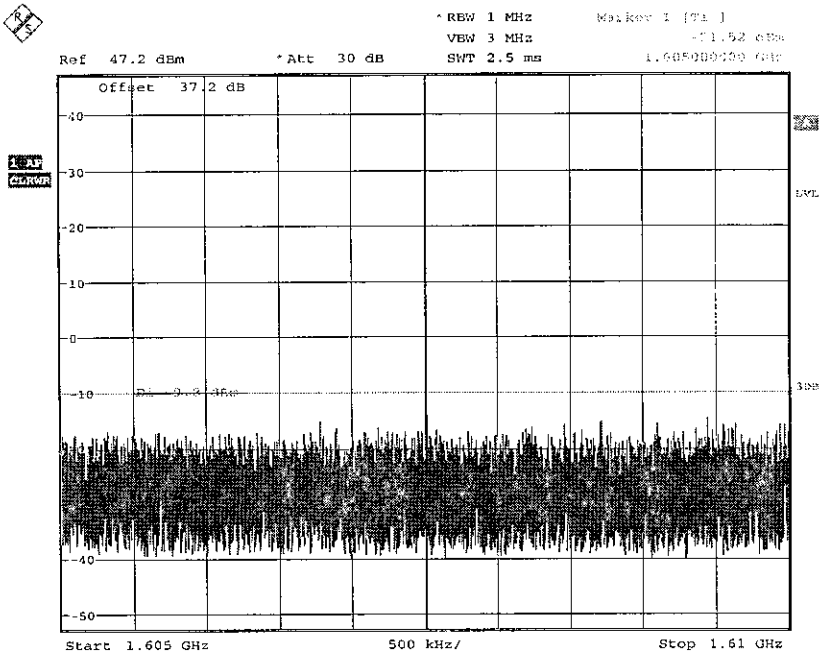
5.5.2.3.6 1605 MHz to 1610 MHz



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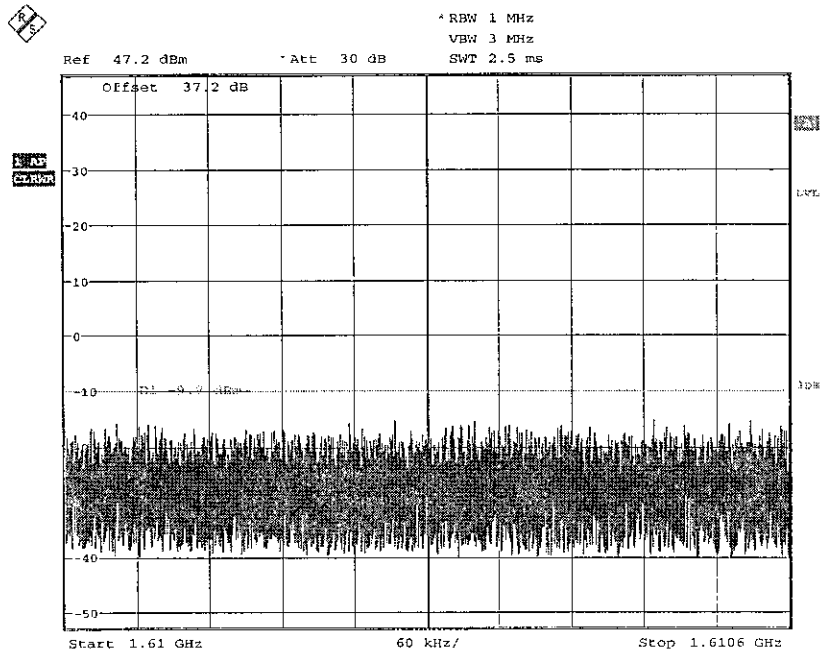
5.5.2.3.7 1610 MHz to 1610.6 MHz



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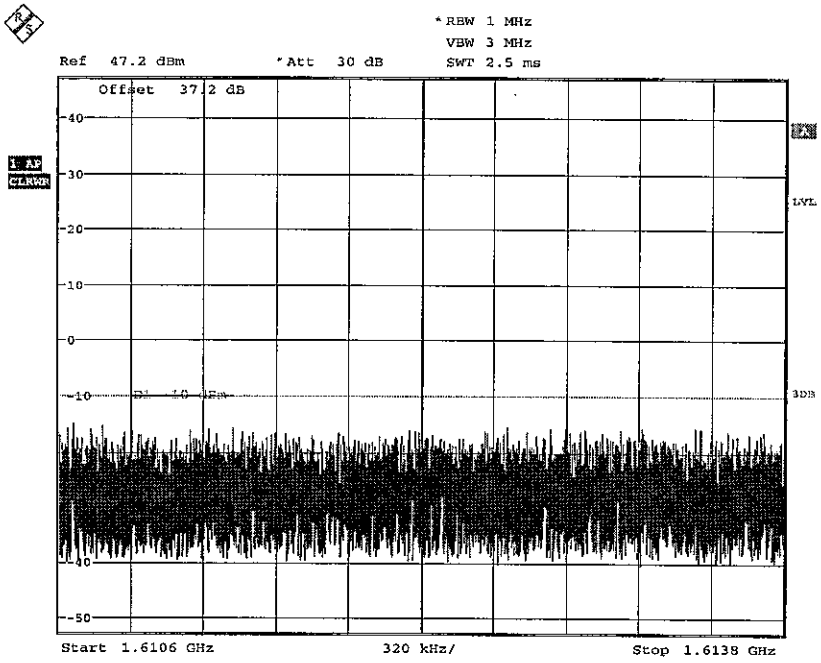
5.5.2.3.8 1610.6 MHz to 1613.8 MHz



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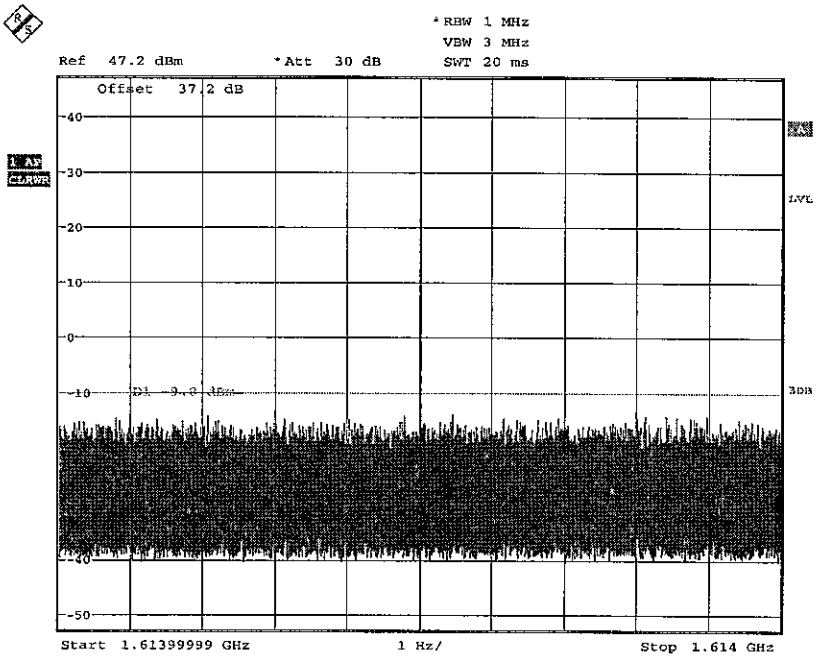
5.5.2.3.9 1613.8 MHz to 1614 MHz



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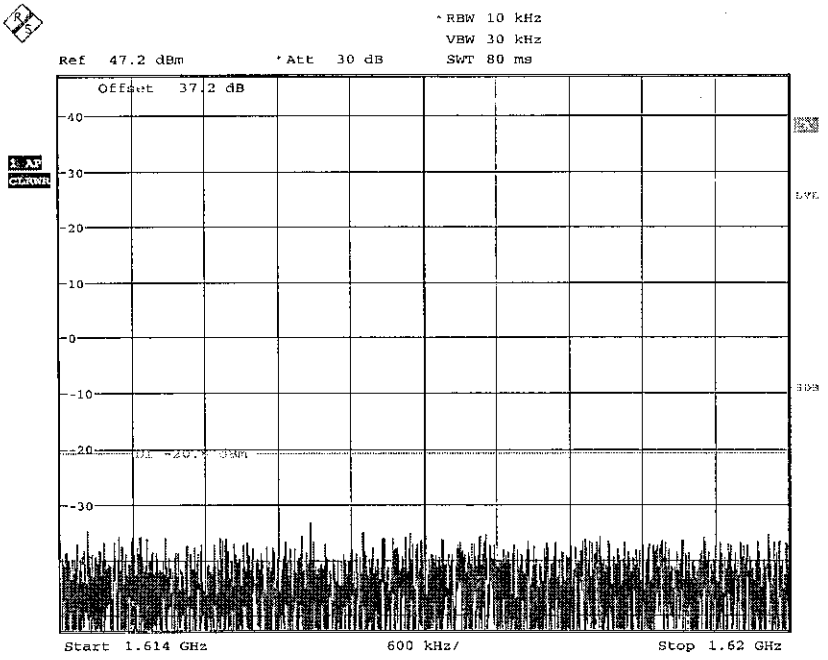
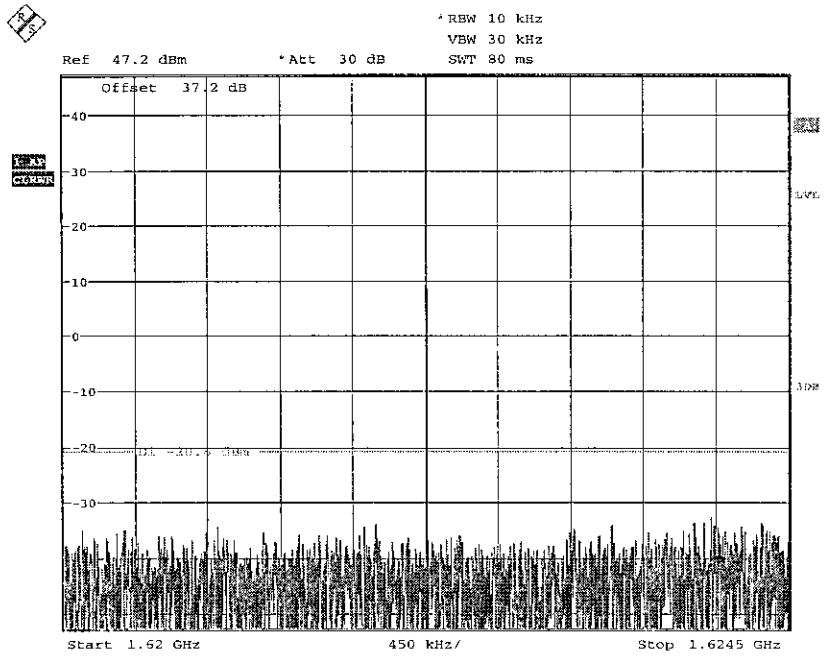
5.5.2.3.10 1614 MHz to 1620 MHz



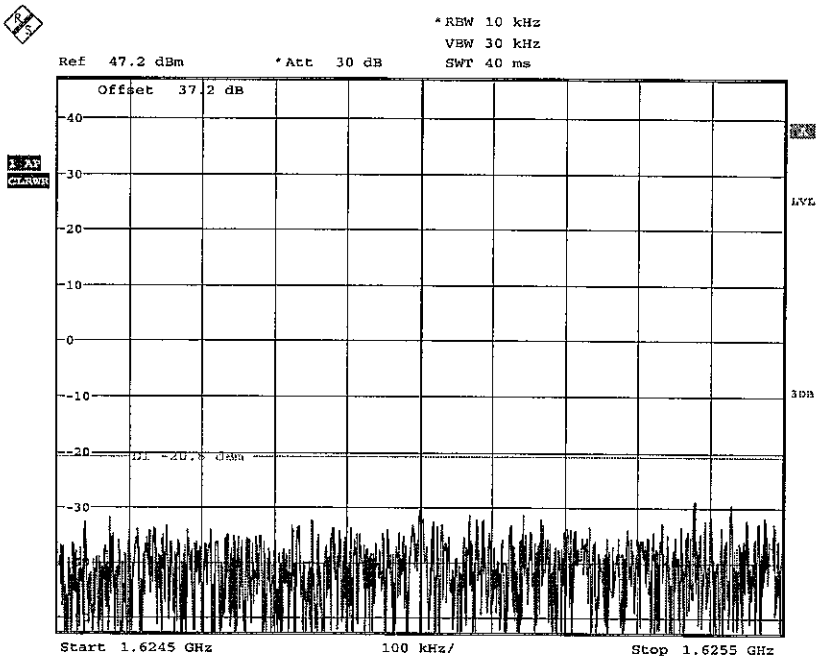
Date: 21.OCT.2008 16:35:46

5.5.2.3.11 1620 MHz to 1624.5 MHz



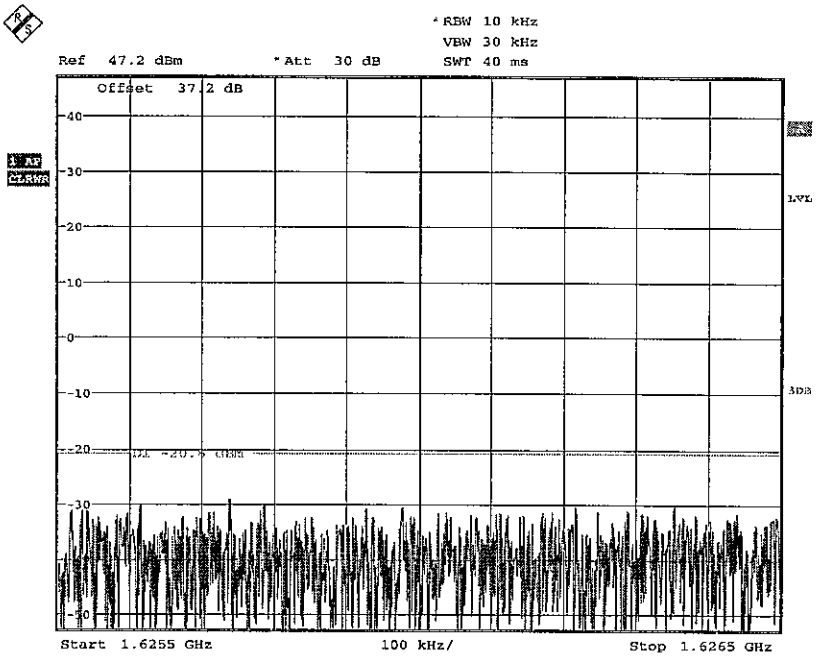
Date: 21.OCT.2008 16:36:27

5.5.2.3.12 1624.5 MHz to 1625.5 MHz



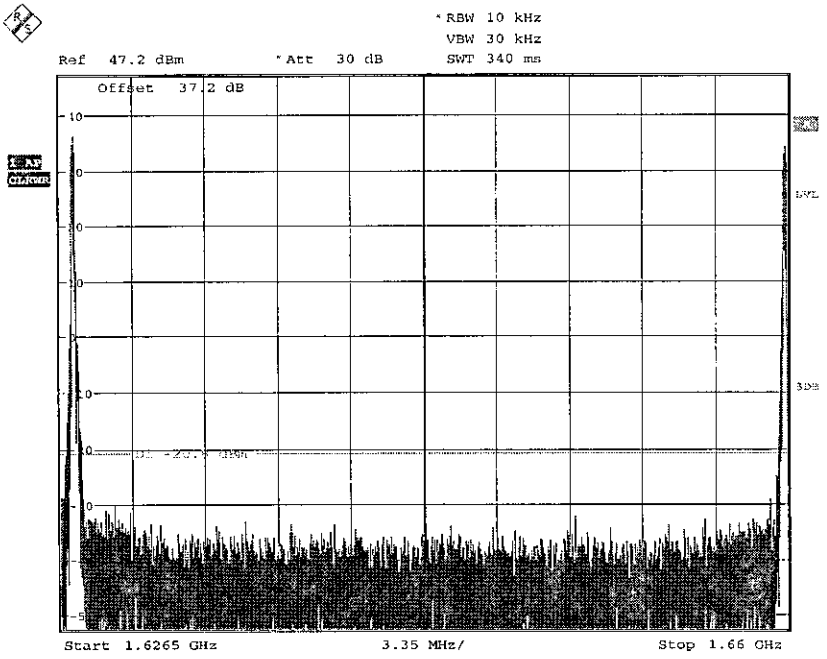
Date: 21.OCT.2008 16:37:11

5.5.2.3.13 1625.5 MHz to 1626.5 MHz



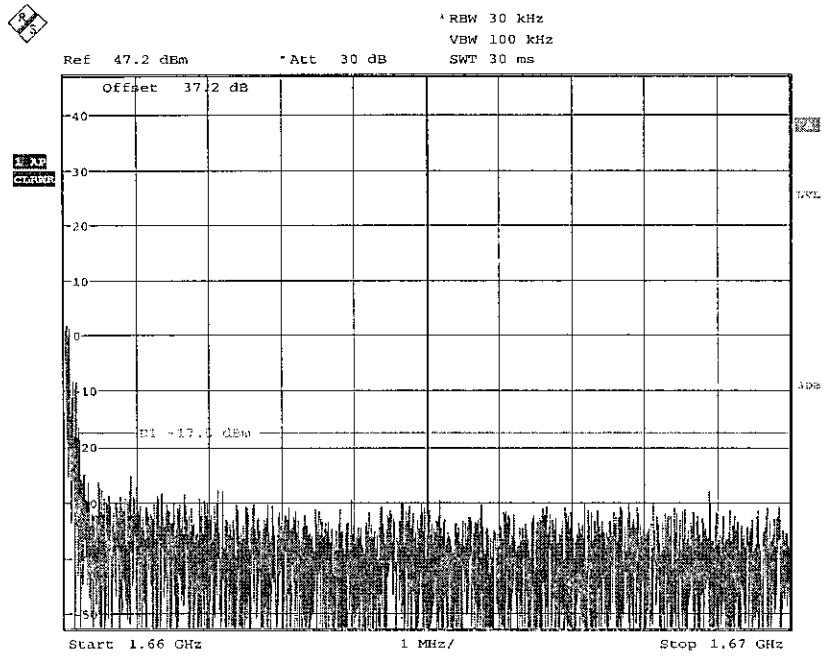
Date: 21.OCT.2008 16:38:12

5.5.2.3.14 1626.5 MHz to 1660 MHz



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

5.5.2.3.15 1660 MHz to 1670 MHz



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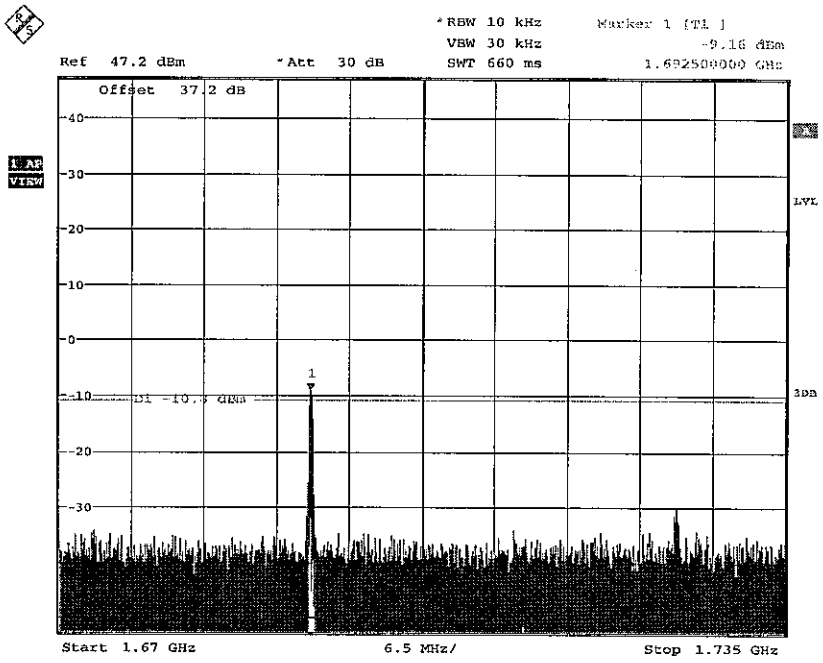
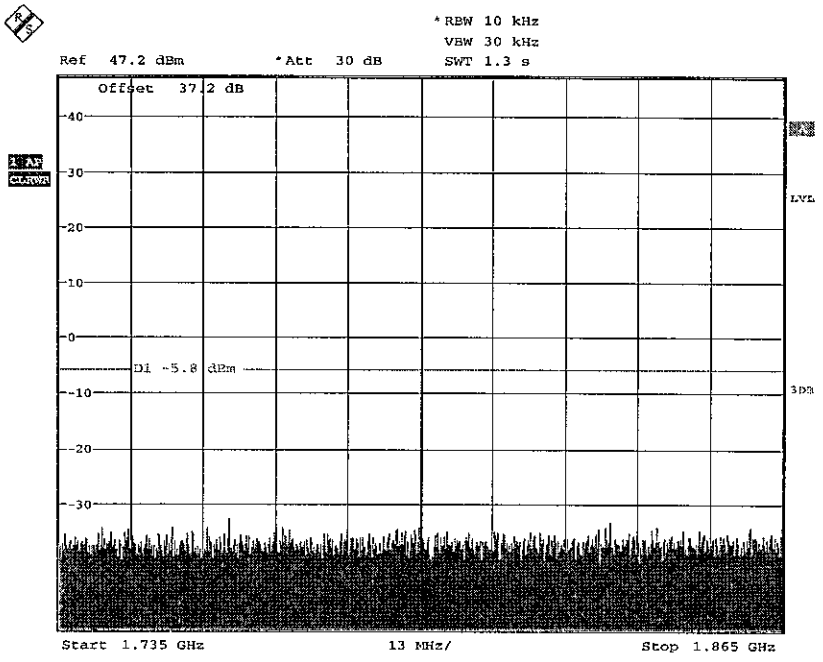
5.5.2.3.16 1670 MHz to 1735 MHz



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

5.5.2.3.17 1735 MHz to 1865 MHz



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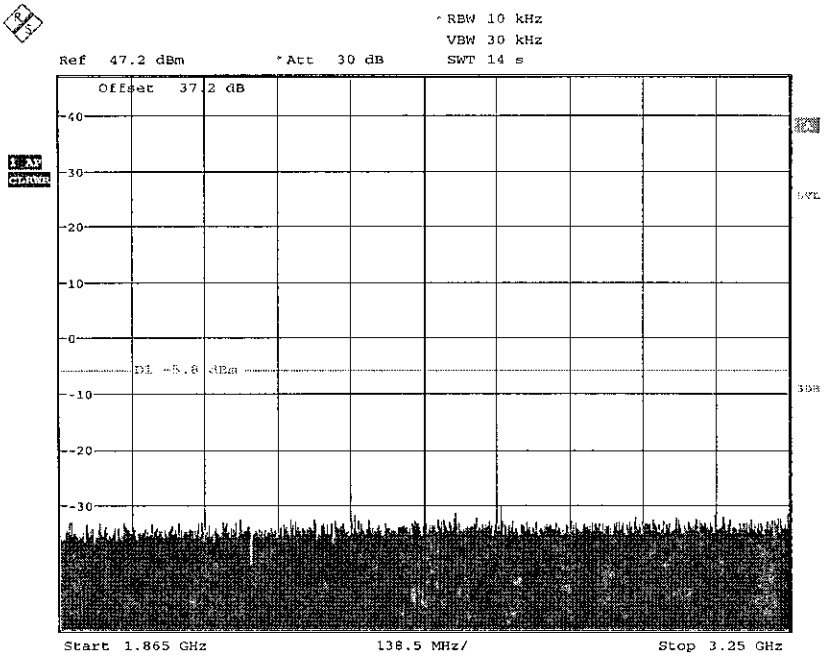
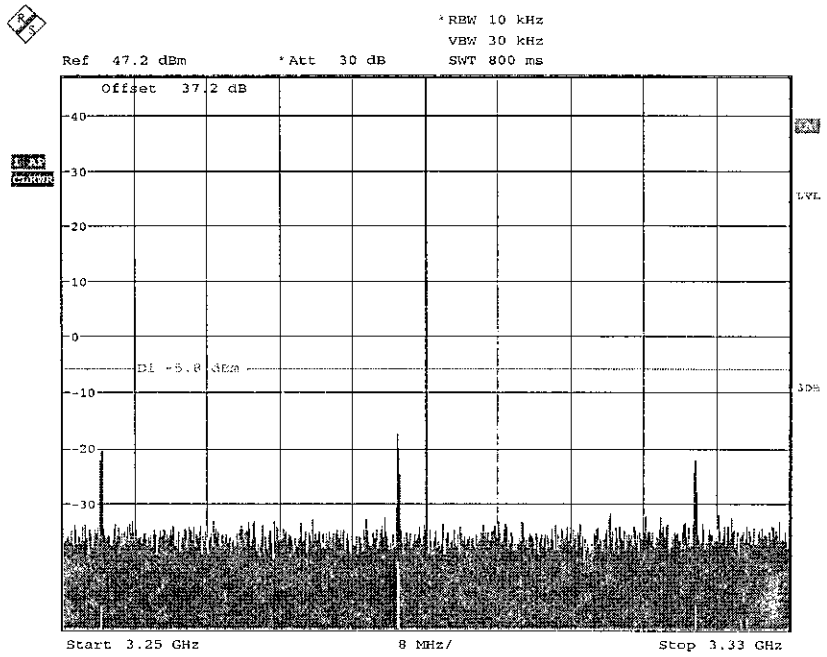
5.5.2.3.18 1865 MHz to 3250 MHz



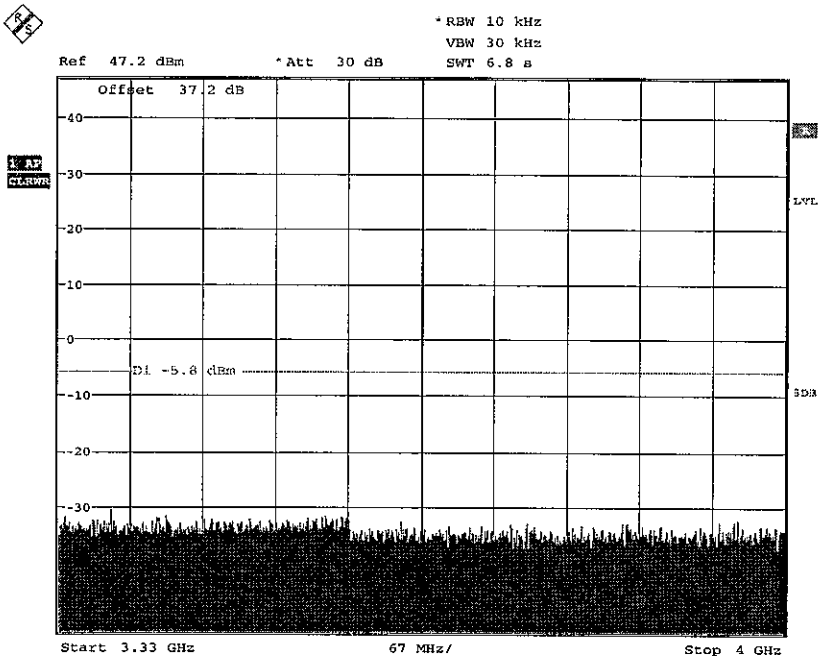
Date: 21.OCT.2008 16:45:16

5.5.2.3.19 3250 MHz to 3330 MHz



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

5.5.2.3.20 3330 MHz to 4000 MHz



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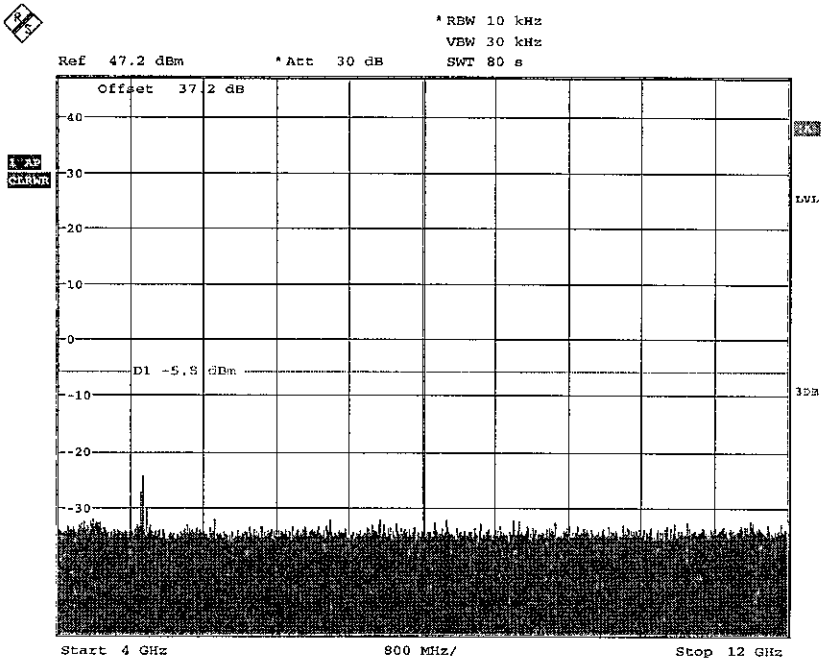
5.5.2.3.21 4 GHz to 12 GHz



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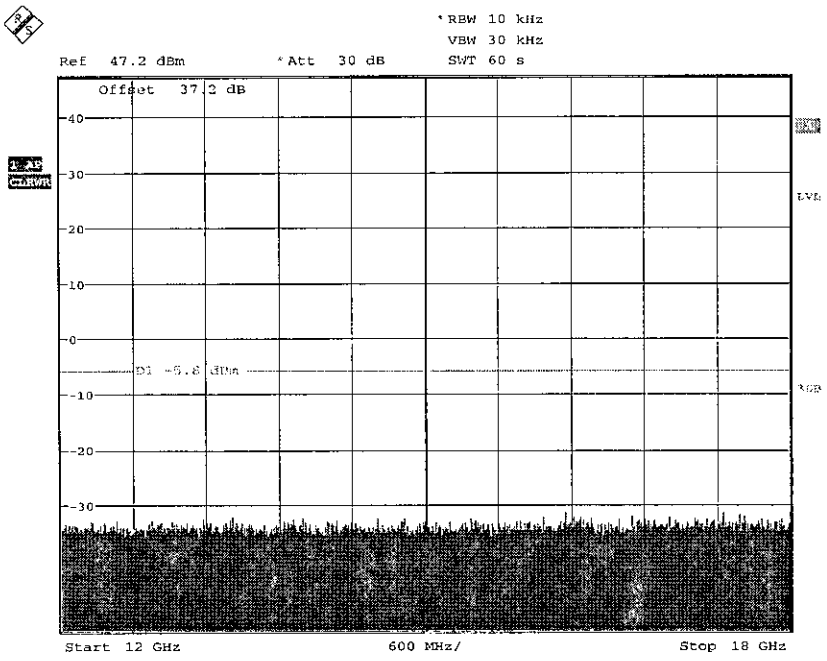
5.5.2.3.22 12 GHz to 18 GHz



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6 Conclusions, Deviations and Waiver Requests.

6.1 General

6.1.1 The FMHPA FCC ID: KV6TFS-HPA82166A has been tested in conjunction with the SDU FCC ID: KV6TFS-HPA82155D providing the required transmit signals. The FCC certification application for the FMHPA, will be linked to the application for the SDU.

6.2 RF Output Power

6.2.1 The Thales FMHPA, FCC ID: KV6TFS-HPA82166A, 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 FMHPA, FCC ID: KV6TFS-HPA82166A, meets the requirements of FCC 47 CFR Parts 2.1049 and 87.135 for RF Occupied Bandwidth.

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

6.4 Conducted Spurious Emissions

6.4.1 Thales tested the FMHPA using an alternative method. Sections 4.2.3.3 to 4.2.3.7 provide the justification for the use of this alternative method.

6.4.2 Thales have concluded that using this alternative method the FMHPA, FCC ID: KV6TFS-HPA82166A does meet the requirements of FCC 47 CFR Parts 2.1051 and 87.139 for Conducted Spurious Emissions.

6.4.3 Thales are therefore requesting a waiver against the test method used for the measurement of the FMHPA, FCC ID: KV6TFS-HPA82166A, for Conducted Spurious Emissions – exhibit 13c. This waiver in test method was approved for the KVS-TFS-SDU82155A.

6.5 Radiated Emissions

6.5.1 The Thales FMHPA, FCC ID: KV6TFS-HPA82166A, meets the requirements of FCC 47 CFR Part 15.209 for radiated emissions.

6.6 Intermods

6.6.1 The Thales FMHPA, FCC ID: KV6TFS-HPA82166A, 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.

6.6.2 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. This would produce approximately an EIRP of 10.69dBm if not for the 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.

6.6.3 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 the FMHPA are satisfactory and fit for purpose.

7 Testimonial and Statement of Certification

The Thales Avionics Ltd FMHPA, FCC ID: KV6TFS-HPA82166A 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 FMHPA 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 FMHPA, FCC ID: KV6TFS-HPA82166A. 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)

.....

R. Thorburn
(Systems Engineer)

.....

J. Livingstone
(TFS Satcom Systems Project Leader)

.....

B. Feehan
(TFS Satcom Product Design Authority)