Test Report No. S08ICM02010/EMC/01A
dated 06 Feb 2009

PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
FCC Parts 2, 15 and 25 : 2008
OF A
SATELLITE BROADBAND COMMUNICATOR
[Model : SABRE RANGER]
[FCC ID : QY9-SBRANGER]

TEST FACILITY	TÜV SÜD PSB Pte Ltd, Electrical & Electronics Centre (EEC), Product Services, 1 Science Park Drive, Singapore 118221
FCC REG. NO.	90937 (3m & 10m OATS) 99142 (10m Semi-Anechoic Chamber) 871638 (3m Semi-Anechoic Chamber) 325572 (10m Semi-Anechoic Chamber)
IND. CANADA REG. NO.	2932I-1 (3m and 10m Semi-Anechoic Chambers)
PREPARED FOR	Mr Prabakar Kuttaniseeri Addvalue Communications Pte Ltd 190 Changi Road #02-02 MDIS Building Singapore 419974 Tel : +65 6342 5420 Fax : +65 6342 5426
QUOTATION NUMBER	53Q0601508 & Q08ICM00399
JOB NUMBER	53S062852 & S08ICM02010
TEST PERIOD	28 Nov 2008 – 30 Nov 2008

PREPARED BY

Quek Keng Huat
Associate Engineer

APPROVED BY

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Assistant Vice President

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LA-2007-0380-A
LA-2007-0380-A-1
LA-2007-0381-F
LA-2007-0382-B
LA-2007-0383-G
LA-2007-0384-G
LA-2007-0385-E
LA-2007-0386-C

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
FCC Parts 2, 15 and 25: 2008		
15.107(a), 15.207	Conducted Emissions	Pass
15.109	Radiated Emissions	Pass
2.1046(a), 25.204	RF Output Power	Pass
2.1051, 25.202(f)	Unwanted Emissions at Antenna Terminal	Pass
2.1053, 25.202(f)	Radiated Spurious Emissions	Pass
25.216(h)(i)(j)	Protection of Aeronautical Radio Navigation Satellite Service	Pass
2.1055, 25.202(d)	Frequency Stability (Temperature Variation)	Pass
2.1055, 25.202(d)	Frequency Stability (Voltage Variation)	Pass
1.1310	Maximum Permissible Exposure	Pass

TEST SUMMARY

Notes

1. Three channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) were chosen and tested. For each channel, the EUT was configured to operate in the test mode.

Transmit Channel	Frequency (GHz)
Lower Channel	1.626590
Middle Channel	1.643500
Upper Channel	1.660330

2. The following tests were based on conducted measurements.
   a. RF Output Power
   b. Unwanted Emissions at Antenna Terminal
   c. Frequency Stability (Temperature Variation)
   d. Frequency Stability (Voltage Variation)

3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.

4. All RF satellite test measurement procedures are according to ANSI/TIA-603-B-2002.

5. All non-RF test measurement procedures are according to ANSI C63.4: 2003.

Modifications

No modifications were made.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is a **SATELLITE BROADBAND COMMUNICATOR.**
Manufacturer	:	Addvalue Communications Pte Ltd 190 Changi Road #02-02 MDIS Building Singapore 419974
Model Number	:	Sabre Ranger
FCC ID	:	QY9-SBRANGER
Serial Number	:	Nil
Microprocessor	:	OMAP 5190, FPGA XC3S4000
Operating / Transmitting Frequency	:	Satellite Uplink: 1.6265GHz - 1.6605GHz Downlink: 1.525GHz - 1.559GHz GPS 1.57542GHz
Clock / Oscillator Frequency	:	OMAP 5910 30MHz, 60MHz, 120MHz FPGA XC3S4000 9.6768MHz, 24.192MHz, 38.192MHz
Modulation	:	Satellite Pi/4 QPSK (transmit) Pi/4 QPSK and 16-QAM (receive) GPS BPSK
Port / Connectors	:	Refer to manufacturer's user manual / operating manual.
Rated Input Power	:	100VAC - 240VAC 50/60Hz
Accessories	:	Nil

SUPPORTING EQUIPMENT DESCRIPTION

For all tests expect conducted and radiated emissions

Equipment Description (Including Brand Name)	**Model, Serial & FCC ID Number**	**Cable Description** (List Length, Type & Purpose)
Dell Notebook	M/N: PP10L S/N: 24746315248 FCC ID: DoC	Nil
Dell AC/DC Adapter	M/N: PA-1650-05D2 S/N: Nil FCC ID: Verification	0.5m unshielded DC power cable with ferrite loaded 2.00m 7unshielded AC power cable
DVE AC/DC Adapter (EUT AC/DC Adapter)	M/N: DSA-0412S-14 242 S/N: Nil FCC ID: DoC	2.0m unshielded DC power cable with ferrite loaded 1.5m unshielded AC power cable

For conducted and radiated emissions

Equipment Description (Including Brand Name)	**Model, Serial & FCC ID Number**	**Cable Description** (List Length, Type & Purpose)
Laptop	M/N: 2388 S/N: KM-31517 FCC ID: Nil	2.00m unshielded power cable
Adapter (For Laptop)	M/N: PA-1121-06l S/N: Nil FCC ID: Nil	2.00m unshielded power cable 3.00m RJ45 LAN cable
DVE AC/DC Adapter (EUT AC/DC Adapter)	M/N: DSA-0421S-14 2 42 S/N: Nil FCC ID: DoC	2.0m unshielded DC power cable with ferrite loaded 1.5m unshielded AC power cable

EUT OPERATING CONDITIONS

FCC Part 15
1. Conducted Emissions **2. Radiated Emissions**
The EUT was exercised in the following manner during the tests: a. The transmitter was allowed to transmit in its intended operating condition (Satellite mode), i.e intended modulation with maximum transmission power. b. The receiver was allowed to receive the intended modulated signal (Satellite and GPS modes), i.e wanted signal with the received signal strength was at least 30dB above the manufacturer declared receiver's sensitivity.
FCC Parts 2 and 25
1. RF Output Power **2. Unwanted Emissions at Antenna Terminal** **3. Radiated Spurious Emissions** **4. Protection of Aeronautical Radio Navigation Satellite Service** **5. Frequency Stability (Temperature Variation)** **6. Frequency Stability (Voltage Variation)** **7. Maximum Permissible Exposure**
The EUT was exercised by operating in maximum continuous transmission, i.e transmitting at lower, middle and upper channels respectively at one time. The satellite continuous transmission and reception was simulated by activating the client's provided test program, "<lotus-test-script".

CONDUCTED EMISSION TEST

FCC Parts 15.107(a) and 15.207 Conducted Emission Limits

Frequency Range (MHz)	Limit Values (dBµV)	
	Quasi-peak (QP)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50
* Decreasing linearly with the logarithm of the frequency		

FCC Parts 15.107(a) and 15.207 Conducted Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer-SA7	E7403A	US41160167	20 May 2009
Schaffner LISN – LISN10 (for EUT)	NNB42	04/10055	03 Jul 2009

CONDUCTED EMISSION TEST

FCC Parts 15.107(a) and 15.207 Conducted Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another LISN.

FCC Parts 15.107(a) and 15.207 Conducted Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10kHz. Both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line.

Sample Calculation Example

At 20 MHz Q-P limit (Class B) = 1000 μV = 60.0 dBμV

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dBμV
(Calibrated for system losses)

Therefore, Q-P margin = 40.0 - 60.0 = -20.0 i.e. **20.0 dB below Q-P limit**

Conducted Emissions Test Setup (Front View)

Conducted Emissions Test Setup (Rear View)

CONDUCTED EMISSION TEST

FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Operating Mode	Satellite + GPS	Temperature	22°C
Test Input Power	110V 60Hz	Relative Humidity	58%
Line Under Test	AC Mains	Atmospheric Pressure	1030mbar
		Tested By	Pang Wai Tian

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.3211	47.3	-12.4	36.3	-13.4	Live	Lower
0.3765	39.0	-10.4	25.2	-16.2	Neutral	Upper
0.6030	39.0	-17.0	25.2	-20.8	Neutral	Upper
1.0580	36.1	-19.9	30.0	-16.0	Neutral	Upper
1.3091	32.1	-23.9	25.2	-20.8	Live	Middle
1.7859	32.5	-23.5	28.3	-17.7	Neutral	Upper

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   9kHz - 30MHz
   RBW: 10kHz VBW: 30kHz
4. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ±2.4dB.

RADIATED EMISSION TEST

FCC Part 15.109 Radiated Emission Limits (Class B)

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m) @ 3m
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
Above 960	54.0*
* Above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.	

FCC Part 15.109 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESMI1 (Ref)	ESMI	849182/003 848926/007	21 Aug 2009
MITEQ Preamplifier (0.1-26.5GHz) – PA11	NSP2650-N	728231	27 Jan 2009
Schaffner Preamplifier (9kHz-2GHz) –PA13	CPA9231A	3422	18 Feb 2009
Schaffner Bilog Antenna – BL4	CBL6112B	2593	19 May 2009
EMCO Horn Antenna- H2 (Ref)	3115	9403-4250	02 Apr 2009
K & L Variable Bandstop Filter (1GHz - 2.0GHz)	3TNF-0008	436	13 Aug 2009

FCC Part 15.109 Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard as shown in the setup photos.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

FCC Part 15.109 Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from 30MHz to 5th harmonic of the highest frequency used or generated by the EUT, using the Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

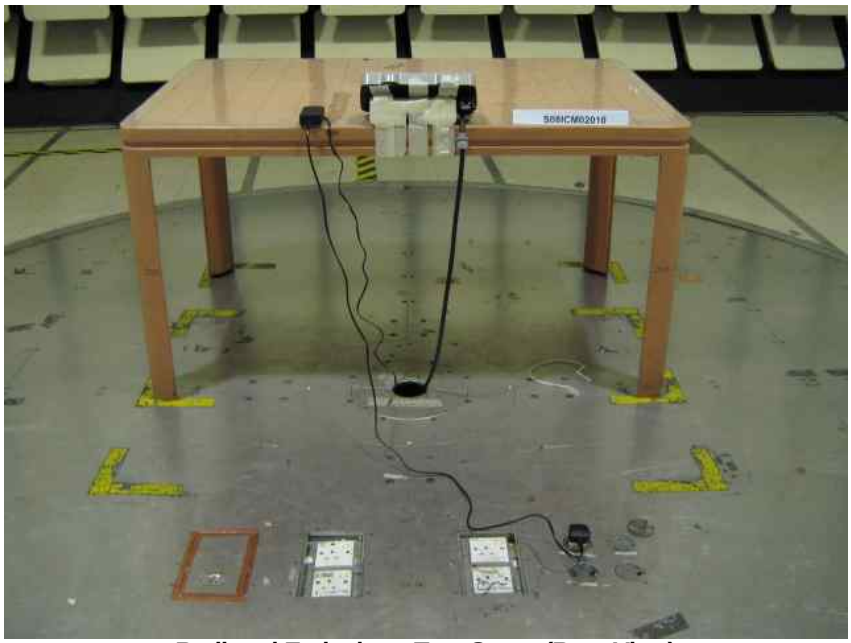
At 300 MHz Q-P limit (Class B) = 70.8 μV/m = 37.0 dBμV/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 31.0 dBμV/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 31.0 - 37.0 = -6.0 i.e. **6 dB below Q-P limit**

Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)

FCC Part 15.109 Radiated Emission Results

Operating Mode	Satellite + GPS	Temperature	22°C
Test Input Power	110V 60Hz	Relative Humidity	58%
Test Distance	3m	Atmospheric Pressure	1030mbar
		Tested By	Pang Wai Tian

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
42.1840	11.2	-28.8	198	110	V	Middle
55.9930	19.2	-20.8	204	117	V	Middle
175.0030	21.5	-22.0	75	103	V	Middle
182.1330	23.1	-20.4	77	100	V	Middle
249.9740	25.9	-20.1	158	110	H	Middle
951.1900	35.0	-11.0	186	145	V	Middle

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBµV/m)	Average Value (dBµV/m) *See Note 2	Average Margin (dB) *See Note 3	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
3.2624	26.0	-	-28.0	312	400	V	Lower
3.2938	24.7	-	-29.3	327	400	H	Middle
3.4329	23.4	-	-30.6	193	200	H	Lower
3.5362	23.0	-	-31.0	238	400	V	Upper
4.1377	24.1	-	-29.9	105	400	V	Lower
4.7168	24.0	-	-30.0	31	300	H	Lower

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.

Notes (continued)

5. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
6. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25.0GHz is ±4.6dB.

FCC Parts 2.1046 and 25.204 RF Output Power Test Limits

1. 25.204 Power Limits
   (a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1GHz and 5GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:

   +40dBW in any 4kHz band for θ: 0^O

   +40dBW + 3.θdBW in any 4kHz band for $0^O < \theta \leq 5^O$

   where θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

   (c) For angles of evaluation of the horizon greater than 5^O there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

   (d) Notwithstanding the e.i.r.p and e.i.r.p density limits specified in the station authorization, each earth station transmission shall be conducted at the lowest power level that will provide the required signal quality as indicated in the application and further amended by coordination agreements.

2. 2.1046 Measurements Required: RF Power Output
   (a) For transmission other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

   (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

FCC Parts 2.1046 and 25.204 RF Output Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Universal Radio Communication Tester	CMU	837728/071	03 Mar 2009
HP Spectrum Analyzer	8564E	3846A01433	15 Jul 2009
JFW 20dB RF Attenuator	50FHC-020-15	Nil	13 Aug 2009

RF OUTPUT POWER TEST

FCC Parts 2.1046 and 25.204 RF Output Power Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a RF attenuator and a low-loss coaxial cable.
4. The spectrum analyser was then calibrated to the power meter level as shown by the Universal Radio Communicator Tester with a calibrated RF signal source.
5. All other supporting equipment were powered separately from another filtered mains.

FCC Parts 2.1046 and 25.204 RF Output Power Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, transmitting frequency at lower channel.
2. The maximum peak power of the transmitting frequency was measured and recorded.
3. The RF carrier peak and average pots were plotted.
4. The steps 2 to 4 were repeated with the transmitting frequency was set to middle and upper channels respectively.

RF Output Power Test Setup

FCC Parts 2.1046 and 25.204 RF Output Power Results

Operating Mode	Satellite	Temperature	23 °C
Test Input Power	110V 60Hz	Relative Humidity	55%
Antenna Gain	8 dBi	Atmospheric Pressure	1030mbar
Attached Plots	1 - 12	Tested By	Thor Wen Lei

Symbol Rate: 0.5 x 33.6kS/s

Channel	Channel Frequency (GHz)	Peak Power (dBm)	EIRP Peak (dBm)	Mean Power (dBm)	EIRP Mean (dBm)
Lower	1.62659	31.9	39.9	31.7	39.7
Middle	1.64350	31.9	39.9	31.8	39.8
Upper	1.66033	32.0	40.0	32.0	40.0

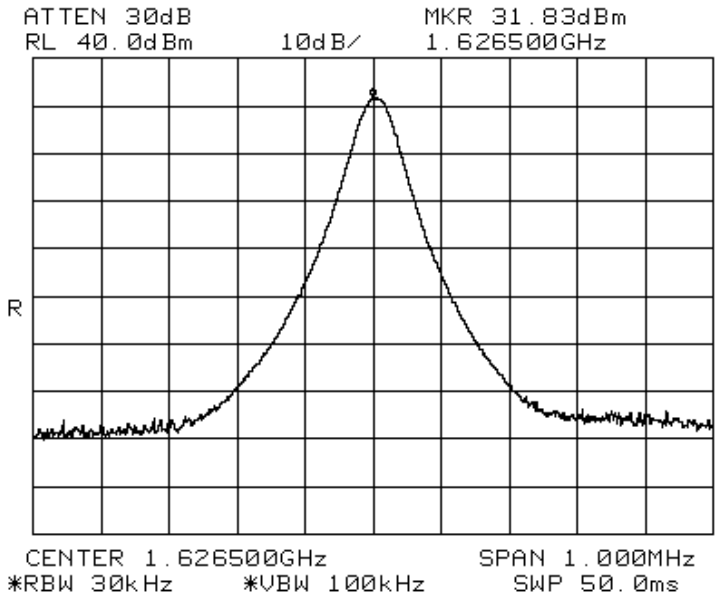
Symbol Rate: 4.5 x 33.6kS/s

Channel	Channel Frequency (GHz)	Peak Power (dBm)	EIRP Peak (dBm)	Mean Power (dBm)	EIRP Mean (dBm)
Lower	1.62676	31.2	39.2	30.8	38.8
Middle	1.64350	31.2	39.2	31.2	39.2
Upper	1.66033	31.4	39.4	31.2	39.2

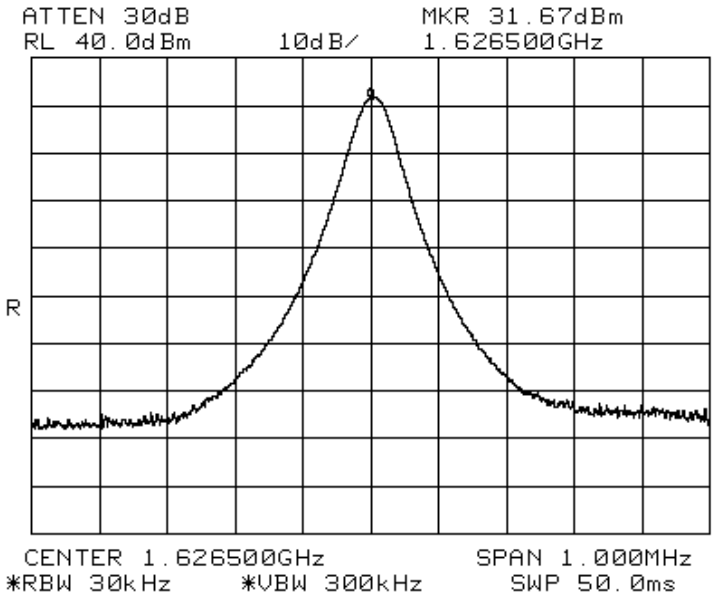
Notes

1. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.

Output Power Plots @ Symbol Rate: 0.5 x 33.6kS/s

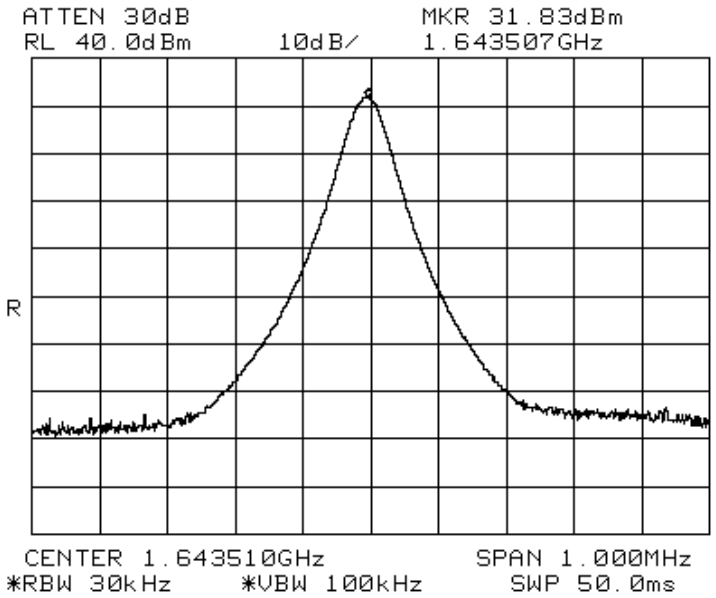


Plot 1 – Lower Channel (Peak)

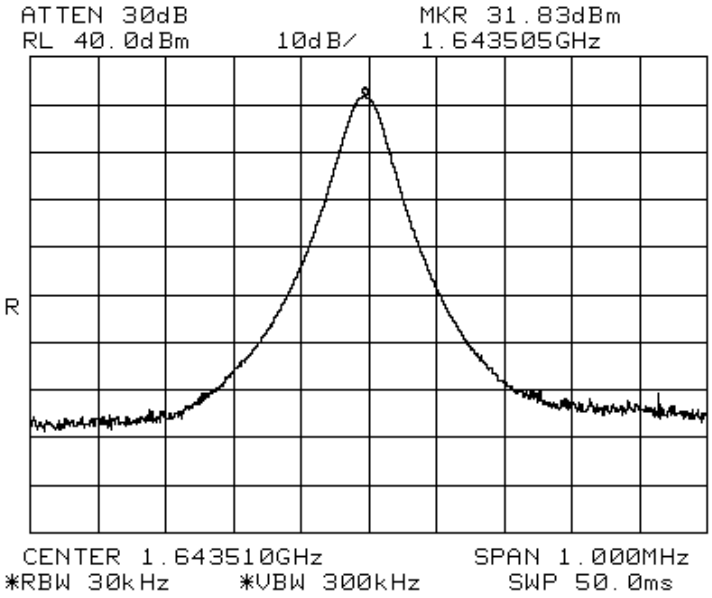


Plot 2 – Lower Channel (Average)

Output Power Plots @ Symbol Rate: 0.5 x 33.6kS/s

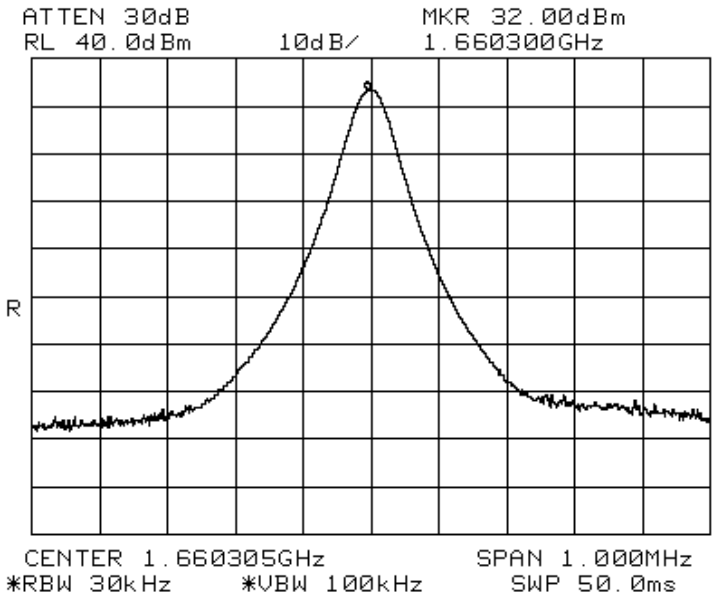


Plot 3 – Middle Channel (Peak)

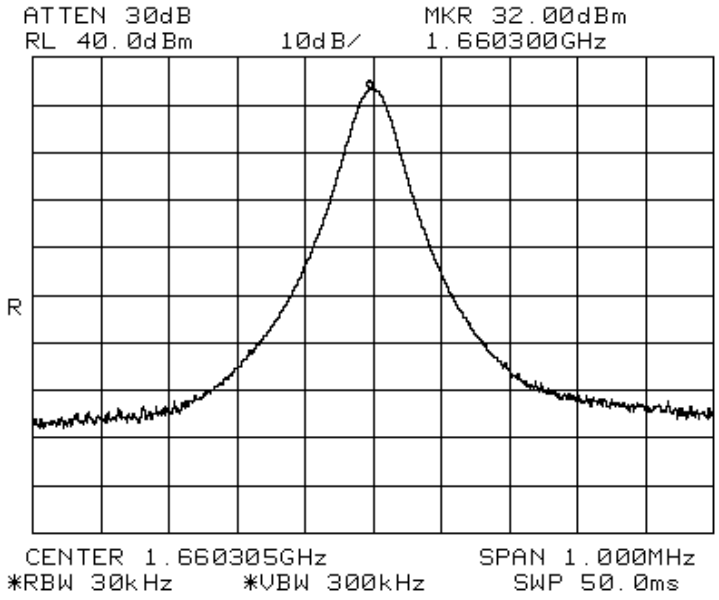


Plot 4 – Middle Channel (Average)

Output Power Plots @ Symbol Rate: 0.5 x 33.6kS/s

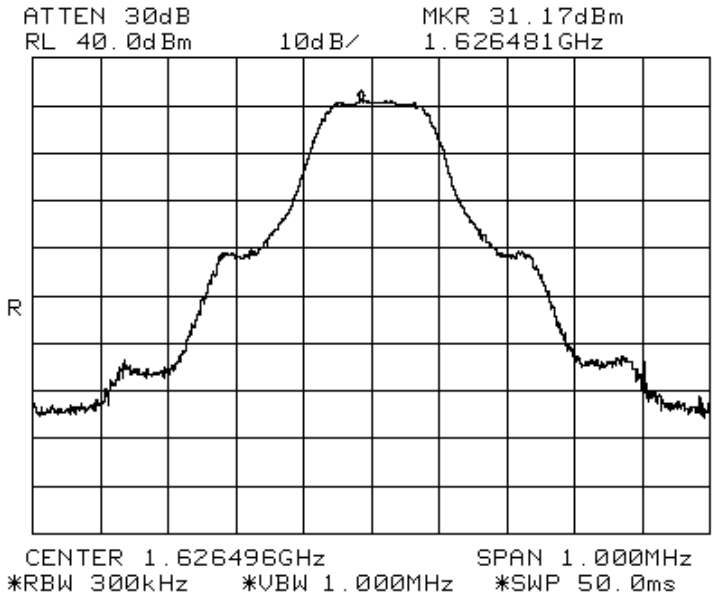


Plot 5 – Upper Channel (Peak)

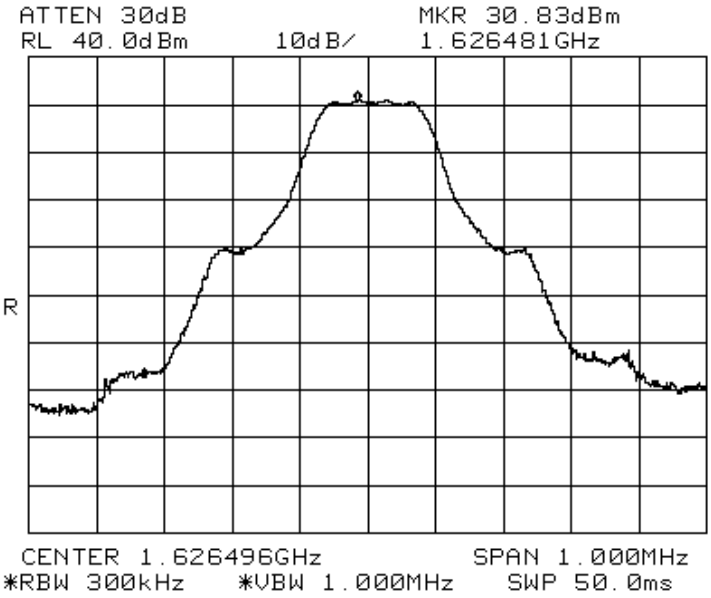


Plot 6 – Upper Channel (Average)

Output Power Plots @ Symbol Rate: 4.5 x 33.6kS/s

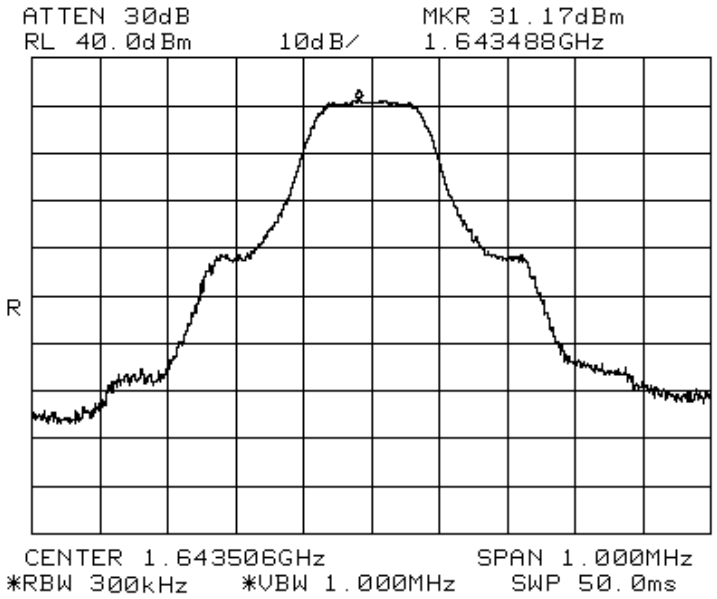


Plot 7 – Lower Channel (Peak)

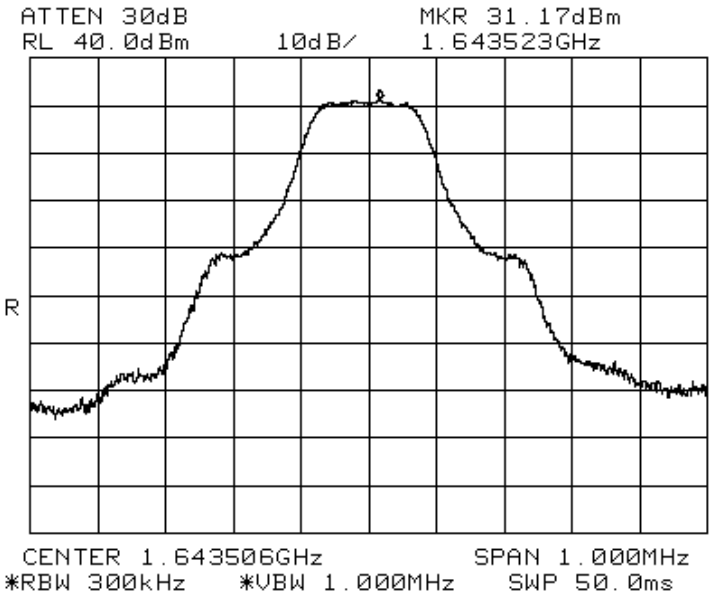


Plot 8 – Lower Channel (Average)

Output Power Plots @ Symbol Rate: 4.5 x 33.6kS/s

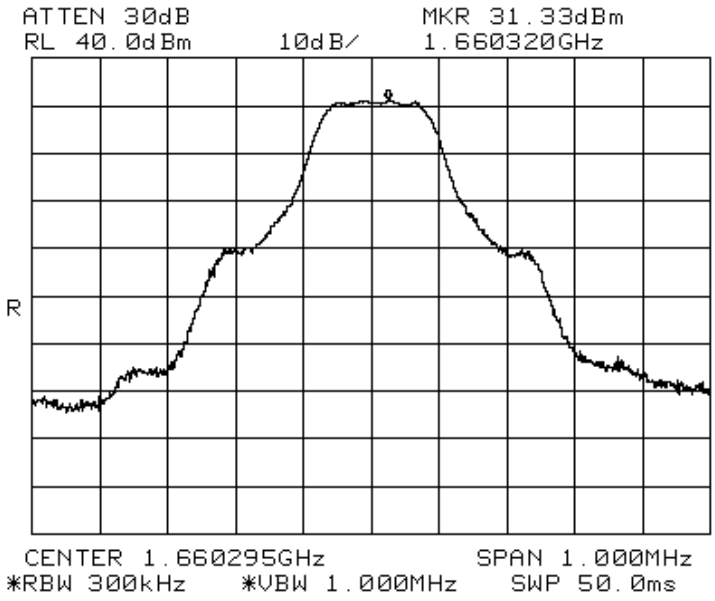


Plot 9 – Middle Channel (Peak)

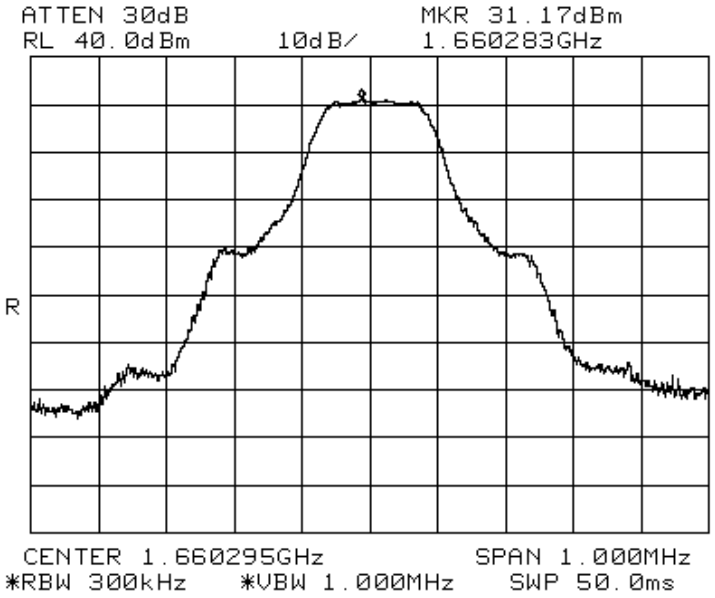


Plot 10 – Middle Channel (Average)

Output Power Plots @ Symbol Rate: 4.5 x 33.6kS/s



Plot 11 – Upper Channel (Peak)



Plot 12 – Upper Channel (Average)

UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

FCC Parts 2.1051 and 25.202(f) Unwanted Emissions at Antenna Terminal Test Limits

1. 25.202 Emissions Limitations
   (f) The mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:
   (1) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth: 25 decibels;
   (2) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth: 35 decibels;
   (3) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 250% of the authorized bandwidth: an amount equal to 43 decibels plus 10 times logarithm (to the base 10) of the transmitter power in watts.

2. 2.1051 Measurements Required: Spurious Emissions at Antenna Terminals
   The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20dB below the permissible value needed not be specified.

FCC Parts 2.1051 and 25.202(f) Unwanted Emissions at Antenna Terminal Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (for Out of Band Spurious)	8564E	3846A01433	15 Jul 2009
HP Spectrum Analyzer (for 26dB Bandwidth and In Band Emissions)	8593E	3831U02087	16 Oct 2009
JFW 20dB RF Attenuator	50FHC-020-15	Nil	13 Aug 2009

UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

FCC Parts 2.1051 and 25.202(f) Unwanted Emissions at Antenna Terminal Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a RF attenuator and a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another filtered mains.

FCC Parts 2.1051 and 25.202(f) Unwanted Emissions at Antenna Terminal Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, transmitting frequency at lower channel.
2. The 26dB bandwidth of the transmitting channel was measured.
3. The emission mask was drawn based on the authorized bandwidth and the measured average output power.
4. The transmitting channel emissions were plotted.
5. The steps 2 to 5 were repeated with the transmitting frequency was set to middle and upper channels respectively.

Unwanted Emissions at Antenna Terminal Test Setup

UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

FCC Parts 2.1051 and 25.202(f) Unwanted Emissions at Antenna Terminal Results

Operating Mode	Satellite	Temperature	24°C
Test Input Power	110V 60Hz	Relative Humidity	58%
Antenna Gain	8 dBi	Atmospheric Pressure	1030bar
Attached Plots	13 - 18 (26dB Bandwidth) 19 - 24 (In Band Emissions) 25 - 36 (Out of Band Spurious)	Tested By	Chang Wai Kit

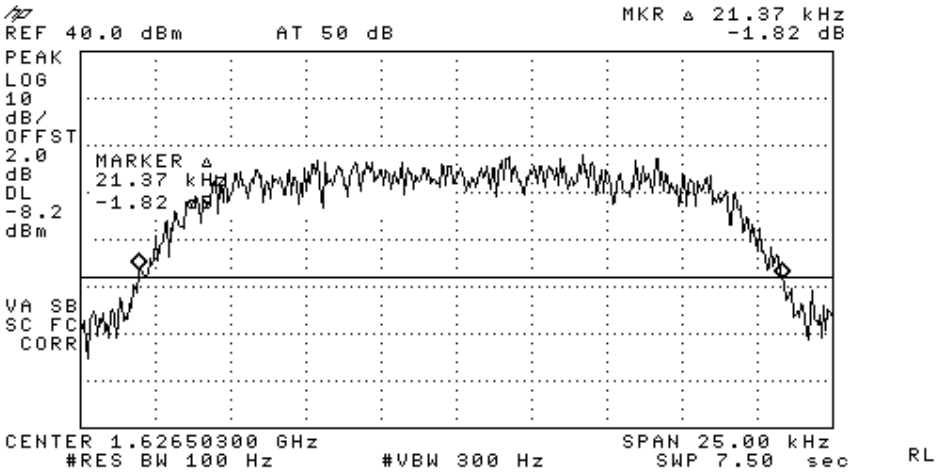
All emissions are within the emission mask. Please refer to the attached plots.

Notes

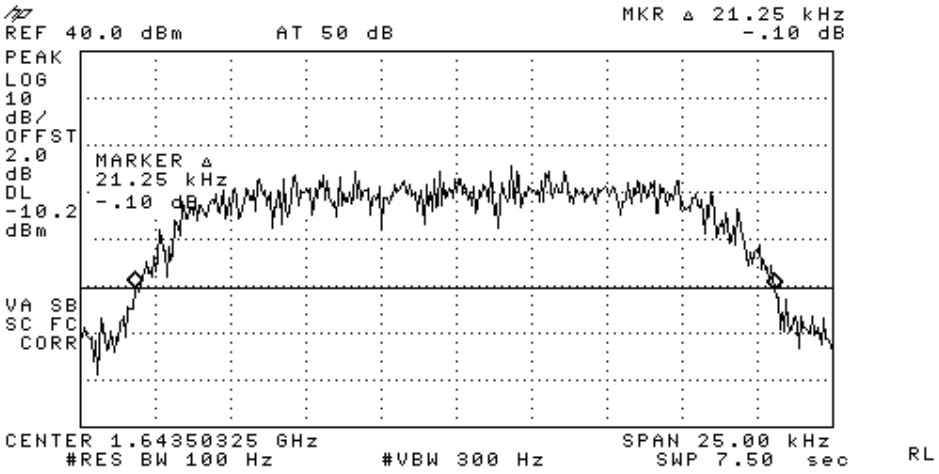
1. The Resolution Bandwidth (RBW) was corrected from 4kHz by $10\log_{10}$ [(used RBW) / 4kHz].
2. Emission limits are computed based on following:
   a. Emissions Limits (dBm) (50% - 100% authorised bandwidth) = P - 25 + CF
   b. Emissions Limits (dBm) (100% - 250% authorised bandwidth) = P - 35 + CF
   c. Emissions Limits (dBm) (> 250% authorised bandwidth) = $P - [43 + 10 \log_{10} P_W] + 30 + CF$

   where P = Measured mean power in dBm
   P_W = Meausred mean power in dBW
   CF = RBW correction factor (see Note 1)

26dB Bandwidth Plots @ Symbol Rate: 0.5 x 33.6kS/s

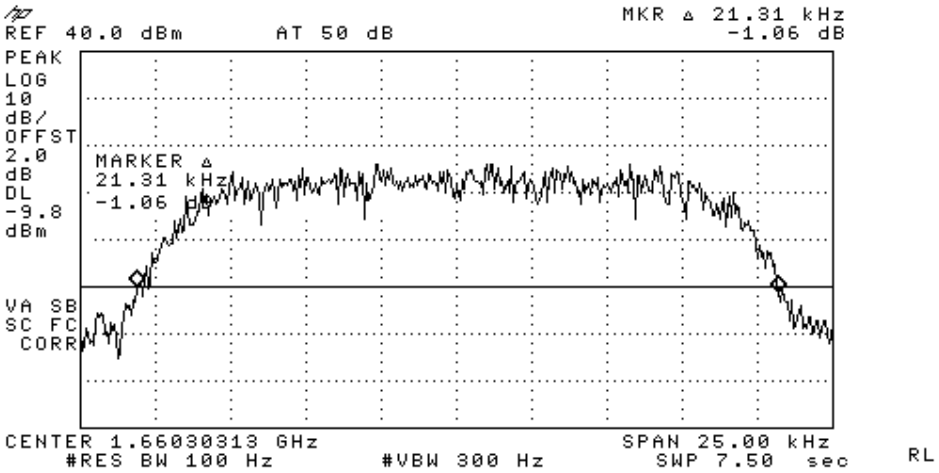


Plot 13 – Lower Channel



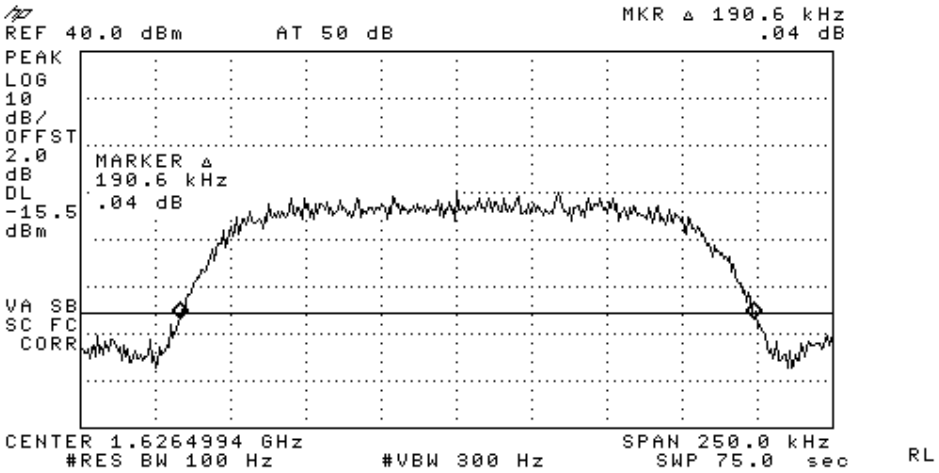
Plot 14 – Middle Channel

26dB Bandwidth Plots @ Symbol Rate: 0.5 x 33.6kS/s

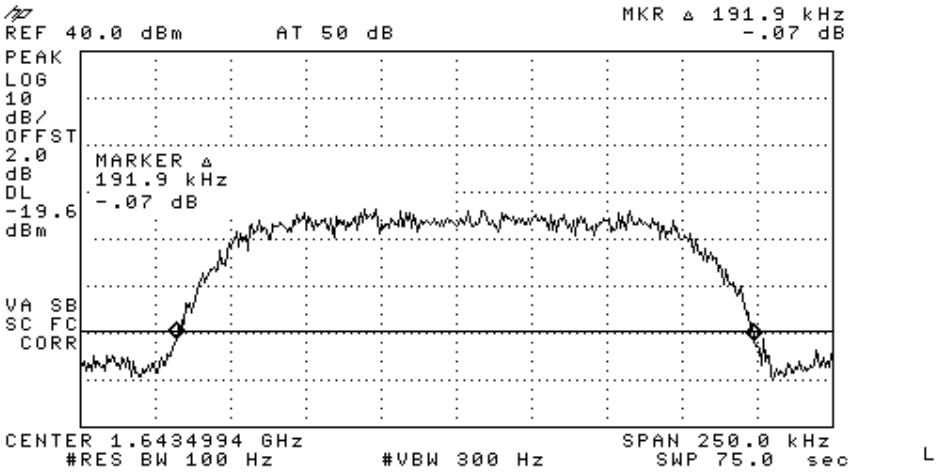


Plot 15 – Upper Channel

26dB Bandwidth Plots @ Symbol Rate: 4.5 x 33.6kS/s

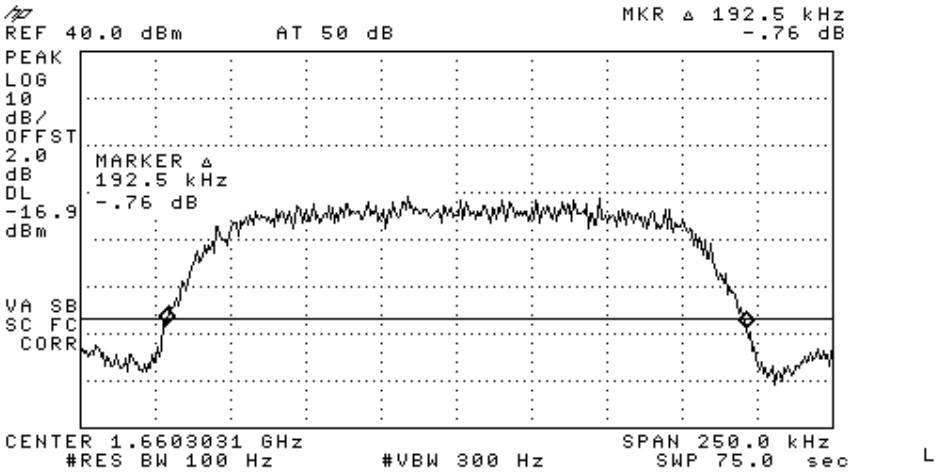


Plot 16 – Lower Channel



Plot 17 – Middle Channel

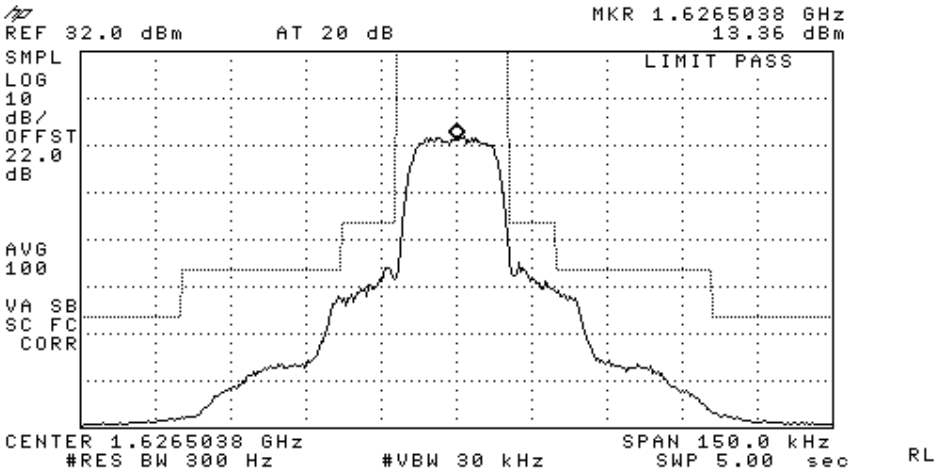
26dB Bandwidth Plots @ Symbol Rate: 4.5 x 33.6kS/s



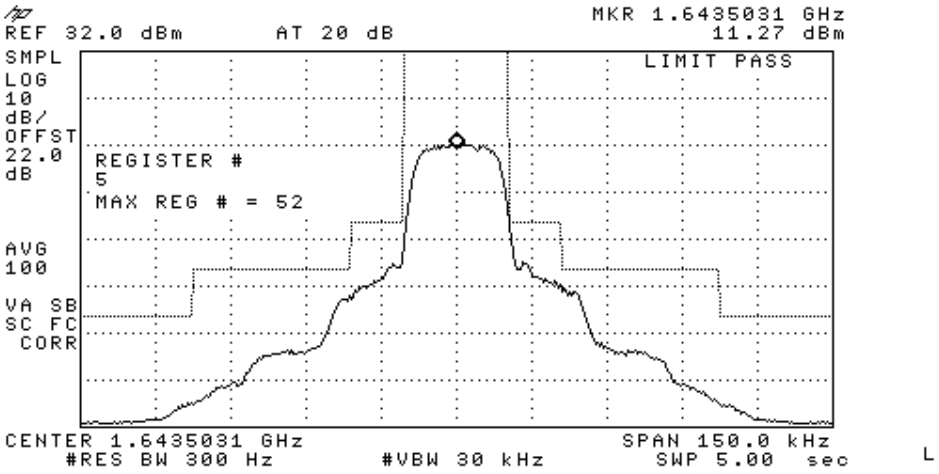
Plot 18 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

In Band Emissions @ Symbol Rate: 0.5 x 33.6kS/s



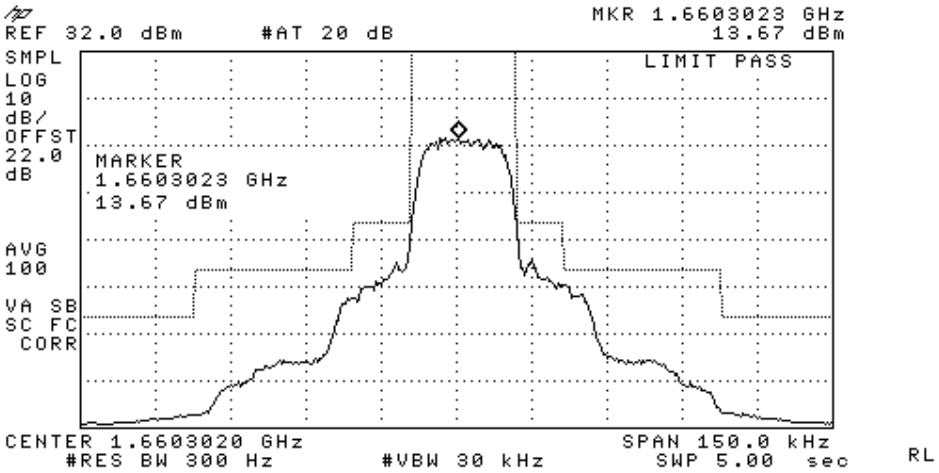
Plot 19 – Lower Channel



Plot 20 – Middle Channel

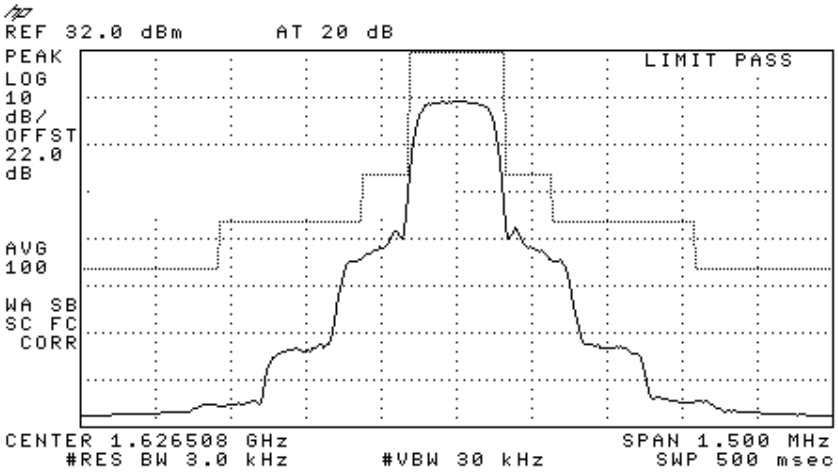
UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

In Band Emissions @ Symbol Rate: 0.5 x 33.6kS/s

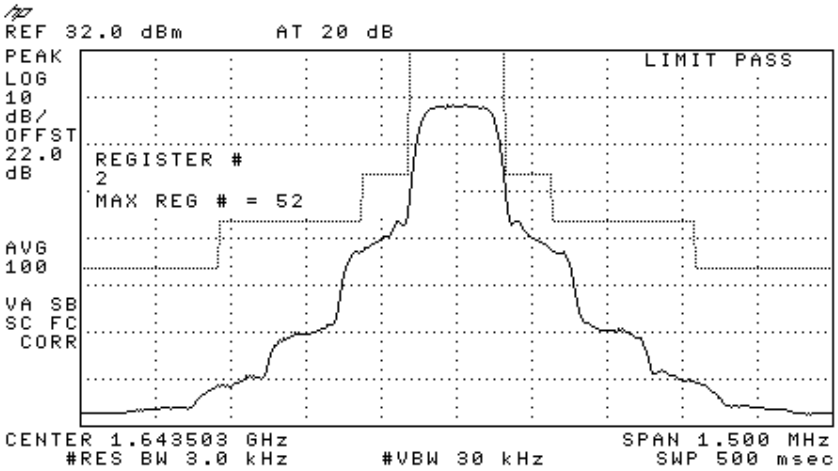


Plot 21 – Upper Channel

In Band Emissions @ Symbol Rate: 4.5 x 33.6kS/s



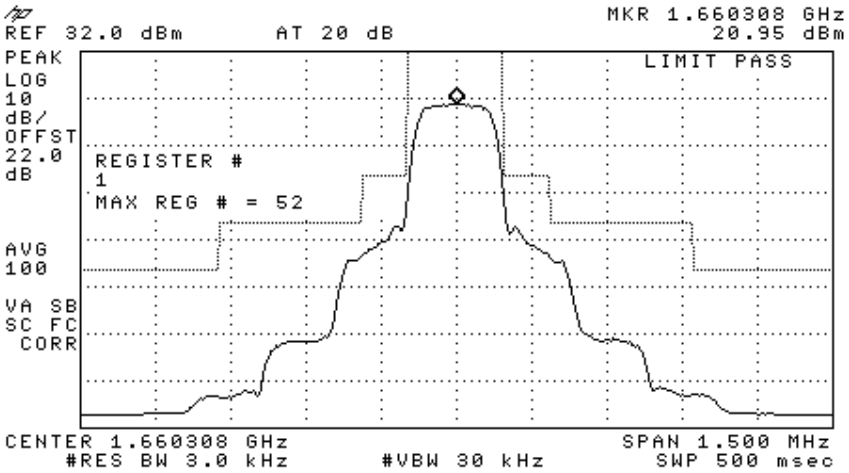
Plot 22 – Lower Channel



Plot 23 – Middle Channel

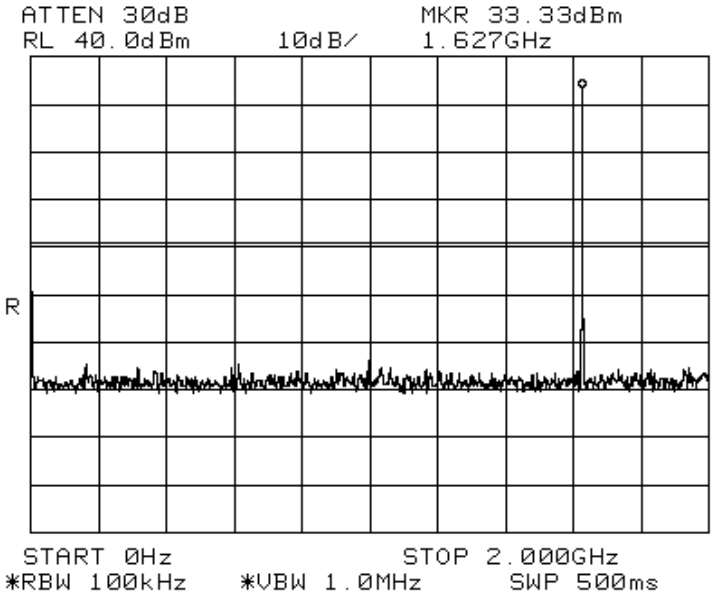
UNWANTED EMISSIONS AT ANTENNA TERNIMAL TEST

In Band Emissions @ Symbol Rate: 4.5 x 33.6kS/s

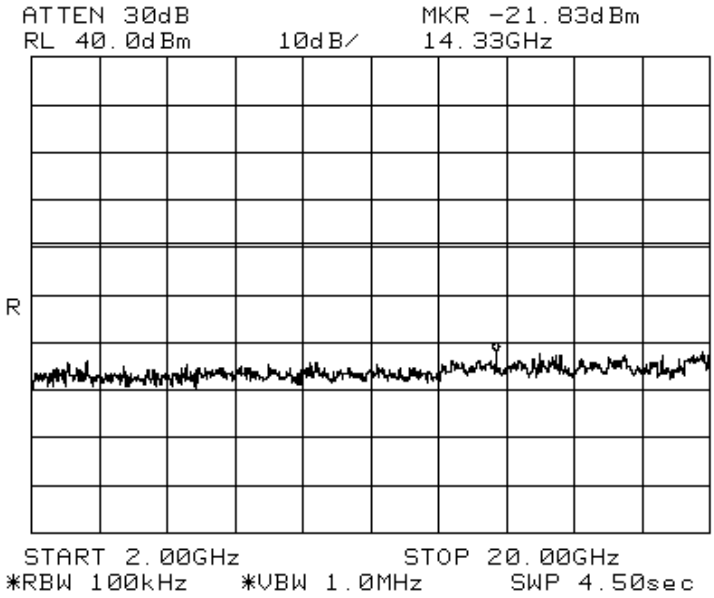


Plot 24 – Upper Channel

Out of Band Spurious @ Symbol Rate: 0.5 x 33.6kS/s

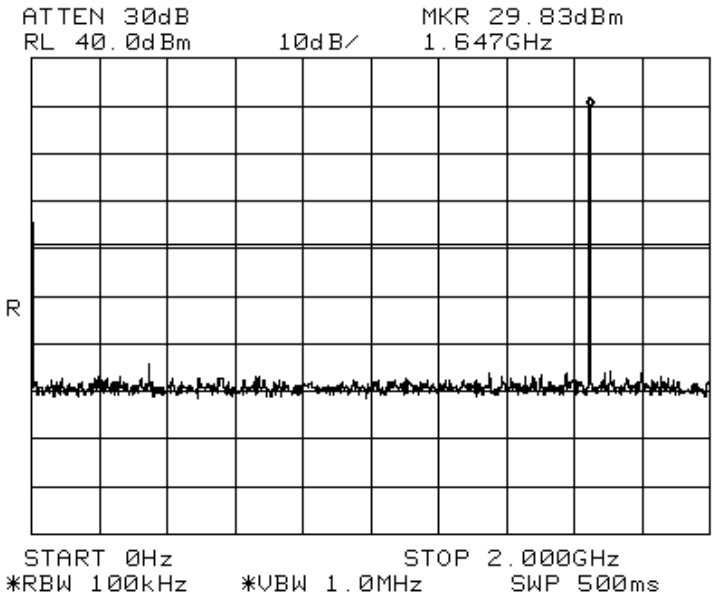


Plot 25 – Lower Channel

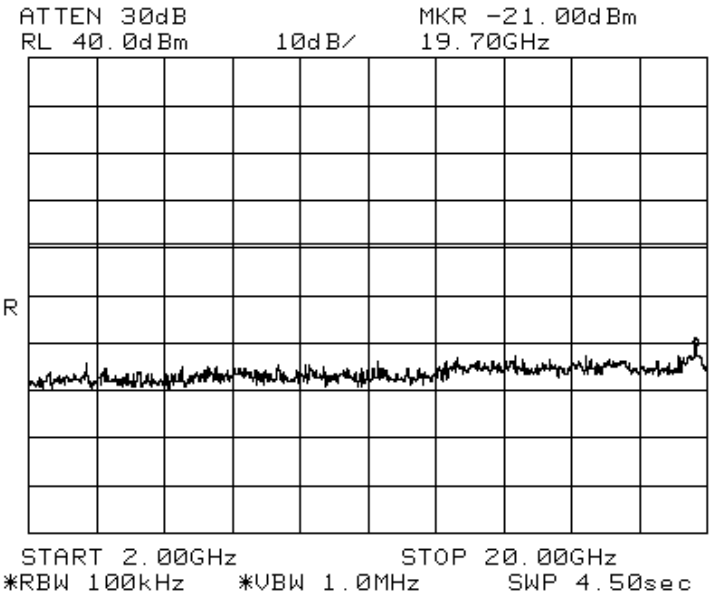


Plot 26 – Lower Channel

Out of Band Spurious @ Symbol Rate: 0.5 x 33.6kS/s

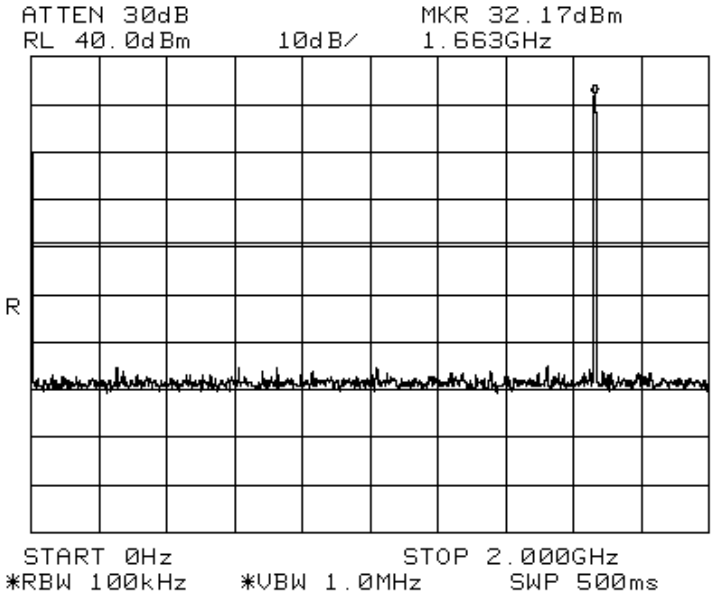


Plot 27 – Middle Channel

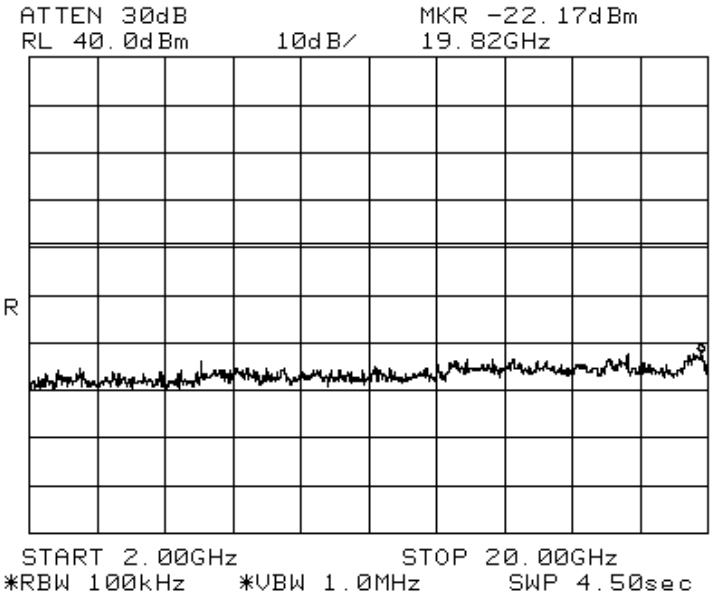


Plot 28 – Middle Channel

Out of Band Spurious @ Symbol Rate: 0.5 x 33.6kS/s

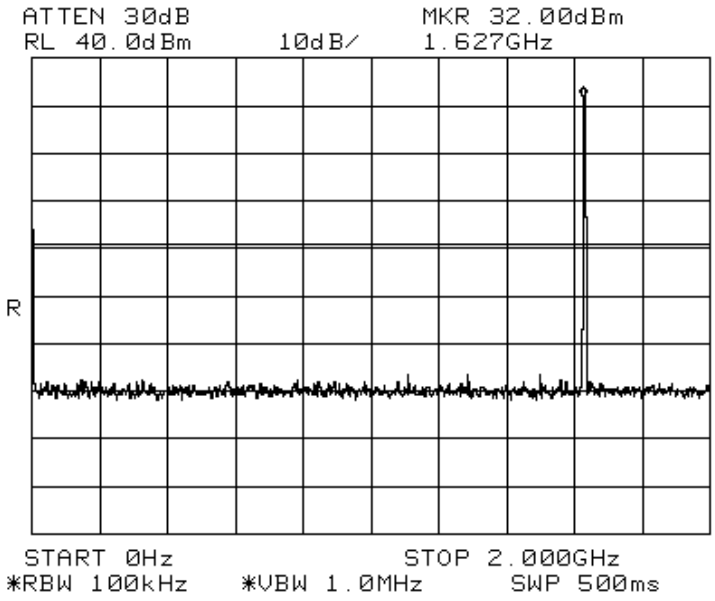


Plot 29 – Upper Channel

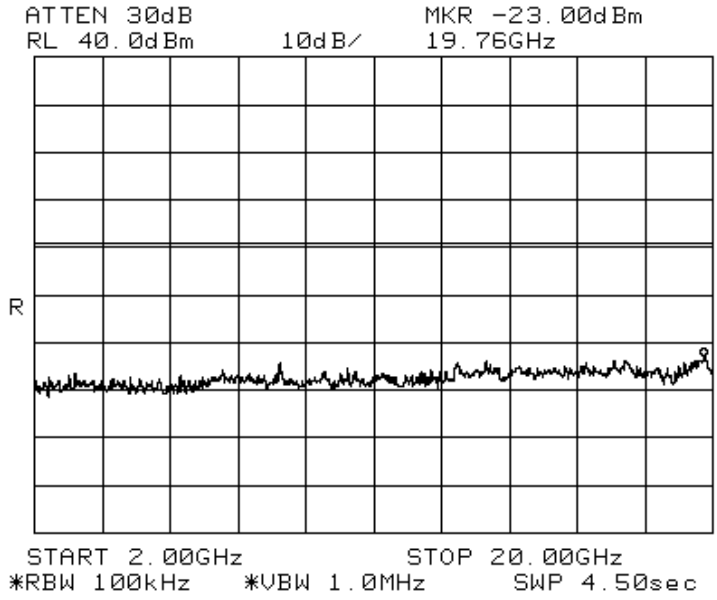


Plot 30 – Upper Channel

Out of Band Spurious @ Symbol Rate: 4.5 x 33.6kS/s

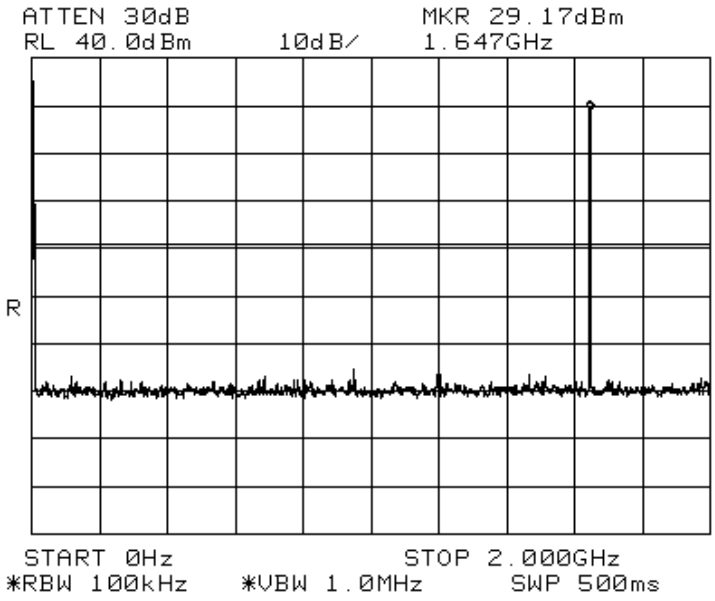


Plot 31 – Lower Channel

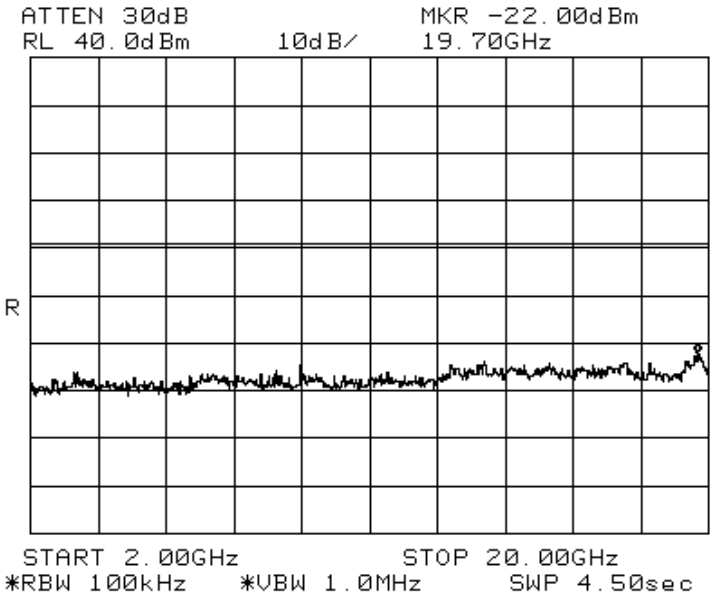


Plot 32 – Lower Channel

Out of Band Spurious @ Symbol Rate: 4.5 x 33.6kS/s

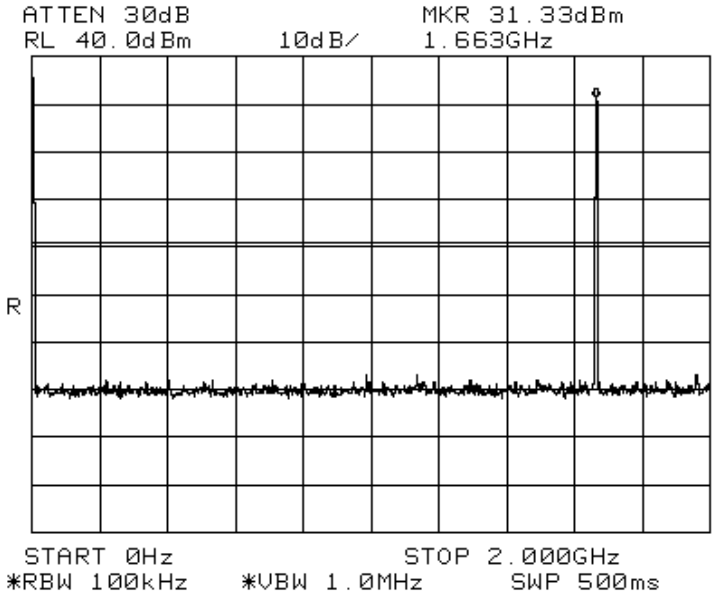


Plot 33 – Middle Channel

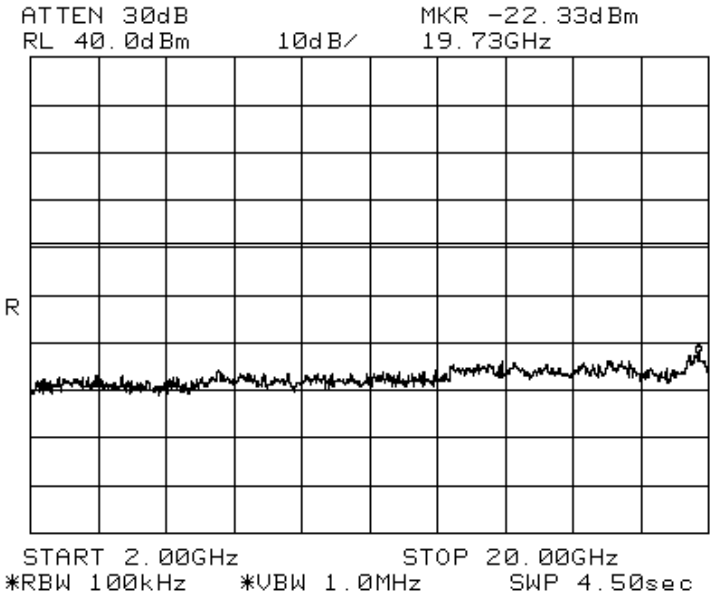


Plot 34 – Middle Channel

Out of Band Spurious @ Symbol Rate: 4.5 x 33.6kS/s



Plot 35 – Upper Channel



Plot 36 – Upper Channel

RADIATED SPURIOUS EMISSION TEST

FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Limits

1. 25.202 Emissions Limitations
   - (f) The mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:
   - (1) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth: 25 decibels;
   - (2) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth: 35 decibels;
   - (3) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 250% of the authorized bandwidth: an amount equal to 43 decibels plus 10 times logarithm (to the base 10) of the transmitter power in watts.

2. 2.1053 Measurements Required: Field Strength of Spurious Emissions
   - (a) Measurement shall be made to detect spurious emissions that may be radiated directly form the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.1049, as appropriate. For equipment operating on frequencies below 890MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.
   - (b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
   - (1) Those in which the spurious emission are required to be 60dB or more below the mean power of the transmitter.
   - (2) All equipment operating on frequencies higher than 25MHz.
   - (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
   - (4) Other types of equipment as required, when deemed necessary by the Commission.

FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESMI1	ESMI	849182/003 848926/007	21 Aug 2009
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	11 Jan 2009
MITEQ Preamplifier (0.1-26.5GHz) – PA4	NSP2650-N	604879	26 Jan 2009
Schaffner Bilog Antenna –BL4	CBL6112B	2593	19 May 2009
Schaffner Bilog Antenna	CBL6112D	22020	19 May 2009
K & L Variable Bandstop Filter (1GHz - 2.0GHz)	3TNF-0008	436	13 Aug 2009
EMCO Horn Antenna – H14	3115	0003-6087	14 May 2009
EMCO Horn Antenna – H15	3115	0003-6088	14 Mar 2009

RADIATED SPURIOUS EMISSION TEST

FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant antenna was set at the required test distance away from the EUT and supporting equipment boundary

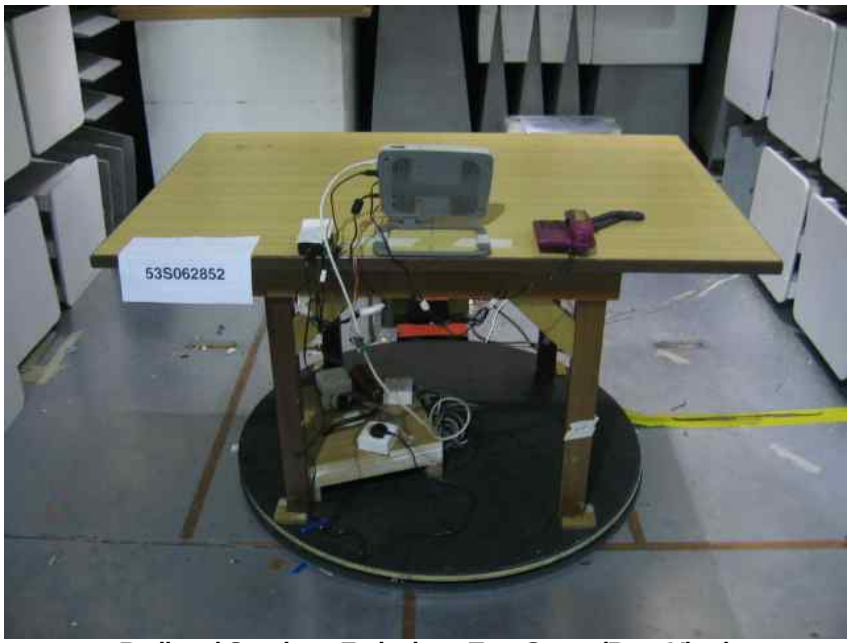
FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Method

1. The EUT was set to transmit at the maximum power at the lower channel with the modulation on at normal test condition.
2. The receiving antenna (test antenna) was set at vertical polarization with the height of 1m.
3. With the spectrum analyser was set to max hold enabled (peak detector mode), the spurious emissions were searched and recorded. For EUT which is a portable device, the spurious emission search was carried out by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces worst emissions.
4. For each spurious emission found, the test antenna was raised or lowered through the specified range of heights (1m – 4m) until a maximum signal level was detected on the test receiver.
5. The EUT was then rotated through 360º in the horizontal plane until the maximum signal was received. The maximum received signal level was recorded as A (in dBm).
6. The EUT was replaced with the substitution antenna with the antenna input was connected to the signal generator via a 10dB attenuator (if required).
7. The signal generator was set to the found spurious frequency. The output level of the signal generator was adjusted until the test receiver was at least 20dB above the level when the signal generator was switched off.
8. The test antenna was raised and lowered through the specified range of heights (1m – 4m) until the maximum signal level was received on the test receiver.
9. The substitution antenna was rotated until the maximum level was detected on the test receiver.
10. The output level of the signal generator was adjusted until the received signal level at the test receiver was equal to the level recorded in step 5 (A dBm). The signal generator output level was recorded as B (in dBm).
11. The spurious emission level, P (e.i.r.p) was computed as followed:

P (e.i.r.p)		=	B – C – D + E
where	C	=	cable loss between the signal generator and the substitution
	D	=	attenuation level if attenuator is used
	E	=	substitution antenna gain

12. The steps 2 to 11 were repeated with the receiving antenna was set to horizontal polarization.
13. Comparison was made on both measured results with vertical and horizontal polarizations. The highest value out of vertical and horizontal polarizations was recorded.
14. The steps 2 to 13 were repeated until all the spurious emissions (up to 10^{th} harmonics of the carrier frequency) were measured.
15. The steps 1 to 14 were repeated with the EUT was set to operate at the middle and upper channels respectively.

Radiated Spurious Emissions Test Setup (Front View)



Radiated Spurious Emissions Test Setup (Rear View)

RADIATED SPURIOUS EMISSION TEST

FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Results

Operating Mode	Satellite	Temperature	23 °C
Test Input Power	110V 60Hz	Relative Humidity	55%
Test Distance	3m	Atmospheric Pressure	1030mbar
		Tested By	Thor Wen Lei

Symbol Rate: 0.5 x 33.6kS/s

Lower Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
3.2532	-55.5	1
4.8798	-57.8	1
--	--	--
--	--	--
--	--	--
--	--	--

Middle Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
3.2872	-54.8	1
4.9305	-56.4	1
--	--	--
--	--	--
--	--	--
--	--	--

Upper Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
0.0721	-32.2	1
3.3207	-55.3	1
4.9810	-55.0	1
--	--	--
--	--	--
--	--	--

RADIATED SPURIOUS EMISSION TEST

FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Results

Operating Mode	Satellite	Temperature	23 °C
Test Input Power	110V 60Hz	Relative Humidity	55%
Test Distance	3m	Atmospheric Pressure	1030mbar
		Tested By	Thor Wen Lei

Symbol Rate: 4.5 x 33.6kS/s

Lower Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
3.2534	-55.4	1
4.8798	-56.1	1
--	--	--
--	--	--
--	--	--
--	--	--

Middle Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
3.2871	-55.6	1
4.9303	-56.2	1
--	--	--
--	--	--
--	--	--
--	--	--

Upper Channel

Frequency (GHz)	Amplitude (dBm)	Limit * See Notes 4, 5 & 6 (dBm)
0.8710	-31.3	1
3.3208	-55.1	1
4.9810	-55.4	1
--	--	--
--	--	--
--	--	--

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. "--" indicates no emissions were found and shows compliance to the limits.
4. The Resolution Bandwidth (RBW) was corrected from 4kHz by $10\log_{10}$ [(used RBW) / 4kHz].
5. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 20GHz
   RBW: 100kHz VBW: 300kHz
6. Emission limits are computed based on following:
   a. Emissions Limits (dBm) (50% - 100% authorised bandwidth) = P - 25 + CF
   b. Emissions Limits (dBm) (100% - 250% authorised bandwidth) = P - 35 + CF
   c. Emissions Limits (dBm) (> 250% authorised bandwidth) = $P - [43 + 10 \log_{10} P_W] + 30 + CF$

   where P = Measured mean power in dBm
   P_W = Meausred mean power in dBW
   CF = RBW correction factor (see Note 1)
7. Radiated Spurious Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25.0GHz (QP only @ 3m & 10m) is ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Limits

25.216(h)(i)(j) Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service

(h) Mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FC 03-283 (from November 6, 2003) with assigned uplink frequencies in the 1626.5MHz - 1660.5MHz band shall suppress the power density of emissions in the 1605MHz - 1610MHz band-segment to an extent determined by linear interoperation from -70dBW/MHz at 1605MHz to -46dBW/MHz at 1610MHz, averaged over any 2ms active transmission interval. The e.i.r.p of discrete emissions of less than 700Hz bandwidth from such stations shall not exceed a level determined by linear interoperation from -80dBW at 1605MHz to -56dBW at 1610MHz, averaged over any 2ms active transmission interval.

(i) The e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies between 1GHz and 3GHz shall not exceed -80dBW/MHz in the 1559MHz - 1610MHz band averaged over any 2ms interval.

(j) A Root-Mean-Square detector shall be used for all power density measurements.

FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESMI1	ESMI	849182/003 848926/007	21 Aug 2009
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	11 Jan 2009
MITEQ Preamplifier (0.1-26.5GHz) – PA4	NSP2650-N	604879	26 Jan 2009
Schaffner Bilog Antenna –BL4	CBL6112B	2593	19 May 2009
Schaffner Bilog Antenna	CBL6112D	22020	19 May 2009
K & L Variable Bandstop Filter (1GHz - 2.0GHz)	3TNF-0008	436	13 Aug 2009
EMCO Horn Antenna – H14	3115	0003-6087	14 May 2009
EMCO Horn Antenna – H15	3115	0003-6088	14 Mar 2009

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Setup

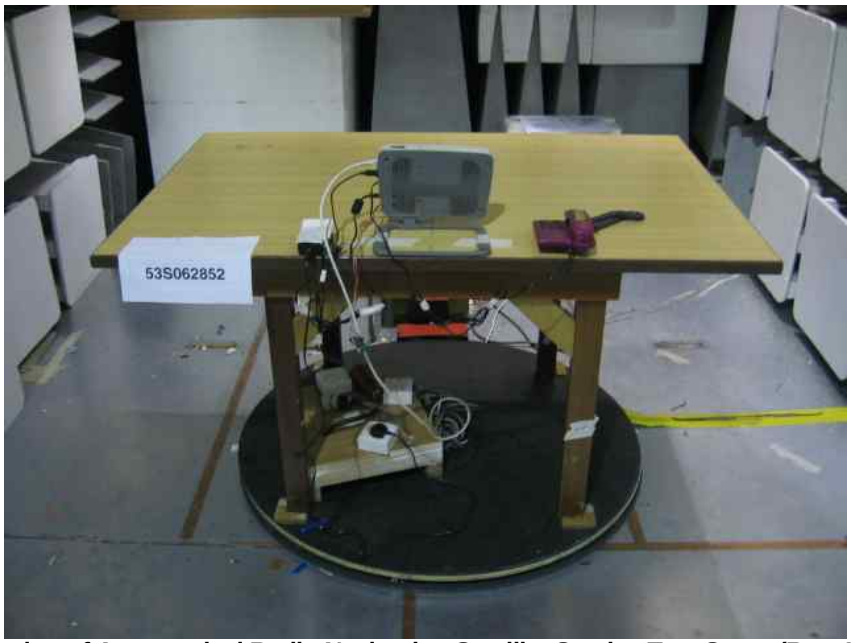
1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant antenna was set at the required test distance away from the EUT and supporting equipment boundary

FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Method

1. The EUT was set to transmit at the maximum power at the lower channel with the modulation on at normal test condition.
2. The receiving antenna (test antenna) was set at vertical polarization with the height of 1m.
3. A prescan was carried out in the frequency range under investigations with the EMI receiver set to max hold mode. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces such emissions.
4. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
5. The maximized emissions were plotted with inclusion of corrector factor of measured radiated emissions to EIRP.
6. The steps 1 to 5 were repeated with the EUT was set to operate at the middle and upper channels respectively.
7. The measurements were repeated with the EUT in carrier off state (standby).

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Protection of Aeronautical Radio Navigation Satellite Service Test Setup (Front View)



Protection of Aeronautical Radio Navigation Satellite Service Test Setup (Rear View)

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

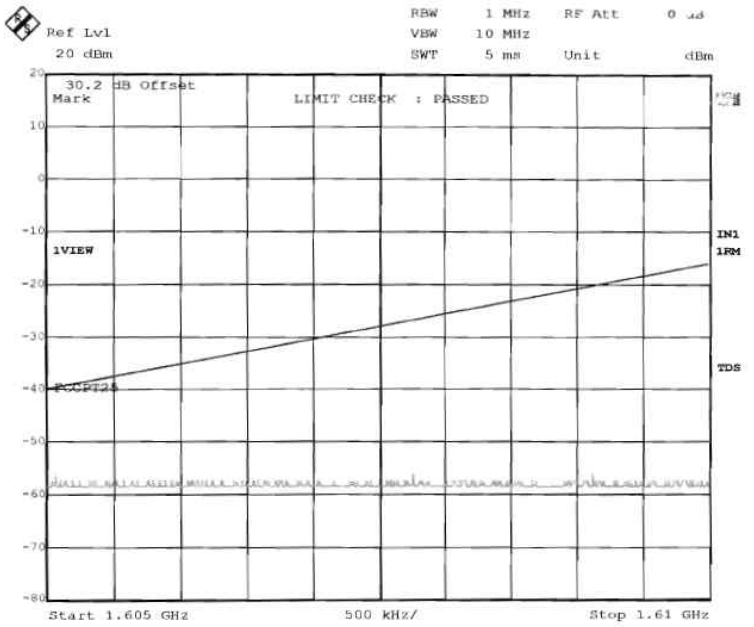
FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Results

Operating Mode	Satellite	Temperature	23 °C
Test Input Power	110V 60Hz	Relative Humidity	55%
Antenna Gain	8 dBi	Atmospheric Pressure	1030mbar
Attached Plots	37 - 43	Tested By	Thor Wen Lei

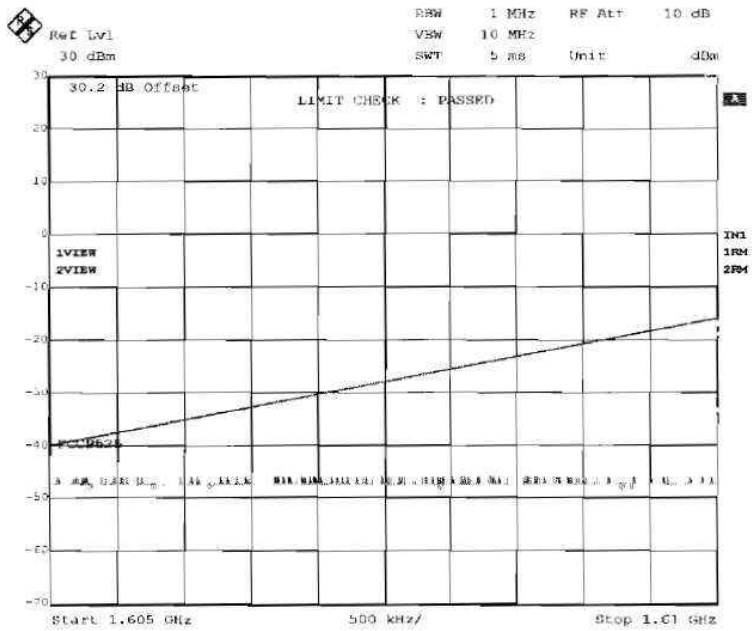
All spurious signals found were below the specified limit. Please refer to the attached plots.

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Symbol Rate: 0.5 x 33.6kS/s - Transmitter On



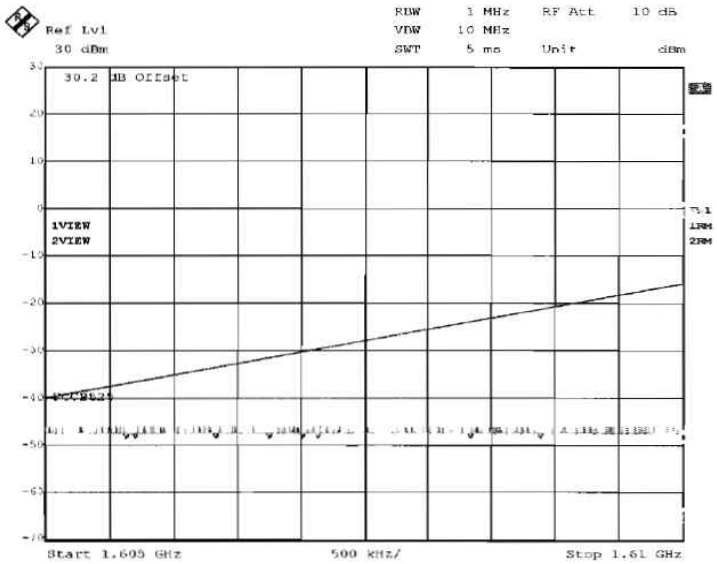
Plot 37 – Lower Channel



Plot 38 – Middle Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

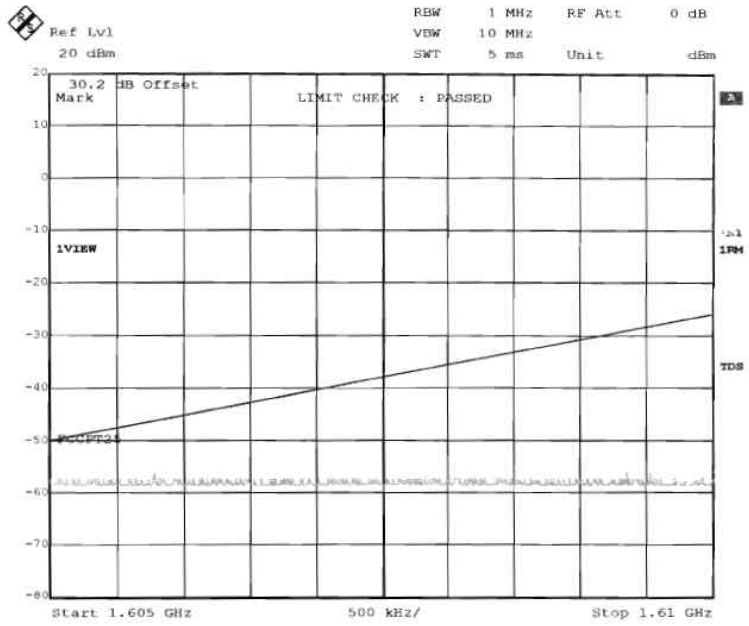
Symbol Rate: 0.5 x 33.6kS/s - Transmitter On



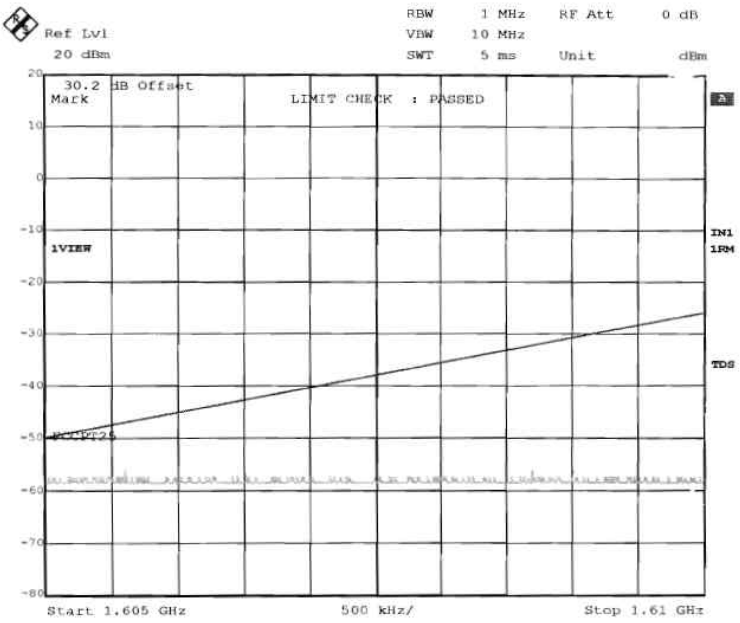
Plot 39 – Upper Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Symbol Rate: 4.5 x 33.6kS/s - Transmitter On



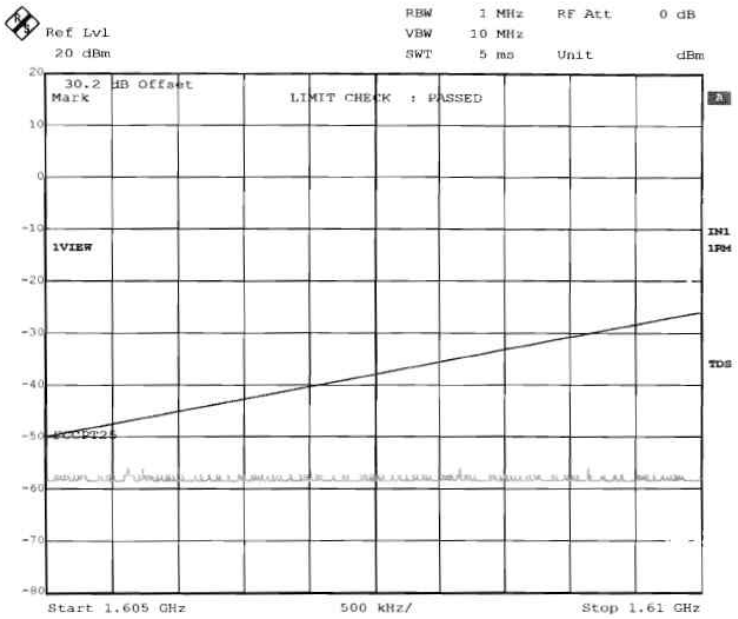
Plot 40 – Lower Channel



Plot 41 – Middle Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

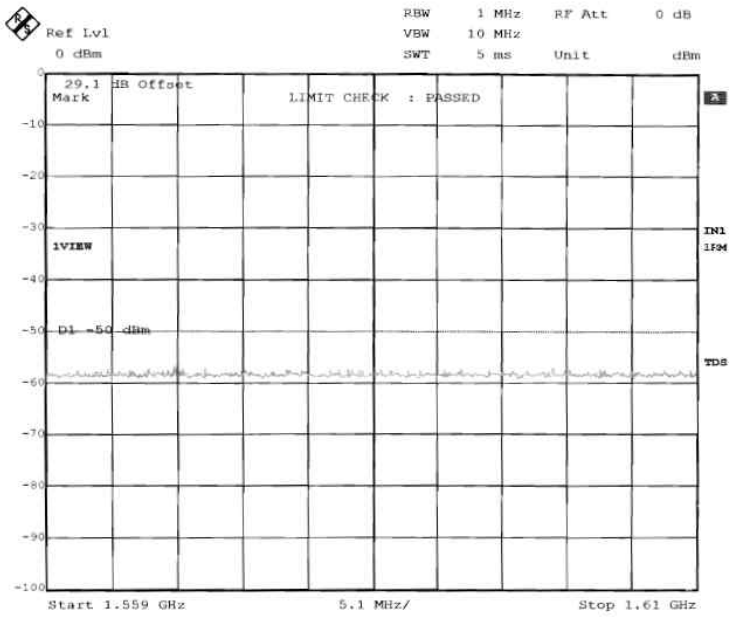
Symbol Rate: 4.5 x 33.6kS/s - Transmitter On



Plot 42 – Upper Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Carrier Off



Plot 43

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Limits

1. 25.202(d) Frequency Tolerance, Earth Stations
   The carrier frequency of each earth station transmitter authorised in these services shall be maintained within 0.001% (10ppm) of the reference frequency.

2. 2.1055 Measurements Required: Frequency Stability
   (a) The frequency stability shall be measured with variation of ambient temperature as follows:
   (1) From -30°C to +50°C for all equipment except that specified in paragraphs (a)(2) and (3) of this section.
   (b) Frequency measurements shall be made at the extremes of the specified temperature range and at interval of not more than 10°C throughout the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion of portions of the transmitter containing the frequency determining and stabilizing circuitry need to be subjected to the temperature variation test.
   (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
   (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
   (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
   (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	15 Jul 2009
HP Universal Counter	53132A	3736A06236	28 Mar 2009
JFW 20dB RF Attenuator	50FHC-020-15	Nil	13 Aug 2009

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Setup

1. The EUT and supporting equipment were set up as shown in the test setup photo. A temperature-controlled chamber was used.
2. The EUT was connected to an appropriate power source while all other supporting equipment were powered separately from another power source.
3. The RF antenna connector of the EUT was connected to the spectrum analyser via a RF attenuator and a low-loss coaxial cable.

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Method

1. The temperature chamber was set at 20^{o}C and permitted to stabilize. The EUT was set to transmit at lower channel without modulation. The carrier frequency was measured as the reference frequency.
2 With the EUT power removed, the temperature of the temperature chamber was set to -30^{o}C and permitted to stabilize.
3. The EUT was turned on and set to operate at lower channel without modulation. The maximum change in the carrier frequency was recorded within a minute.
4. The EUT was powered off and the temperature was raised to -20^{o}C.
5. The EUT was left stabilized for at least an hour before next measurement was taken as described in step 3.
6. The steps 4 and 5 were repeated with increment of temperature in 10^{o}C step until the temperature reached 50^{o}C.
7. The steps 1 to 6 were repeated with the EUT was set to operate at the middle and upper channels respectively.

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

Frequency Stability (Temperature Variation) Test Setup

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Results

Operating Mode	Satellite	Temperature	See table below
Test Input Power	110V 60Hz	Relative Humidity	30%
Test Distance	3m	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Lower Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (ppm)
-30	1.626592102	1.626592002	0.061478
-20	1.626592201	1.626592002	0.127875
-10	1.626592103	1.626592002	0.062093
0	1.626592209	1.626592002	0.127260
10	1.626592108	1.626592002	0.054101
20	1.626592002	1.626592002	0.000000
30	1.626592108	1.626592002	0.054101
40	1.626592104	1.626592002	0.062708
50	1.626592204	1.626592002	0.124186

Middle Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (ppm)
-30	1.643506923	1.643506803	0.073015
-20	1.643506865	1.643506803	0.037724
-10	1.643506712	1.643506803	-0.055369
0	1.643506716	1.643506803	-0.052936
10	1.643506912	1.643506803	0.066322
20	1.643506803	1.643506803	0.000000
30	1.643506954	1.643506803	0.091878
40	1.643506860	1.643506803	0.034682
50	1.643506900	1.643506803	0.059010

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

Upper Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (ppm)
-30	1.660333468	1.660333518	-0.030114
-20	1.660333389	1.660333518	-0.077595
-10	1.660333209	1.660333518	-0.186107
0	1.660333312	1.660333518	-0.127071
10	1.660333411	1.660333518	-0.064445
20	1.660333518	1.660333518	0.000000
30	1.660333325	1.660333518	-0.116242
40	1.660333339	1.660333518	-0.107810
50	1.660333788	1.660333518	0.162618

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Limits

1. 25.202(d) Frequency Tolerance, Earth Stations
   The carrier frequency of each earth station transmitter authorised in these services shall be maintained within 0.001% (10ppm) of the reference frequency.

2. 2.1055 Measurements Required: Frequency Stability
   (a) The frequency stability shall be measured with variation of ambient temperature as follows:
   (1) From -30°C to +50°C for all equipment except that specified in paragraphs (a)(2) and (3) of this section.
   (b) Frequency measurements shall be made at the extremes of the specified temperature range and at interval of not more than 10°C throughout the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion of portions of the transmitter containing the frequency determining and stabilizing circuitry need to be subjected to the temperature variation test.
   (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
   (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
   (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
   (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	15 Jul 2009
HP Universal Counter	53132A	3736A06236	28 Mar 2009
JFW 20dB RF Attenuator	50FHC-020-15	Nil	13 Aug 2009

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Setup

1. The EUT and supporting equipment were set up as shown in the test setup photo. A temperature-controlled chamber was used.
2. The EUT was connected to an appropriate power source while all other supporting equipment were powered separately from another power source.
3. The RF antenna connector of the EUT was connected to the spectrum analyser via a RF attenuator and a low-loss coaxial cable.

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Method

1. The temperature chamber was set at 20^{o}C and permitted to stabilize. The EUT was set to transmit at lower channel without modulation. The carrier frequency was measured as the reference frequency.
2. The EUT was powered from 85% of the nominal supplied voltage and set to operate at lower channel without modulation.
3. The EUT power was varied from 85% to 115% of the nominal supplied voltage. The carrier frequency variation was recorded.
4. The steps 1 to 3 were repeated with the EUT was set to operate at the middle and upper channels respectively.

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

Frequency Stability (Voltage Variation) Test Setup

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Results

Operating Mode	Satellite	Temperature	20°C
Test Input Power	See table below	Relative Humidity	30%
Test Distance	3m	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Lower Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (ppm)
93.5	1.626592209	1.626592002	0.127260
110.0	1.626592002	1.626592002	0.000000
126.5	1.626592225	1.626592002	0.137096

Middle Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (ppm)
93.5	1.643506917	1.643506803	0.069364
110.0	1.643506803	1.643506803	0.000000
126.5	1.643506999	1.643506803	0.119257

Upper Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (ppm)
93.5	1.660333290	1.660333518	-0.137322
110.0	1.660333518	1.660333518	0.000000
126.5	1.660333404	1.660333518	-0.068661

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (min)
0.3 - 1.34	614	1.63	100 Note 2	30
1.34 - 30	824 / f	2.19 / f	$180 / f^2$ Note 2	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
PMM 8053 Portable Field Meter	8053	0220J10308	15 Apr 2009
PMM Electric and Magnetic Field Analyzer	EHP-50A	1311L10515	15 Apr 2009

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Setup

1. The EUT and supporting equipment were set up as shown on the setup photo.
2. Prior the measurement, the minimum safe distance between the EUT and field probe was computed from the following formula:

$$P = (ED)^2 / (30G)$$

where P = Power density, W/m^2
E = Electric filed strength, V/m
d = Test distance, m
G = Numerical isotropic gain

3. The relevant field probe was then positioned at least at the computed test distance away from the EUT and supporting equipment boundary.

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was first carried out at one of the positions / sides of the EUT.
3. Power density measurement (mW/cm^2) was made using the field meter set to the required averaging time.
4. Steps 2 and 3 were repeated for the next position and its associate EUT operating mode, until all possible positions and modes were measured.

Sample Calculation Example

At 2400 MHz, limit = 1.0 mW/cm^2

Power density reading obtained directly from field meter = 0.3 mW/cm^2 averaged over the required 30 minutes.

Therefore, margin = 0.3 – 1.0 = -0.7 mW/cm^2 i.e. **0.7 mW/cm^2 below limit**

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

Maximum Permissible Exposure (MPE) Test Setup

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Operating Mode	Satellite	Temperature	24°C
Test Input Power	110V 60Hz	Relative Humidity	57%
Test Distance	60cm	Atmospheric Pressure	1030mbar
		Tested By	Lucas Beh

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm^2)	Margin (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Lower	1.6265	0.2	-0.8	30	1.0
Middle	1.6435	0.1	-0.9	30	1.0
Upper	1.6603	0.2	-0.8	30	1.0

Notes

1. All possible modes of operation were investigated. Only the worst case highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. The EUT shall maintain a minimum distance separation of 60cm from users during operation.
4. Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 0.1MHz – 3GHz is ±15% .

This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.

2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.

3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment.

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10. Unless otherwise stated, the tests are carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

January 2008

ANNEX A

EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR

Front View

Rear View

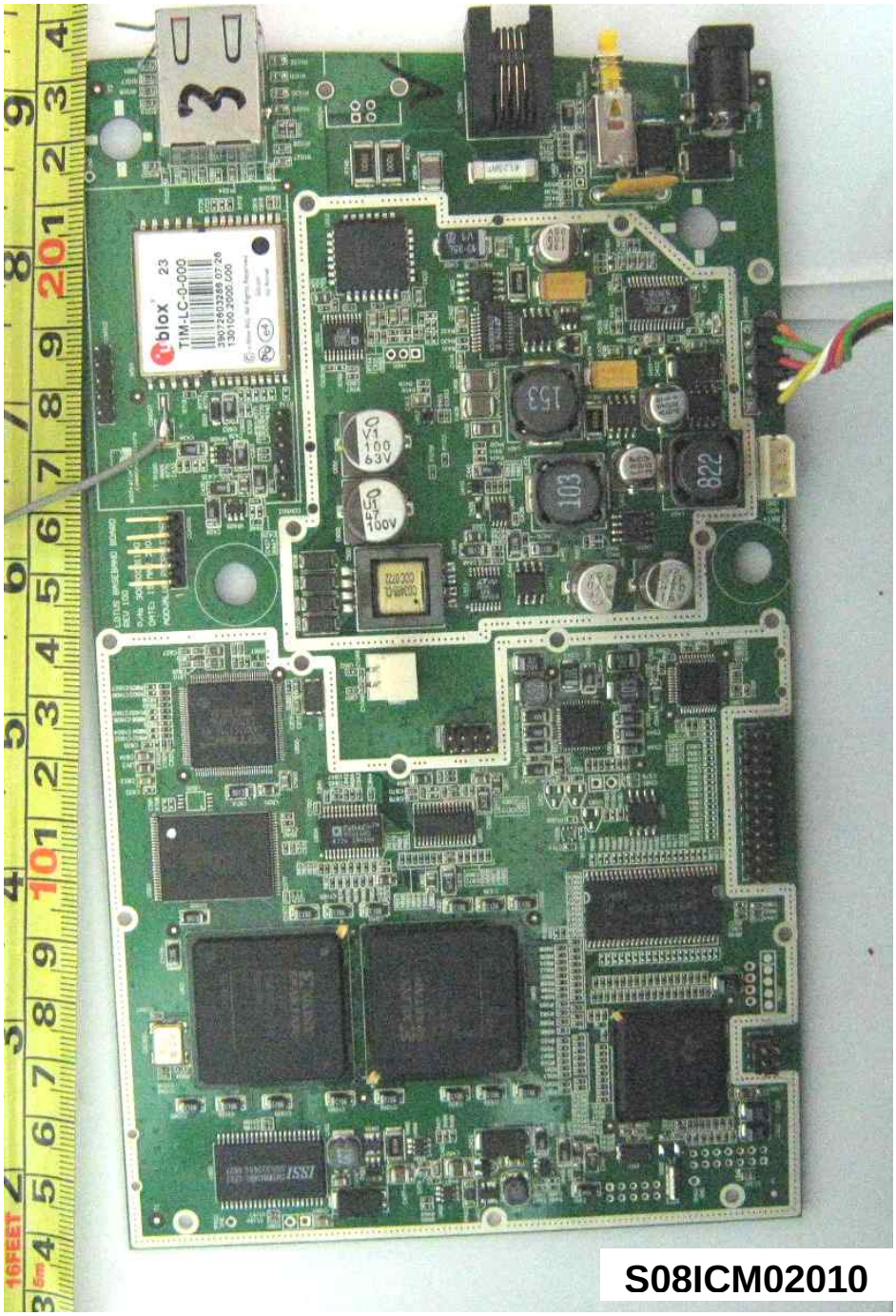
EUT PHOTOGRAPHS / DIAGRAMS ANNEX A

EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR

Internal View

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

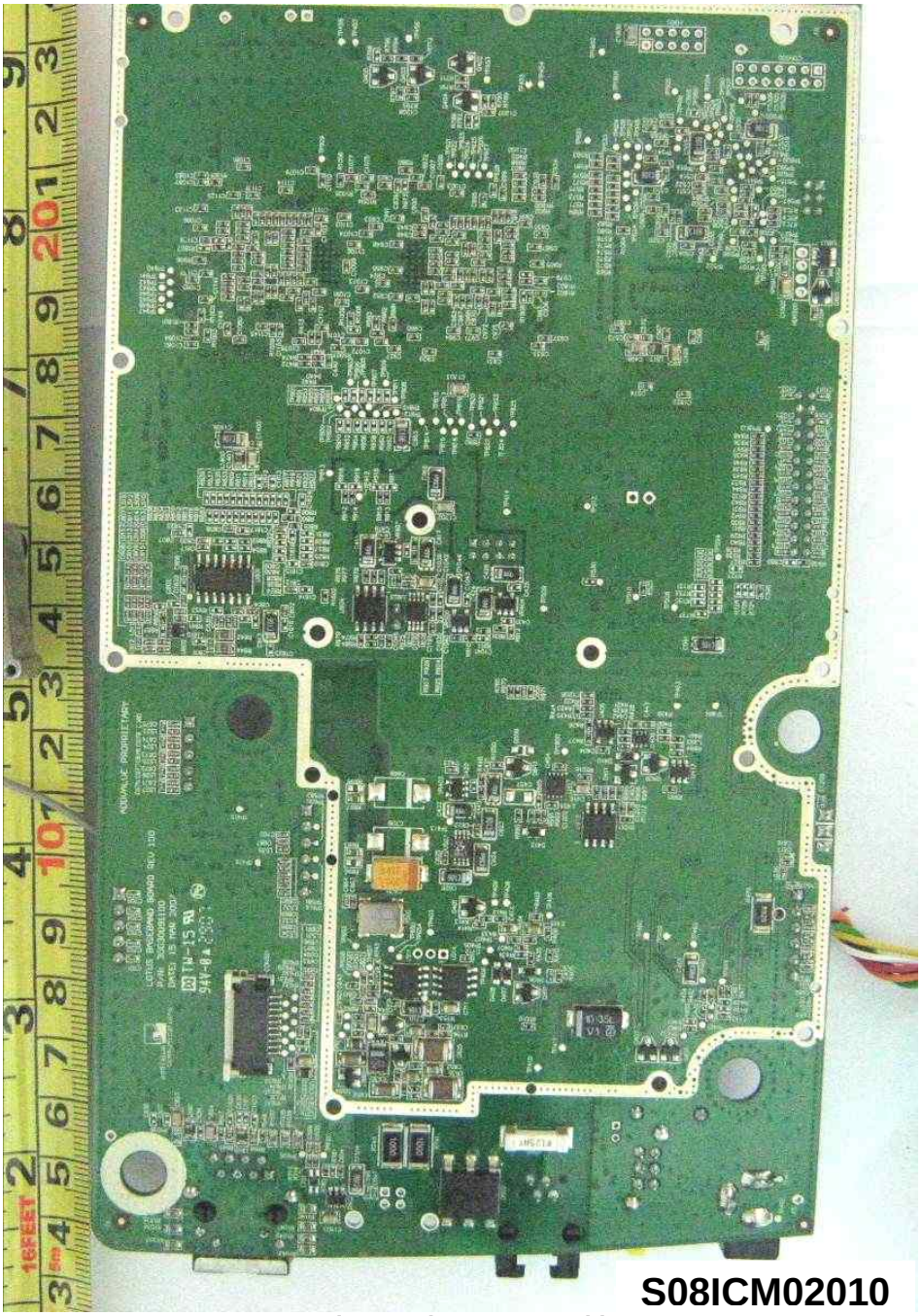
EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



Main-Board PCB Component Side

EUT PHOTOGRAPHS / DIAGRAMS ANNEX A

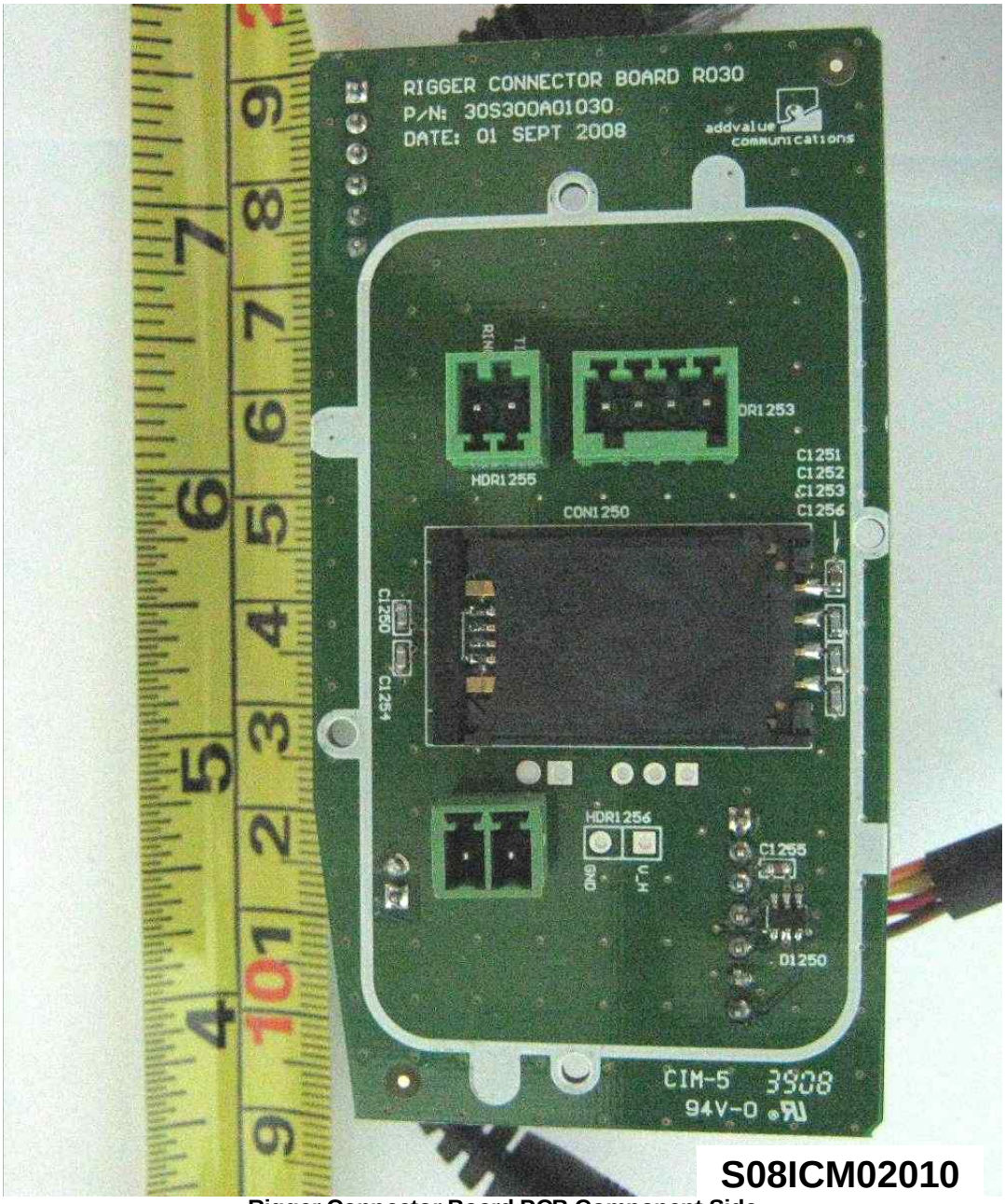
EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



Main-Board PCB Trace Side

EUT PHOTOGRAPHS / DIAGRAMS ANNEX A

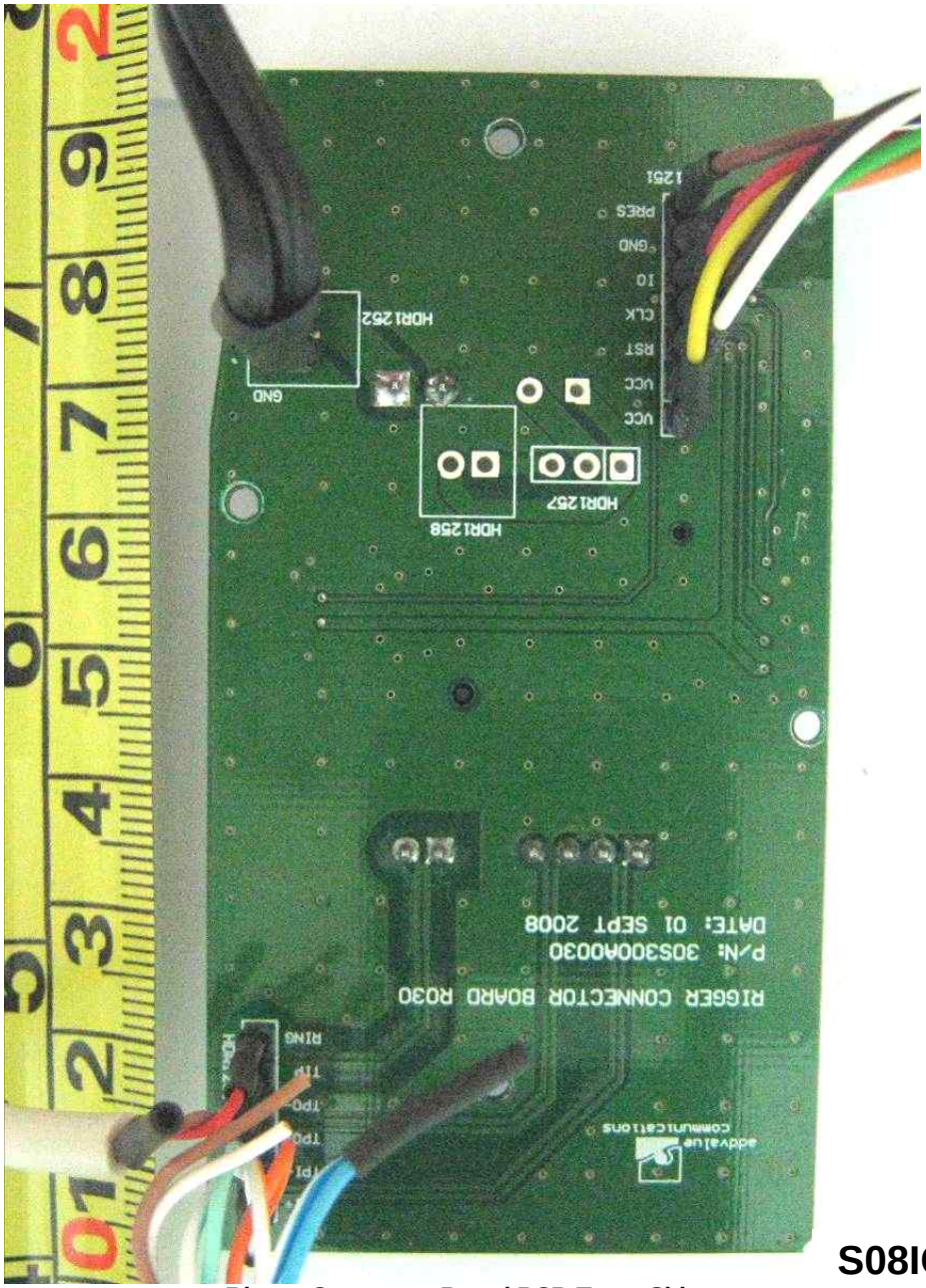
EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



Rigger Connector Board PCB Component Side

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



S08ICM02010

Rigger Connector Board PCB Trace Side

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR

Lotus UT Antenna Board PCB Component Side

EUT PHOTOGRAPHS / DIAGRAMS ANNEX A

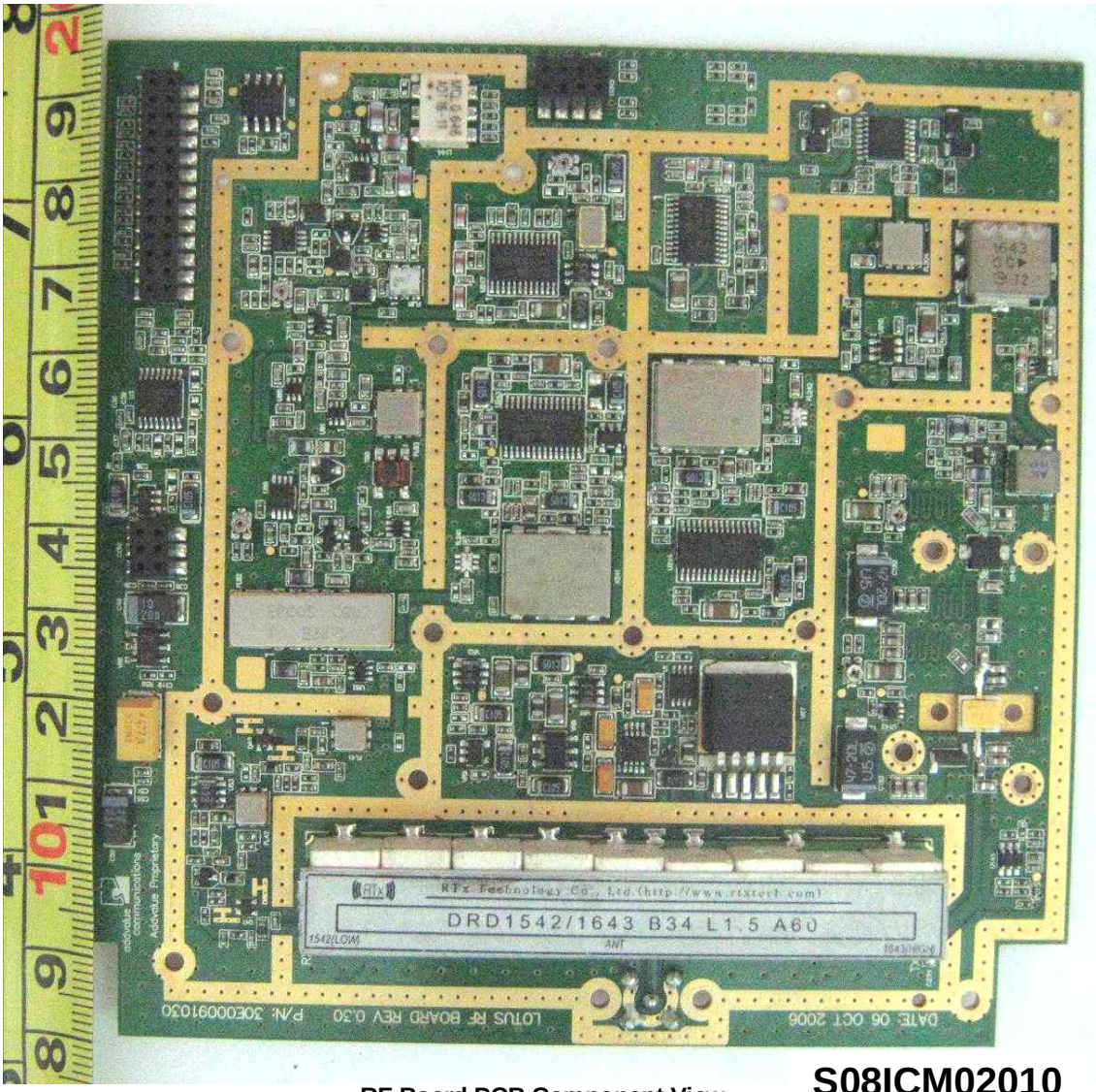
EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR

Lotus UT Antenna Board PCB Trace Side

S08ICM02010

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

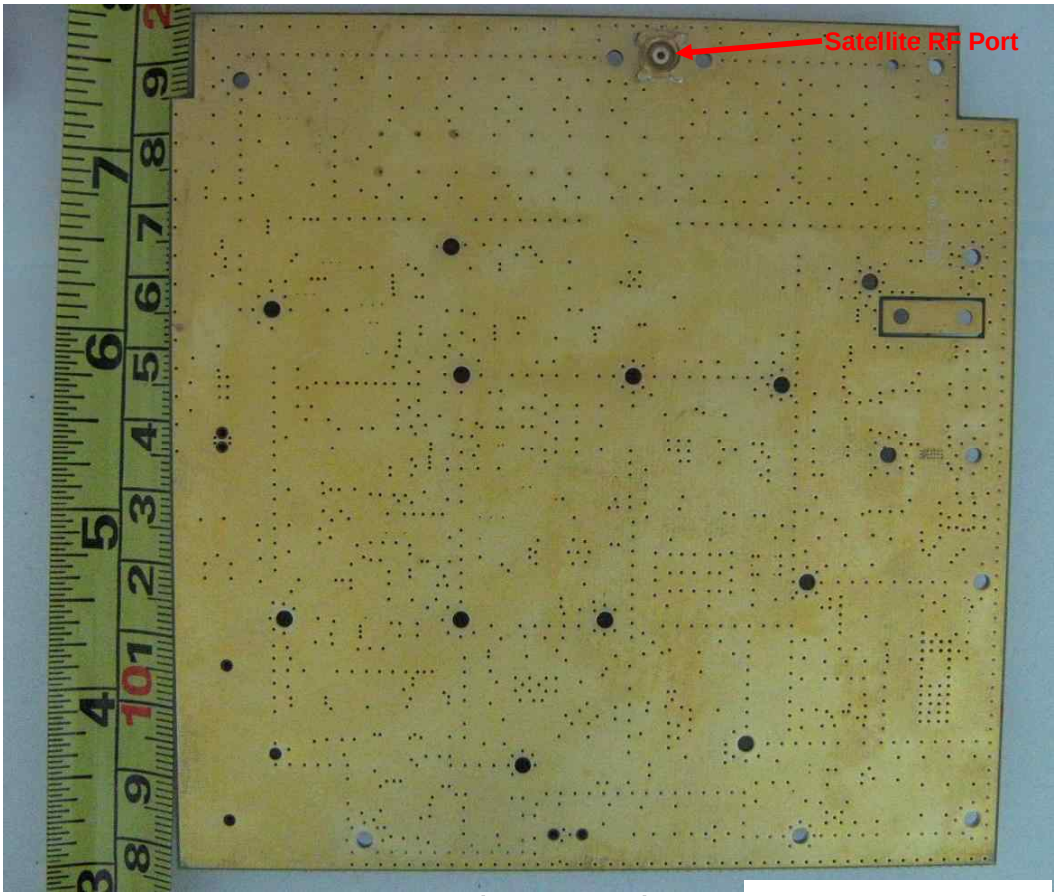
EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



RF Board PCB Component View **S08ICM02010**

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

EUT PHOTOGRAPHS - SATELLITE BROADBAND COMMUNICATOR



RF Board PCB Trace View **S08ICM02010**

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

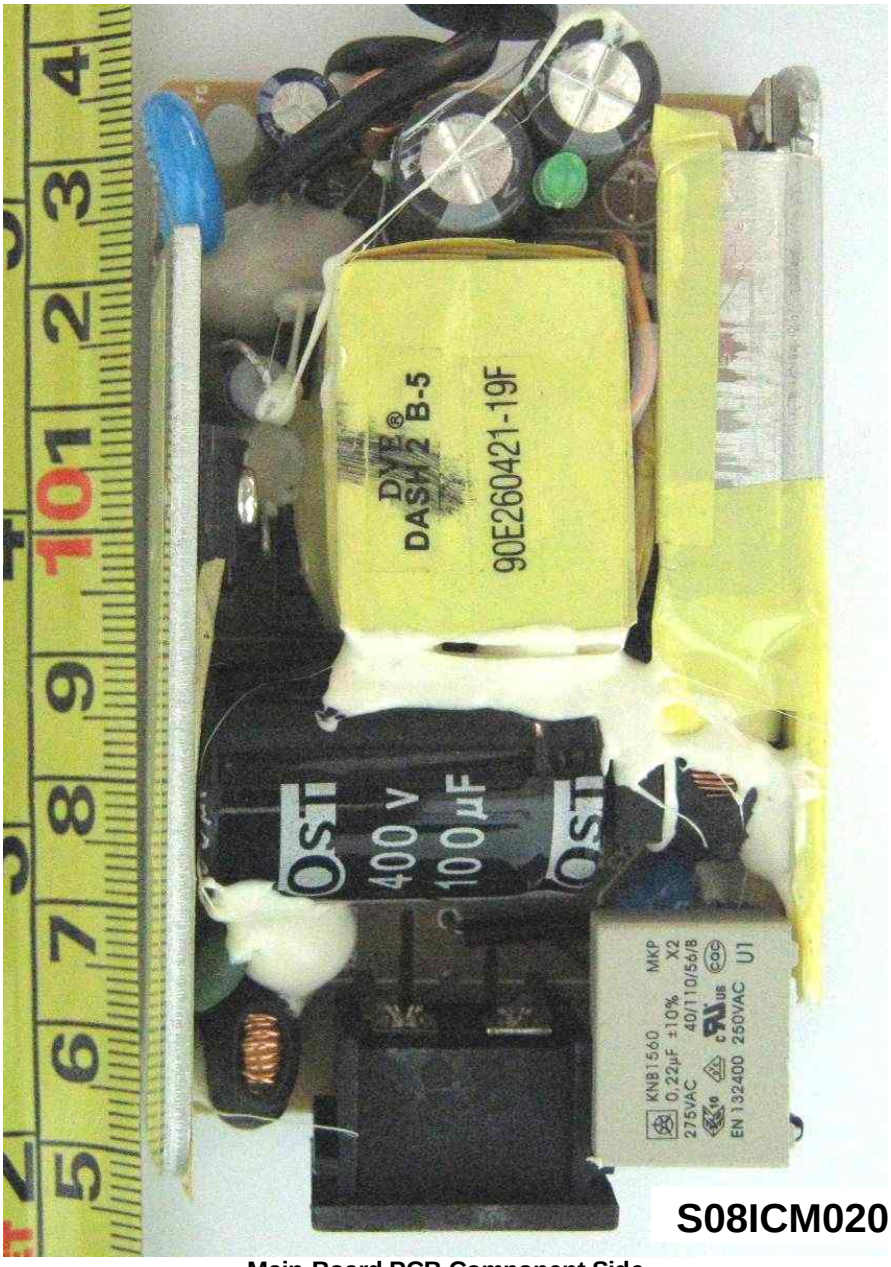
EUT PHOTOGRAPHS FOR POWER ADAPTER

Front View

Rear View

EUT PHOTOGRAPHS / DIAGRAMS ANNEX A

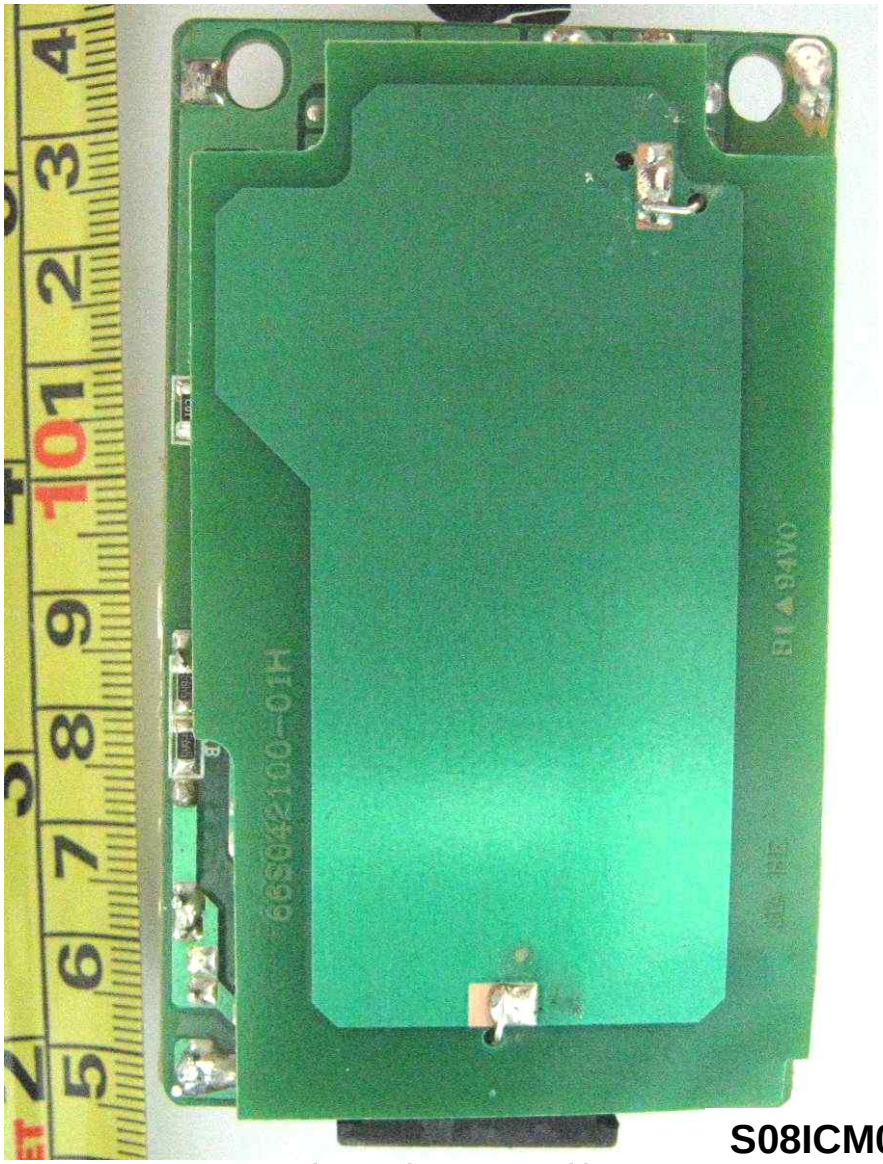
EUT PHOTOGRAPHS FOR POWER ADAPTER



Main-Board PCB Component Side

EUT PHOTOGRAPHS / DIAGRAMS — ANNEX A

EUT PHOTOGRAPHS



S08ICM02010

Main-Board PCB Trace Side

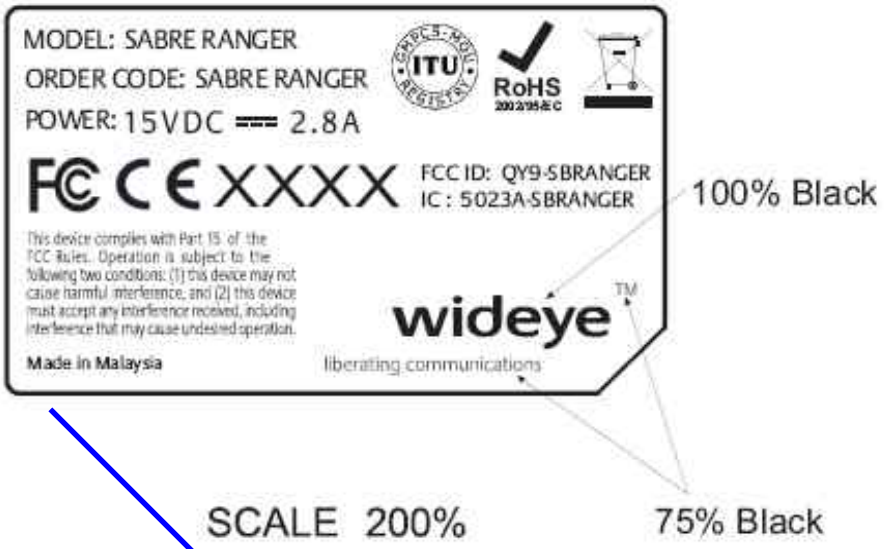
ANNEX B

FCC LABEL & POSITION

FCC LABEL & POSITION — ANNEX B

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.



Sample Label

Physical Location of FCC Label on EUT

ANNEX C

USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS

(Please refer to manufacturer for details)