

Test Report No. 7191076911-EEC13/04

dated 23 Dec 2013



PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 2, 15, and 25 : 2011
OF A
SATELLITE COMMUNICATION SYSTEM
[Model : Fleet One]
[FCC ID : QO4-AVIFLONEINM]

TEST FACILITY

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FCC REG. NO.

99142 (3m and 10m Semi-Anechoic Chamber, Science Park)

IND. CANADA REG. NO.

2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park)

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QUOTATION NUMBER

219150213 & 219154210 & 219185175

JOB NUMBER

7191032490 & 7191037808 & 7191076911

TEST PERIOD

02 May 2012 – 25 May 2012 & 11 Jul 2012 – 25 Jul 2012

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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
47 CFR FCC Parts 2, 15 and 25: 2011		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 3
15.109	Radiated Emissions (Class B)	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	Refer to page 103 for details

TEST SUMMARY

Notes

1. Three channels as listed below, which respectively represent the lower, middle and upper channels (transmit and receive) of the Equipment Under Test (EUT) when it was configured to operate under test mode condition.

Transmit Channel	Frequency (GHz)	Receive Channel	Frequency (GHz)
Lower Channel	1.6266	Lower Channel	1.5251
Middle Channel	1.6435	Middle Channel	1.5420
Upper Channel	1.6604	Upper Channel	1.5589
2. The following tests were based on conducted measurement method:
 - a. RF Output Power
 - b. Unwanted Emissions at Antenna Terminal
 - c. Frequency Stability (Temperature Variation)
 - d. Frequency Stability (Voltage Variation)
3. The Equipment Under Test (EUT) is a DC operated device and contains no provision for public utility connections (for Conducted Emissions)
4. All test measurement procedures are according to ANSI/TIA-603-B-2002.
5. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.
6. This report 7191076911-EEC13/04 was reproduced from TÜV SÜD PSB issued test report, 7191037808-EEC12/04 dated 01 Aug 2012 as per Addvalue Innovation Pte Ltd's declaration models **SKIPPER 150X & FleetOne** are identical in term of components, circuitry design, PCB layouts and mechanical structures. The full EMC tests were applied on **SKIPPER 150X**, the declared model **Fleet One** is deemed to fulfill relevant EMC requirement without further test.

Modifications

The EUT was brought to compliance to Radiated Emission by following modifications:

1. Changed L1805 from P0502NL to CN6962.
2. Changed L1804 from 7443330330 (3.3μH) to 7443330820 (8.2μH).
3. Changed L1805 from 7443330330 (3.3μH) to jumper wire.
4. Added capacitor 0.47nF from pin 5 of RY1801 to casing ground.
5. Added capacitor 0.47nF from GND1 to casing ground.

PRODUCT DESCRIPTION

Description	: The Equipment Under Test (EUT) is a SATELLITE COMMUNICATION SYSTEM .
Applicant	: Addvalue Innovation Pte Ltd 28 Tai Seng Link, Level 5 (Wing 2) Singapore 534158
Manufacturer	: Addvalue Innovation Pte Ltd 28 Tai Seng Link, Level 5 (Wing 2) Singapore 534158
Factor (ies)	: Beyonics Technology (Senai) Sdn Bhd PLO 171, Jalan Perindustrian 7, Kawasan Perindustrian Senai III 81400 Senai, Johor, Malaysia
Model Number	: SKIPPER 150X (Tested) Fleet One (Declared)
FCC ID	: QO4-AVIFLONEINM
Serial Number	: QB1501A121603001
Microprocessor	: OMAP5912
Operating Frequency	: 1626.5MHz – 1660.4MHz (Satellite Transmit) 1525.1MHz – 1558.9MHz (Satellite Receive) 1575MHz (GPS)
Clock / Oscillator Frequency	: <u>Baseband Board</u> 32.768kHz, 12.0MHz, 16.384MHz, 25.0MHz and 39.3216MHz
	<u>Below Deck Unit (BDU) Board</u> 24.192MHz
Port / Connectors	: 1 x RJ45 Ethernet port 1 x 10 Base-T Ethernet port (POE Line) 1 x RJ11 Phone port 1 x DC input port
Modulation / Emissions Designator	: pi/4QPSK and 16QAM (Satellite Transmit) pi/4QPSK and 16QAM (Satellite Receive) QPSK (GPS)
Antenna Gain	: 10.0dBi
Rated Input Power	: 12Vdc 8A / 24Vdc 4A
Accessories	: Primary Handset (Model : FB150-PH)

SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Acer Laptop PC	M/N: Travelmate 2420 S/N: XTB205106613077CFKS00 FCC ID: DoC	2.00m unshielded power cable 2.00m communication cable
Delta Electronics Power Adapter (Laptop)	M/N: SADP-65KB D S/N: 94W0610190186 FCC ID: Nil	2.00m unshielded power cable
Skipper 150 Primary Handset	M/N: FB150-PH S/N: EH150WM101000829 FCC ID: Nil	1x 1m shielded telephone cord
SpaceComm Above Deck Unit Antenna	M/N: AS FB150DST S/N: 1218P001 FCC ID: Nil	1x 25m shielded RF cable 1x 15m shielded RF cable
Atlas 12Vdc Battery	M/N: MF160G51 S/N: Nil FCC ID: Nil	2.00m unshielded battery cable

EUT OPERATING CONDITIONS

47 CFR FCC Parts 2, 15 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 following modes with the EUT simulating the transmission and reception using the client's provided test programs, "terra.exe" and "wftp32.exe"

Satellite Transmission Mode

- Continuous RF transmission at lower channel at maximum RF power
- Continuous RF transmission at middle channel at maximum RF power
- Continuous RF transmission at upper channel at maximum RF power

Satellite Reception (Receive) Mode

- Continuous RF reception at lower channel
- Continuous RF reception at middle channel
- Continuous RF reception at upper channel

GPS Reception (Receive) Mode

- Continuous GPS signal reception

RADIATED EMISSION TEST

47 CFR FCC Part 15.109 Radiated Emission Limits (Class B)

Frequency Range (MHz)	Quasi-Peak Limit Values (dB μ V/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.

47 CFR FCC Part 15.109 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	06 Jun 2013
K&L Microwave Band Reject Filter	3TNF-1000/2000-N/N	436	Output Monitor
Schaffner Bilog Antenna –(30MHz-2GHz) BL3 (Ref)	CBL6112B	2549	19 Jan 2013
EMCO Horn Antenna – H15	3115	0003-6088	20 May 2013
ETS Horn Antenna(18GHz-40GHz)(Ref)	3116	0004-2474	19 Apr 2013

RADIATED EMISSION TEST

47 CFR 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.

47 CFR 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 10th 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 = 37.0 dB μ V/m

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

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

Therefore, Q-P margin = 37.0 - 31.0 = 6.0

i.e. 6.0 dB below Q-P limit

RADIATED EMISSION TEST



Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)



RADIATED EMISSION TEST

47 CFR FCC Part 15.109 Radiated Emission Results

Operating Mode	Continuous Satellite Transmission	Temperature	22°C
Test Input Power	12Vdc	Relative Humidity	56%
Test Distance	3m	Atmospheric Pressure	1030mbar
	Tested By		Lim Kay Tak Tang Keng Xin

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Limit (dB μ V/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
33.1470	11.1	40.0	28.9	269	232	H	L
60.4530	24.6	40.0	15.4	207	164	V	L
131.0540	23.9	43.5	19.6	150	269	H	L
175.3240	13.3	43.5	30.2	190	84	H	L
190.5220	14.7	43.5	28.8	189	67	H	L
389.6400	9.2	46.0	36.8	98	176	H	L

Spurious Emissions above 1GHz

Freq (GHz)	Peak Value (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	AV Value (dB μ V/m)	AV Limit (dB μ V/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
1.1400	60.5	74.0	13.5	23.2	54.0	30.8	234	36	V	L
1.4354	60.7	74.0	13.3	24.4	54.0	29.6	271	43	V	L
1.9156	40.7	74.0	33.3	26.4	54.0	27.6	337	13	V	L
2.0566	46.6	74.0	27.4	27.5	54.0	26.5	356	104	V	L
2.6061	51.0	74.0	23.0	29.2	54.0	24.8	124	32	V	L
2.8895	52.1	74.0	21.9	30.3	54.0	23.7	164	100	V	L

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. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
30MHz - 1GHz
RBW: 120kHz VBW: 1MHz
>1GHz
RBW: 1MHz VBW: 1MHz
4. 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 ± 4.0 dB.

RF OUTPUT POWER TEST

47 CFR 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 $\theta: 0^\circ$
+40dBW + 3.0dBW in any 4kHz band for $0^\circ < \theta \leq 5^\circ$
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° 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.

47 CFR FCC Parts 2.1046 and 25.204 RF Output Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	25 May 2013
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor

RF OUTPUT POWER TEST

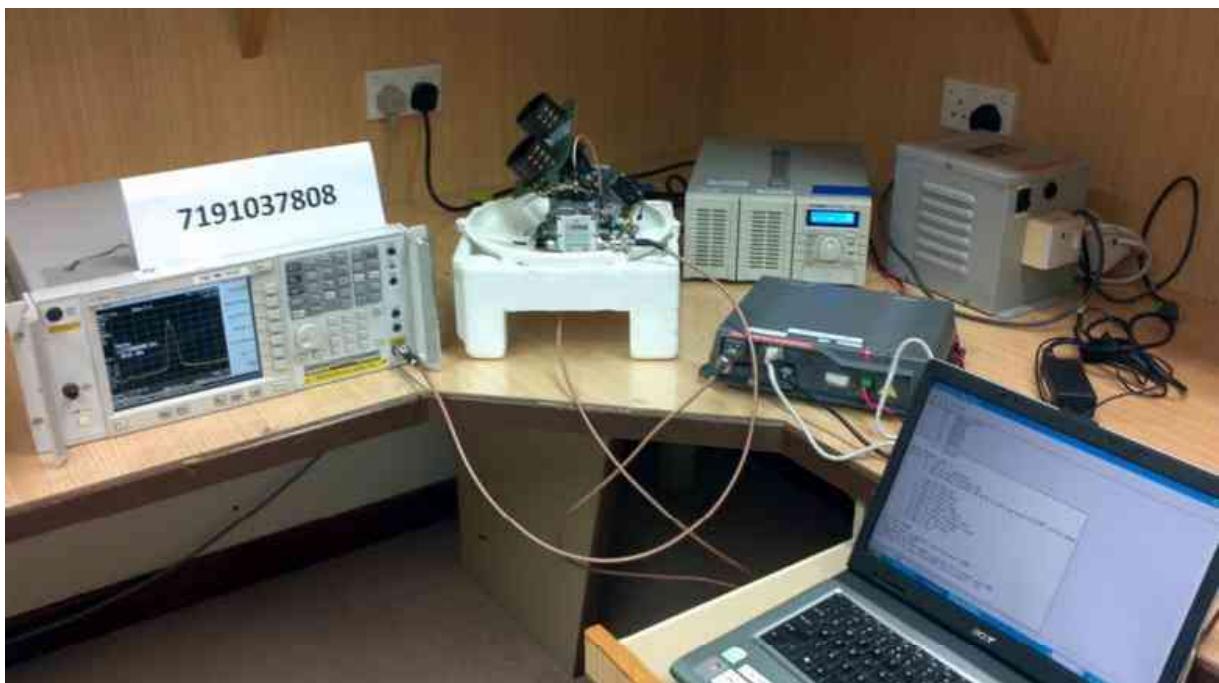
47 CFR FCC Parts 2.1046 and 25.204 RF Output Power Test Setup

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.

47 CFR 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



RF Output Power Test Setup

47 CFR FCC Parts 2.1046 and 25.204 RF Output Power Results

Operating Mode	Continuous Satellite transmission	Temperature	24°C
Test Input Power	12Vdc (Worst Voltage)	Relative Humidity	60%
Antenna Gain	10.0dBi	Atmospheric Pressure	1030mbar
Attached Plots	1 – 6	Tested By	Kyaw Soe Hein, Liau Lee Yin

Frequency (GHz)	Channel	Peak Output Power (dBm)		Average Output Power (dBm)	
		EIRP	ERP	EIRP	ERP
1.6266	Lower	41.40	39.25	41.40	39.25
1.6435	Middle	42.10	39.95	42.10	39.95
1.6604	Upper	42.85	40.70	42.85	40.70

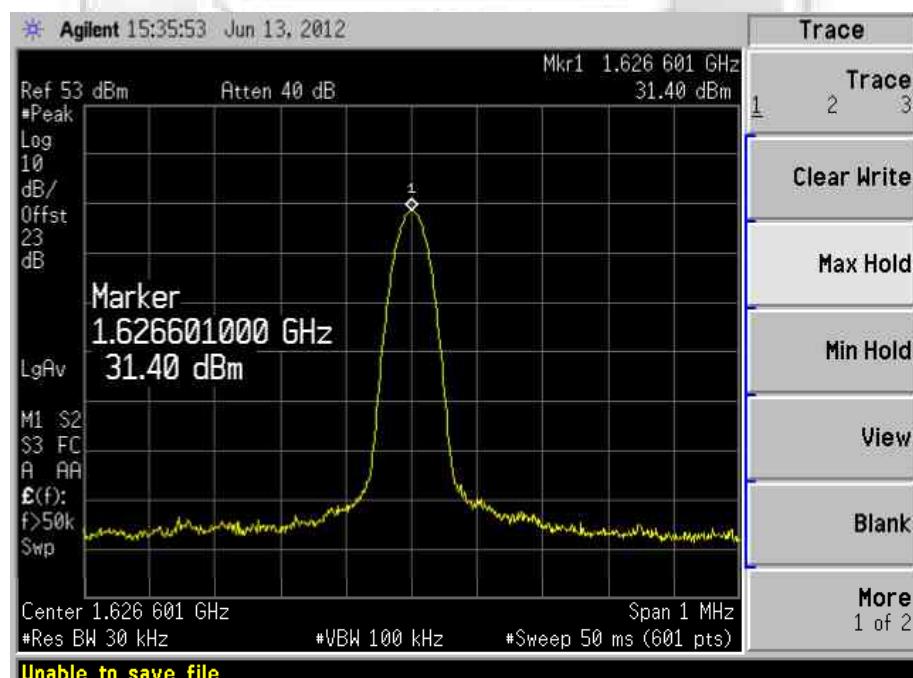
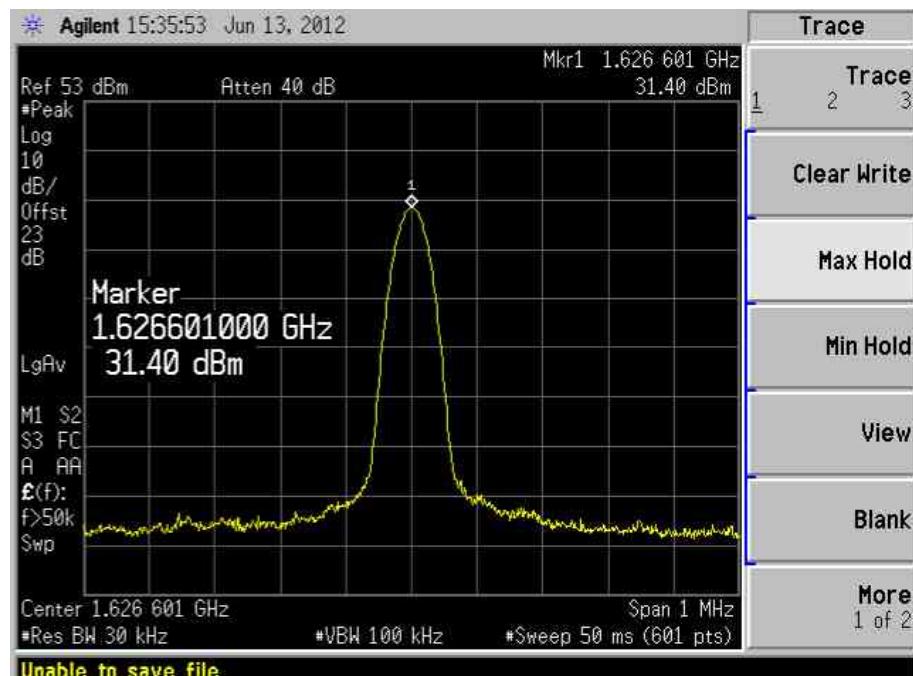
Notes

1. RF Output Power Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of 95%, with a coverage factor of 2 is $\pm 1.0\text{dB}$.

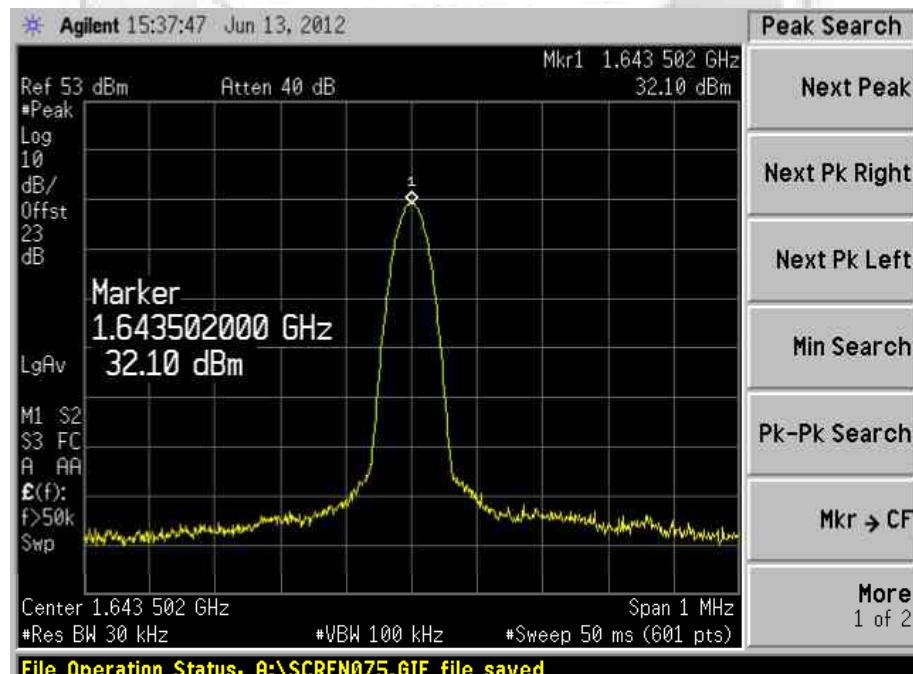
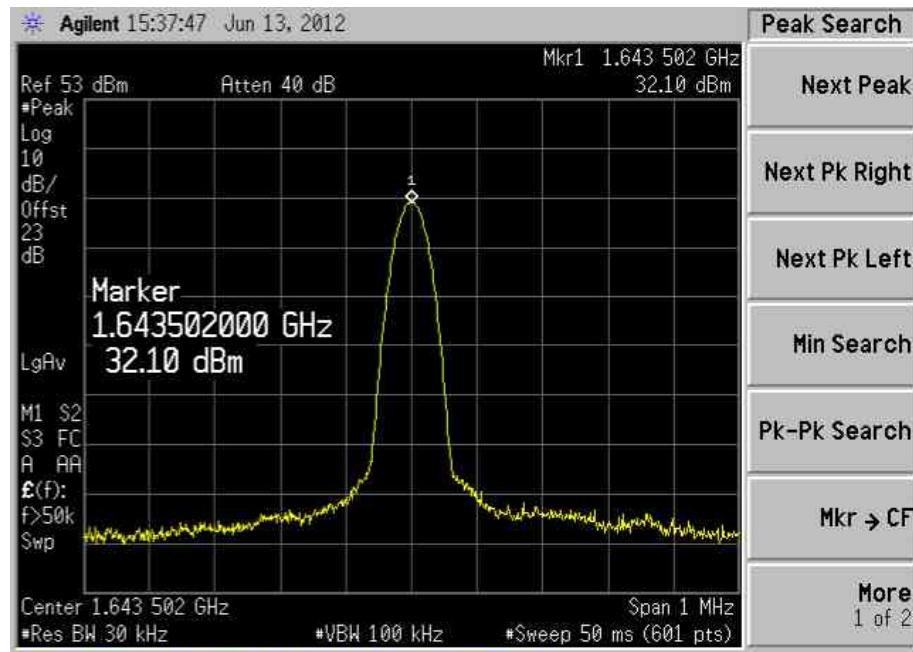
RF OUTPUT POWER TEST

Output Power Plots



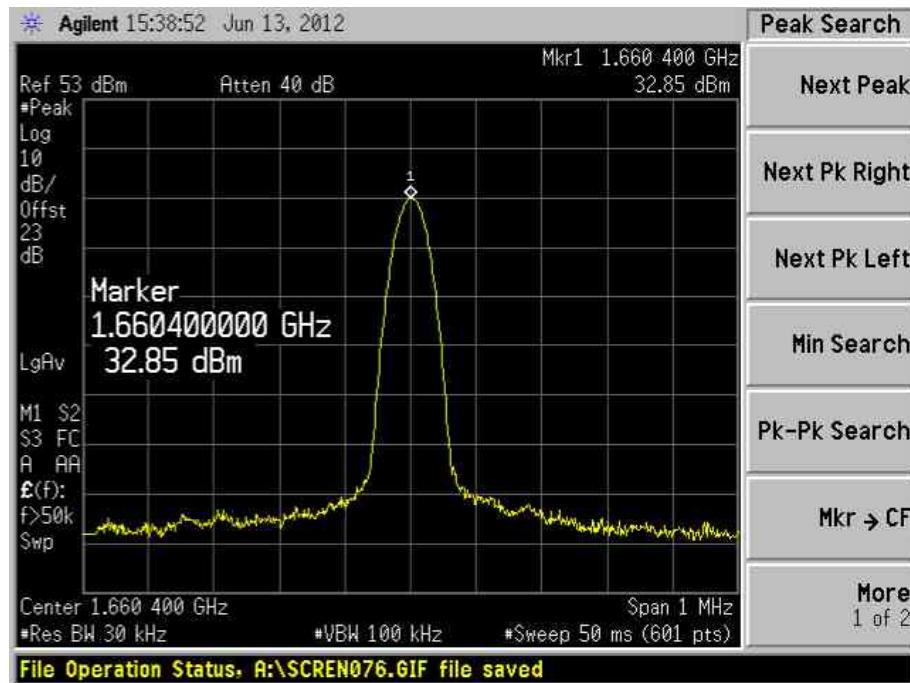
RF OUTPUT POWER TEST

Output Power Plots

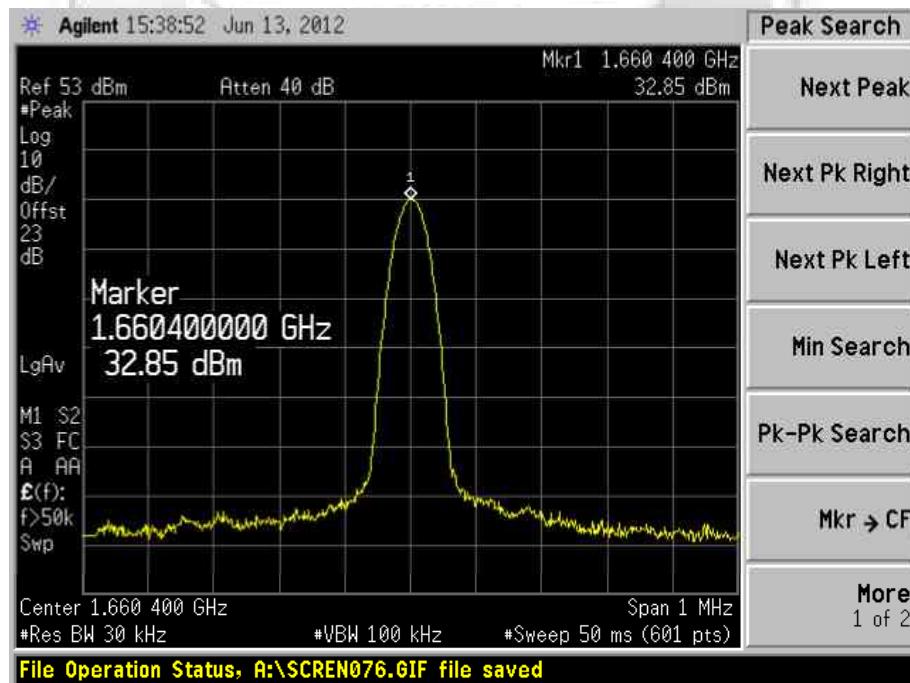


RF OUTPUT POWER TEST

Output Power Plots



Plot 5 – Upper Channel (Peak)



Plot 6 – Upper Channel (Average)

UNWANTED EMISSIONS AT ANTENNA TERMINAL 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 need 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
Agilent Spectrum Analyzer	E4440A	MY45304764	25 May 2013
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor
GW Instek Programmable Power Supply	PSH-3630A	RK200168	30 Jan 2013

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

47 CFR 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.

47 CFR 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



Unwanted Emissions at Antenna Terminal Test Setup

47 CFR FCC Parts 25.254(d)(6) and 2.1049 Occupied Bandwidth Results

Operating Mode	Continuous Satellite transmission	Temperature	23°C
Test Input Power	24Vdc (Worst Voltage)	Relative Humidity	55%
Antenna Gain	10.0dBi	Atmospheric Pressure	1030mbar
Attached Plots	7 – 27 (26dB Bandwidth) 28 – 48 (In Band Emissions) 49 – 90 (Out of Band Spurious)	Tested By	Kyaw Soe Hein, Liau Lee Yin

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

Notes

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

where P = Measured mean power in dBm
 P_w = Measured mean power in W
 CF = RBW correction factor (see Note 1)

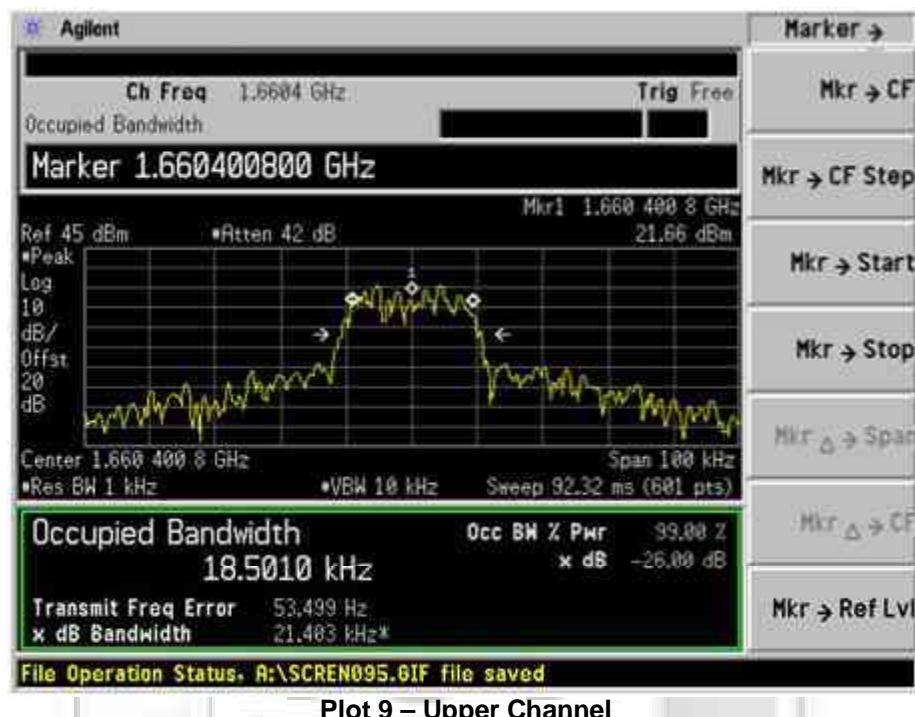
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 0)



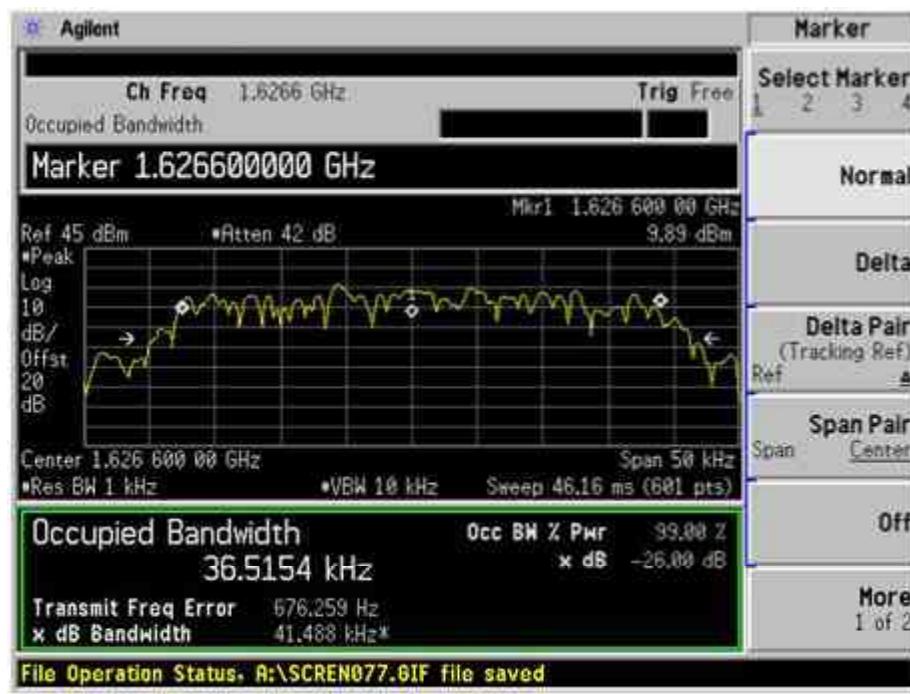
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 0)



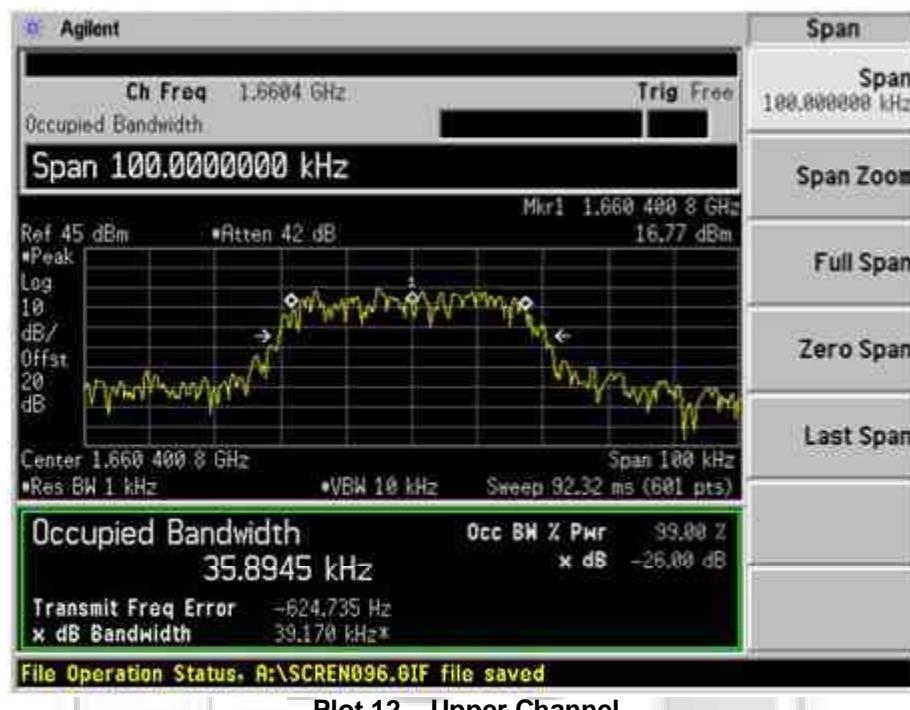
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 3)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 3)



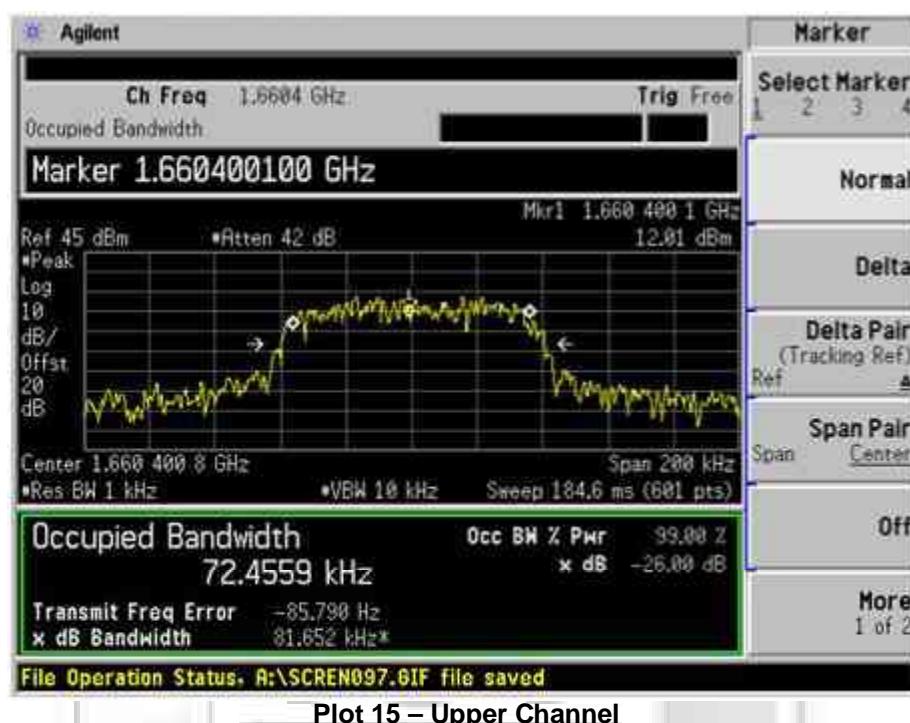
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 5)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 5)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 7)



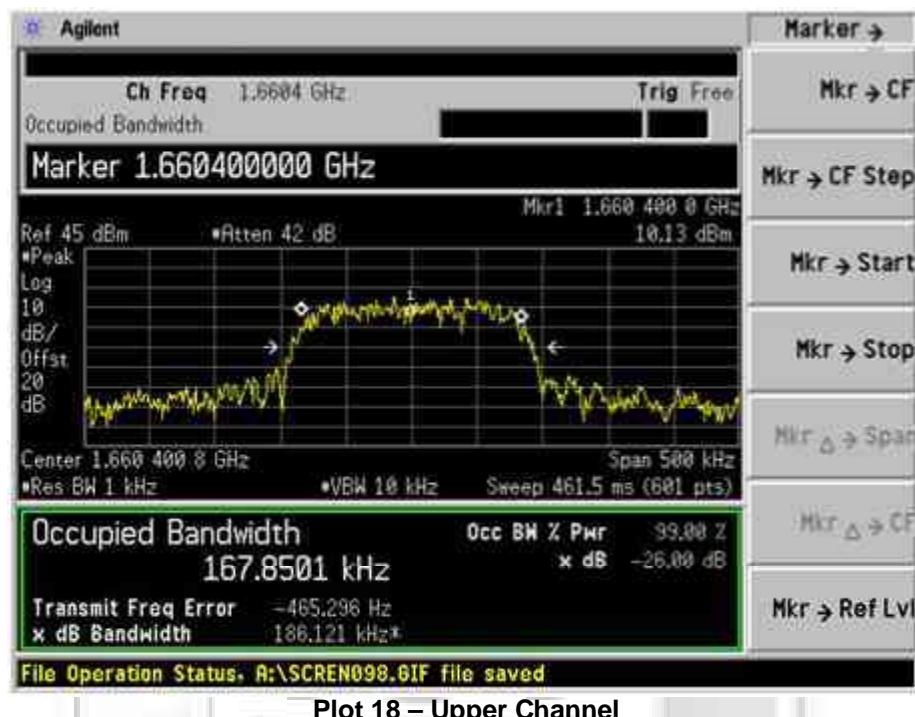
Plot 16 – Lower Channel



Plot 17 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 7)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 11)



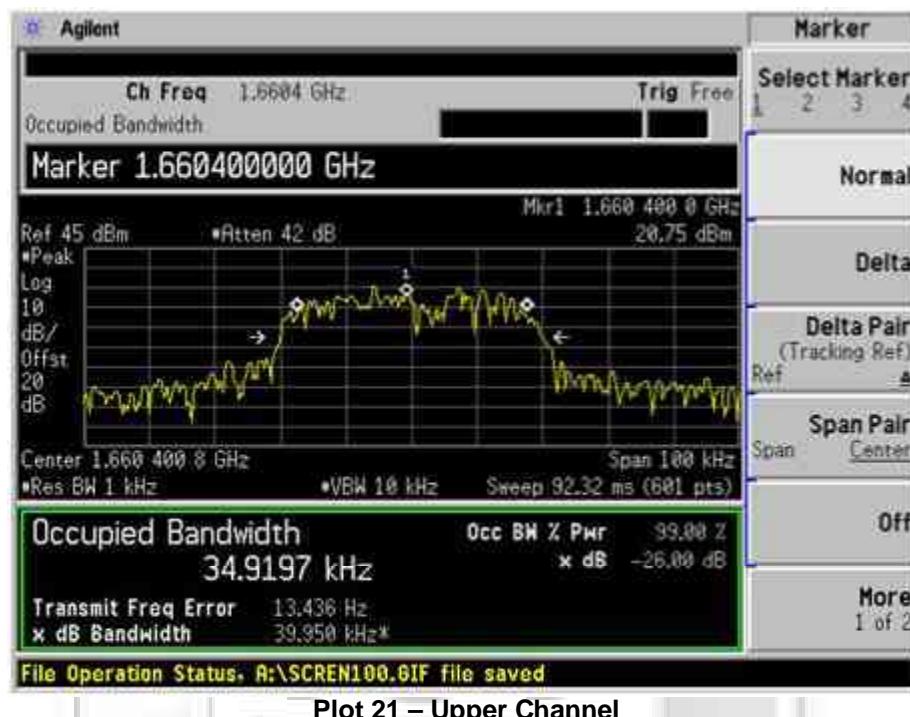
Plot 19 – Lower Channel



Plot 20 – Middle Channel

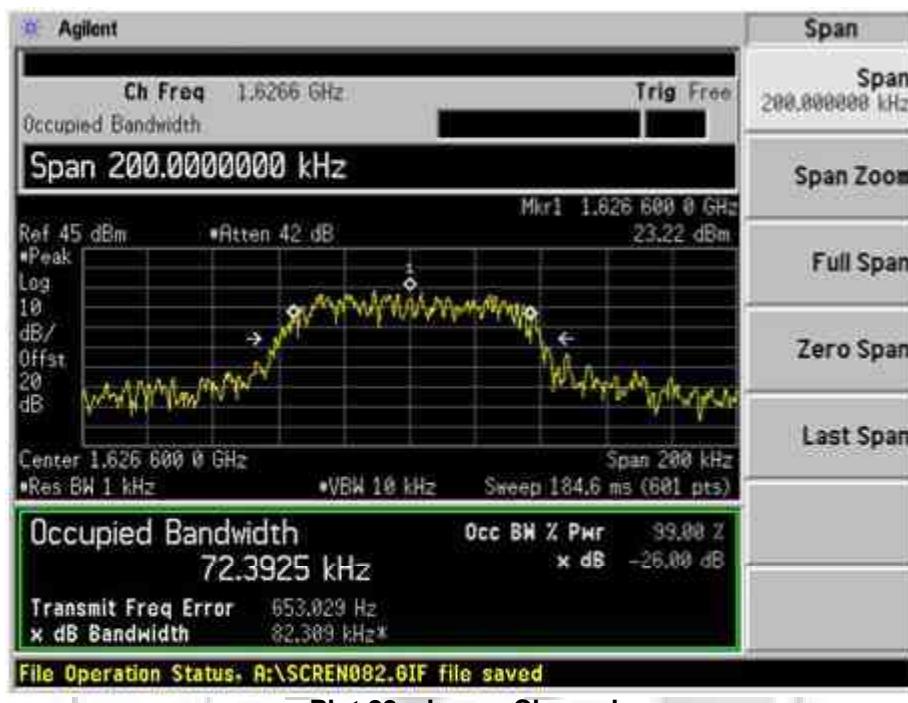
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 11)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 13)



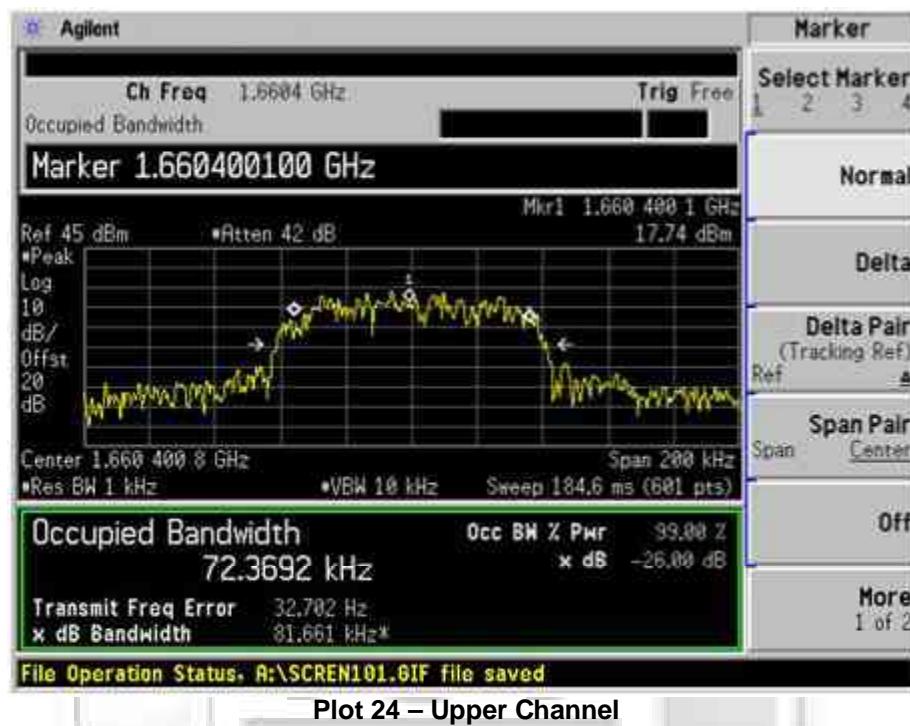
Plot 22 – Lower Channel



Plot 23 – Middle Channel

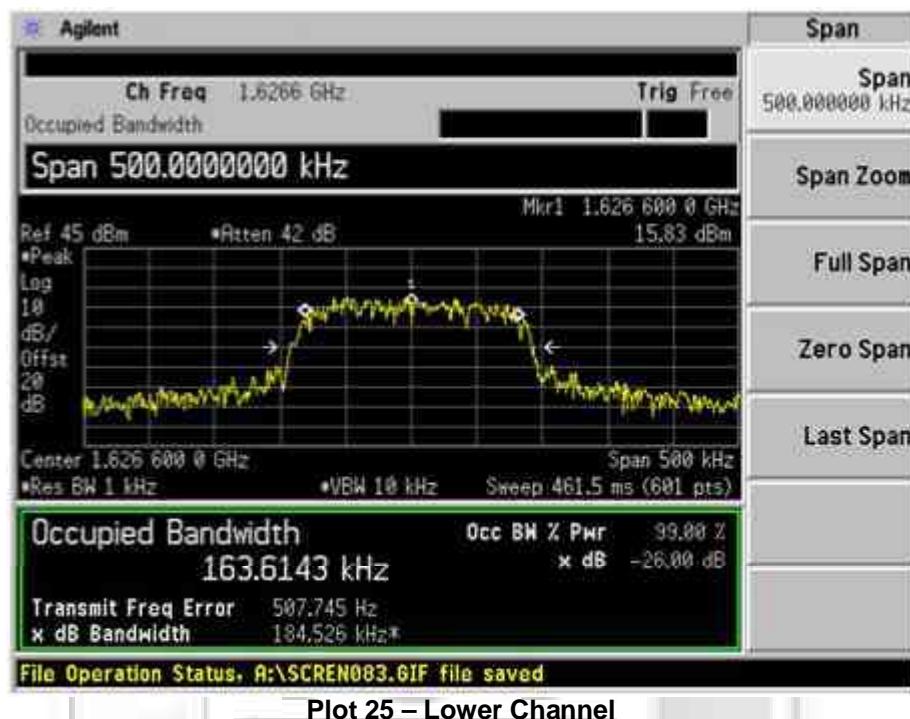
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 13)



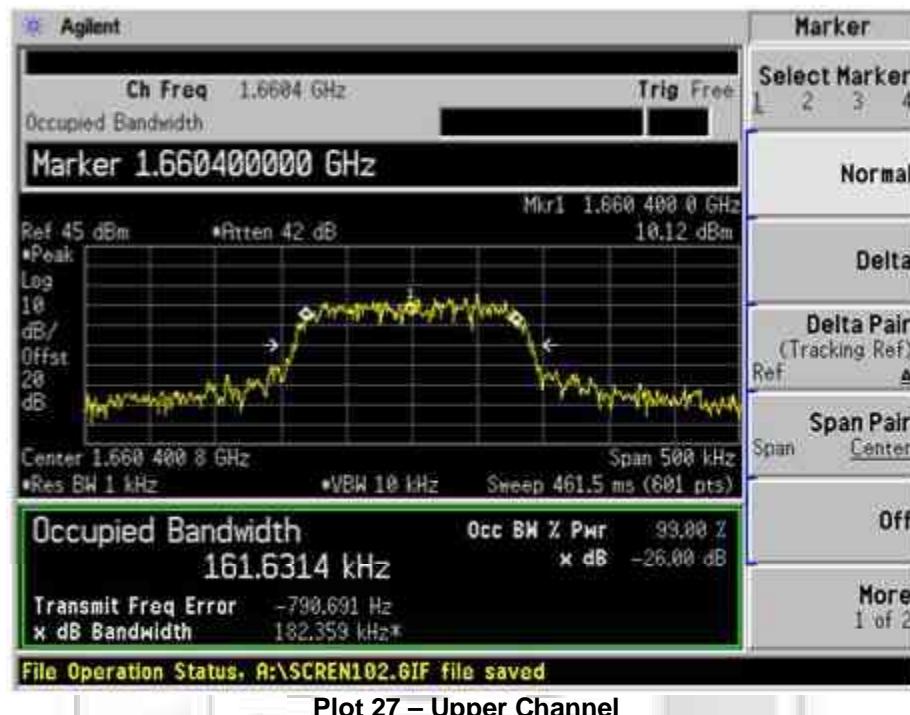
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 15)



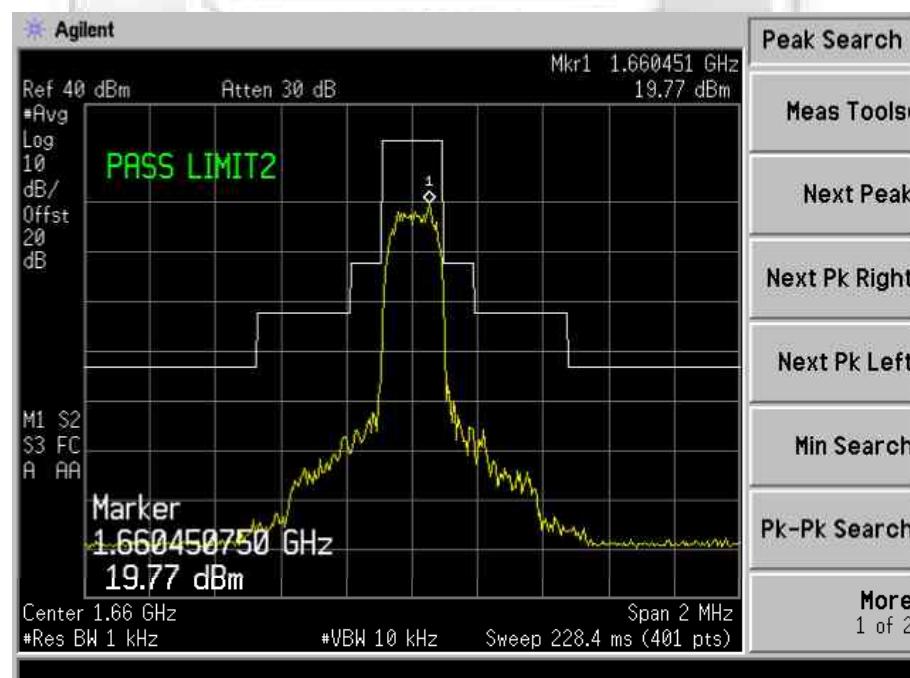
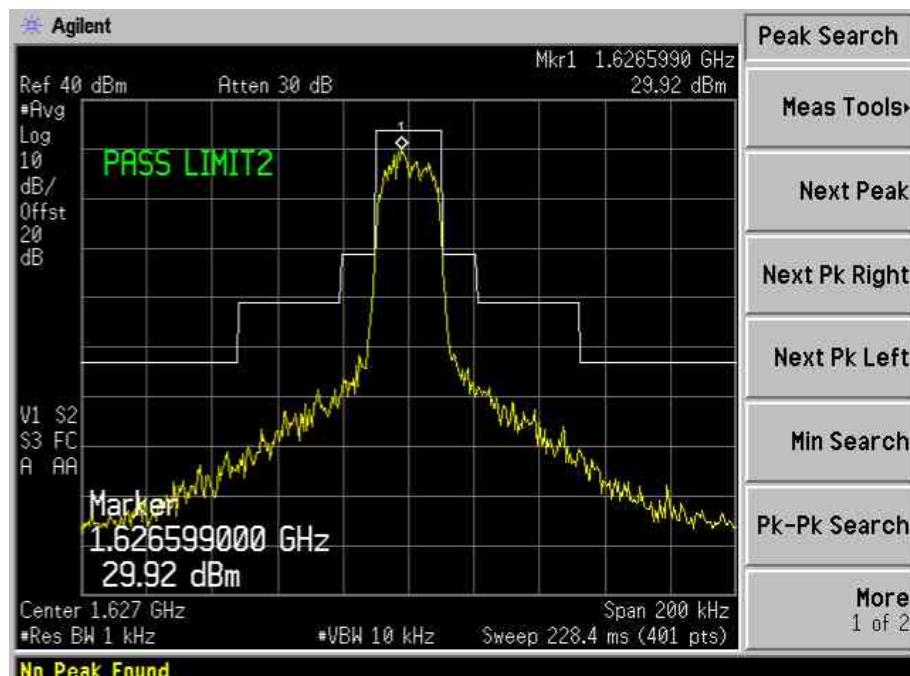
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

26dB Bandwidth Plots (Bearer Type: 15)



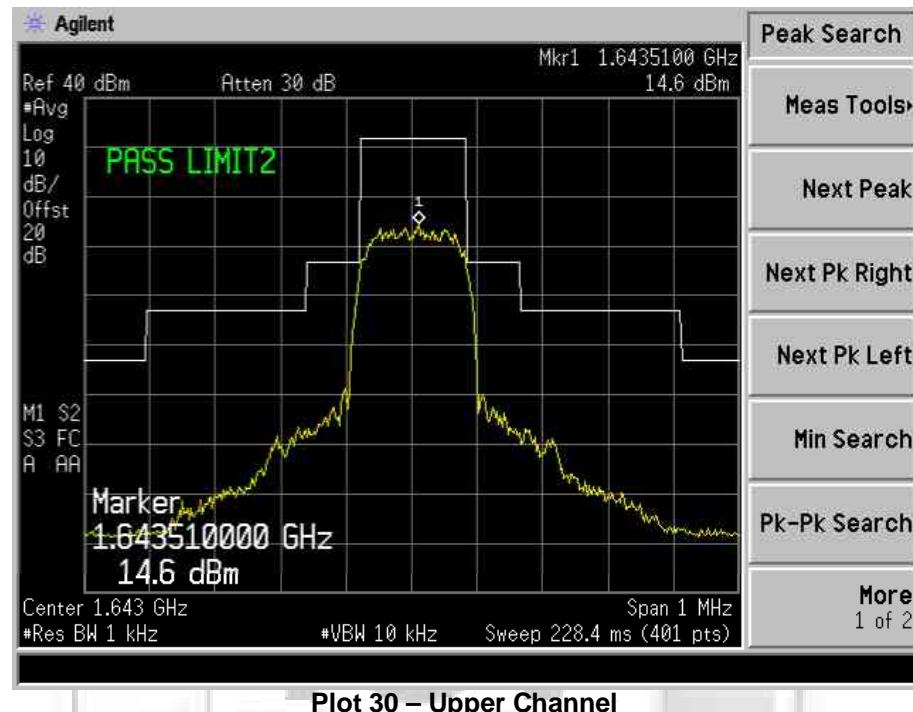
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 0)



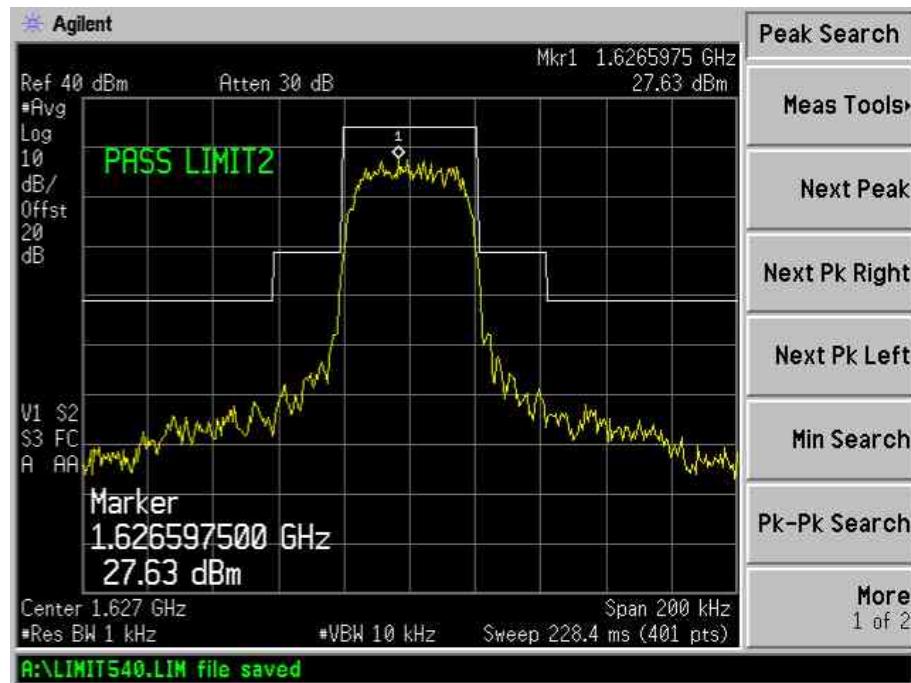
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 0)

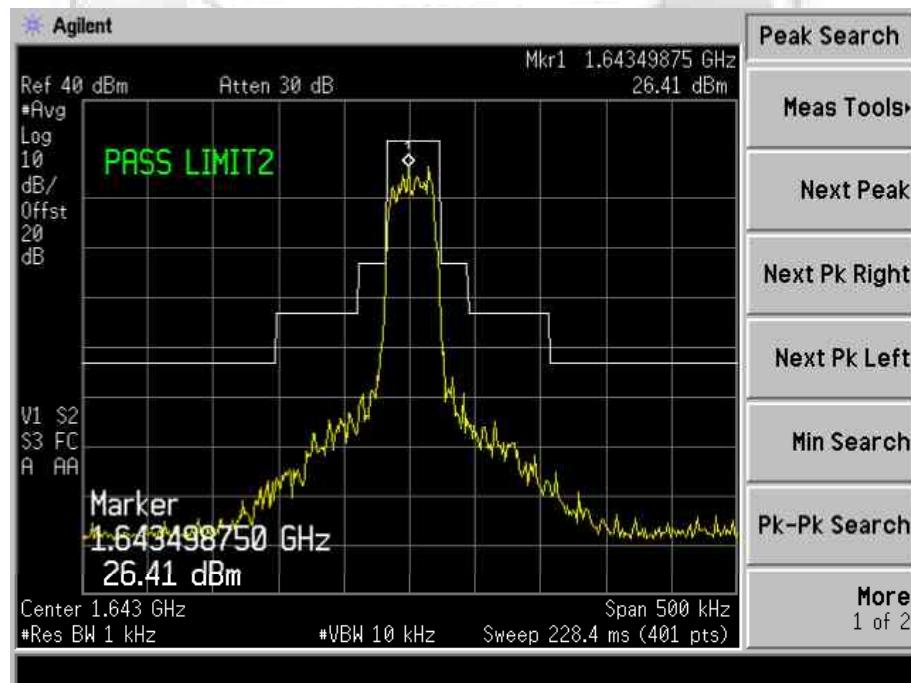


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 3)



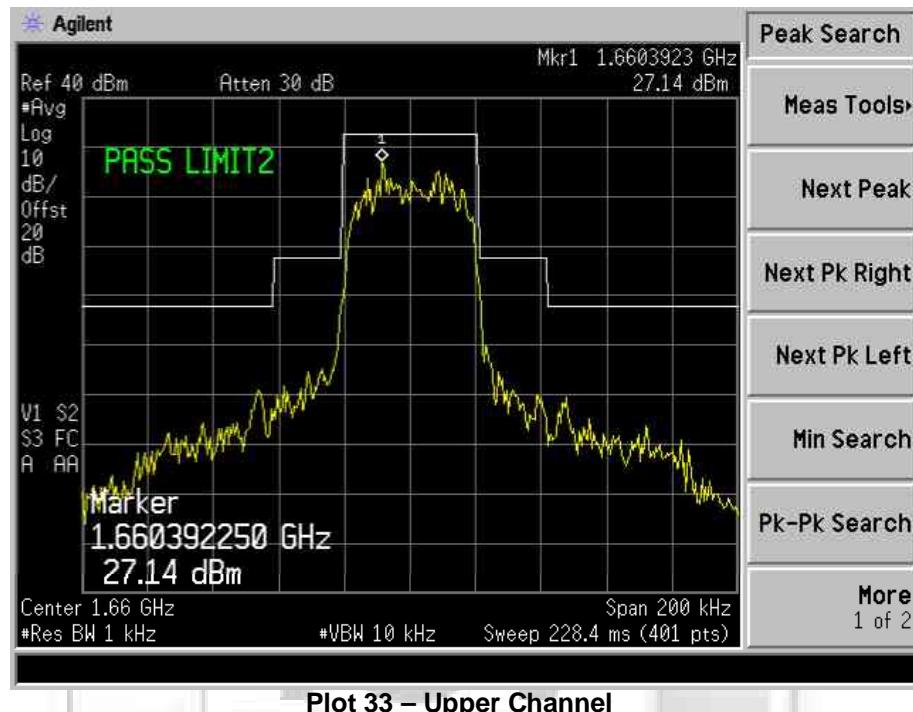
Plot 31 – Lower Channel



Plot 32 – Middle Channel

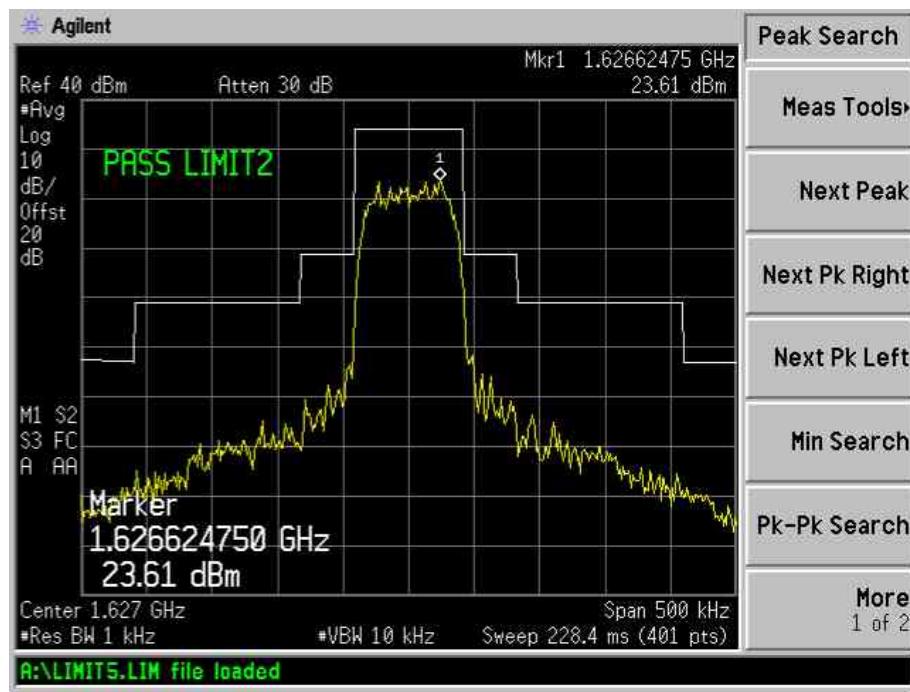
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 3)

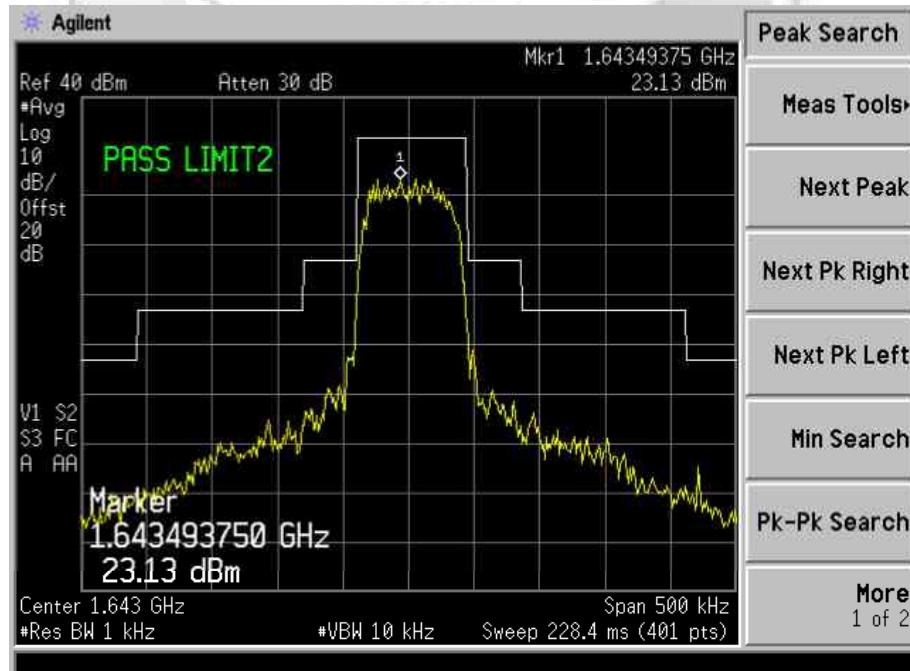


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 5)



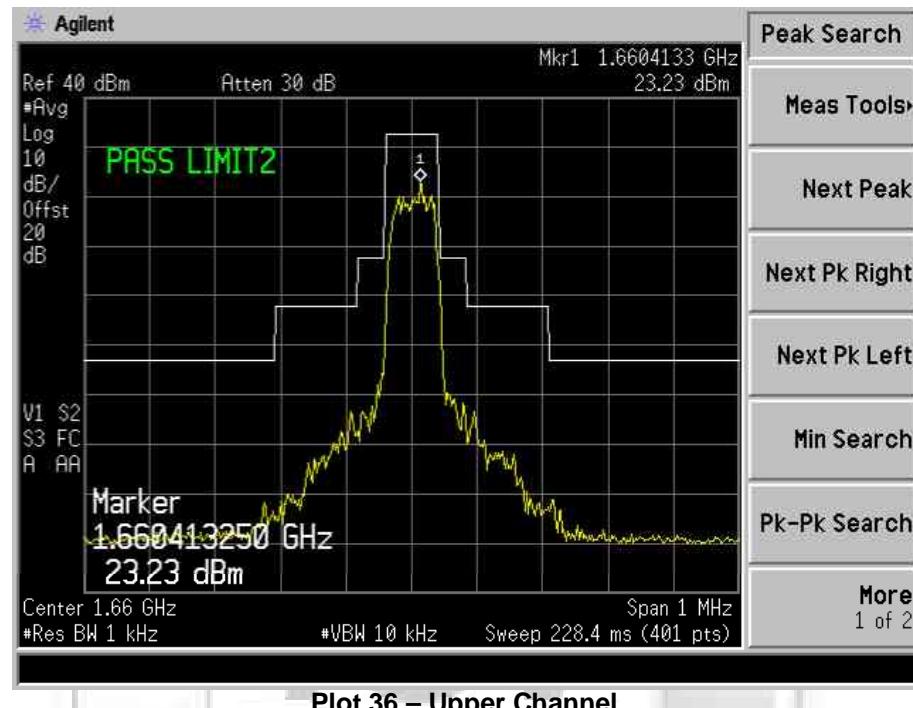
Plot 34 – Lower Channel



Plot 35 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

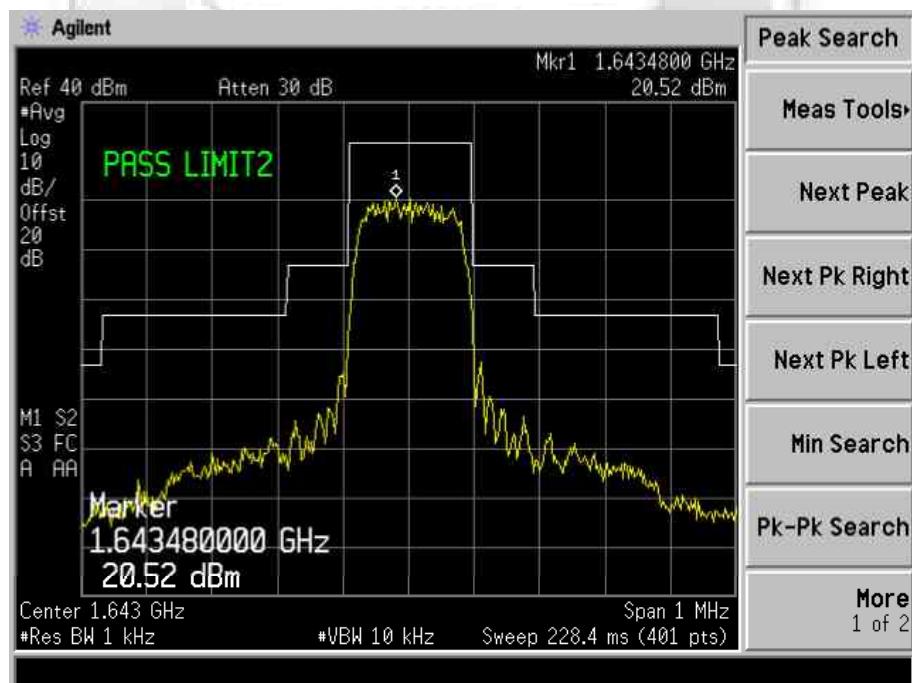
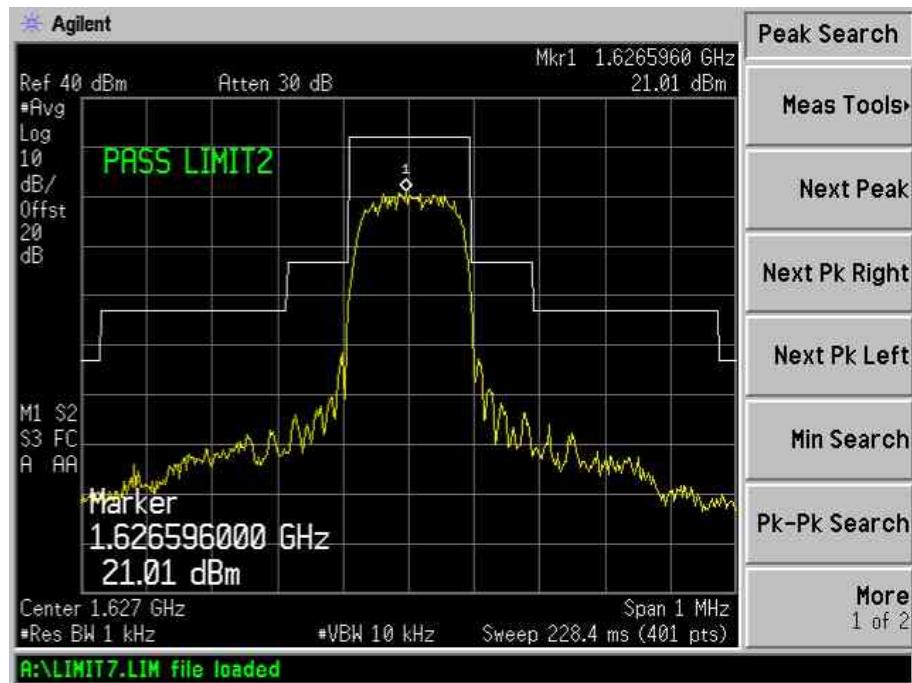
In Band Emissions Plots (Bearer Type: 5)



Plot 36 – Upper Channel

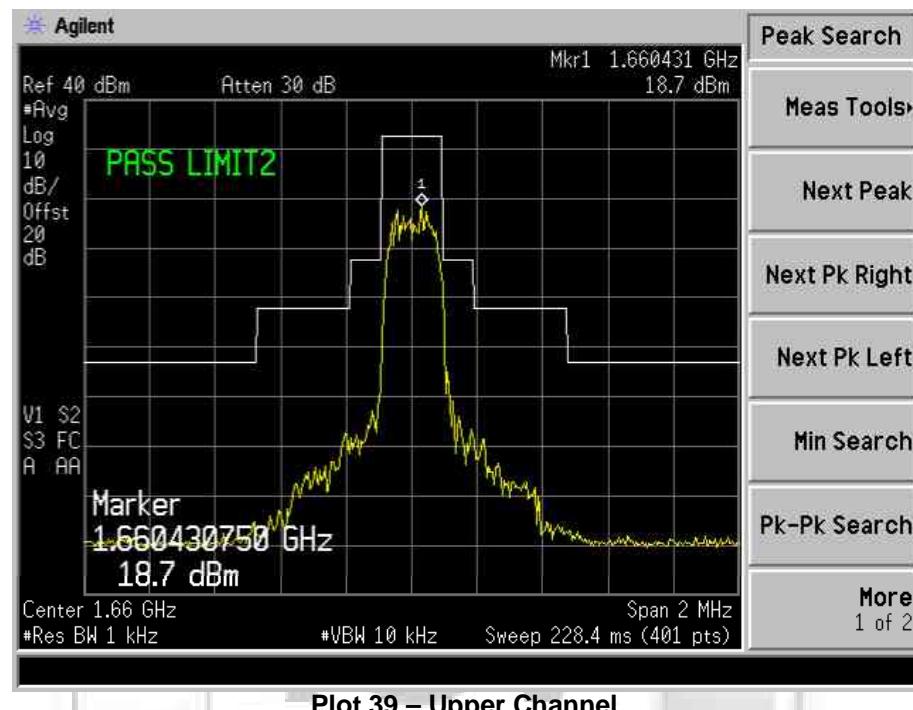
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 7)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

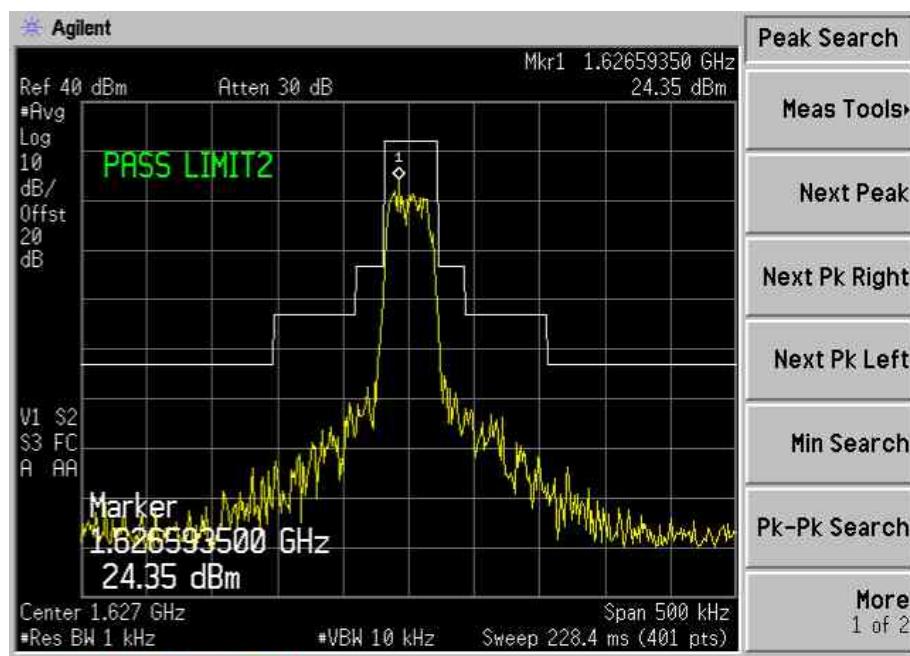
In Band Emissions Plots (Bearer Type: 7)



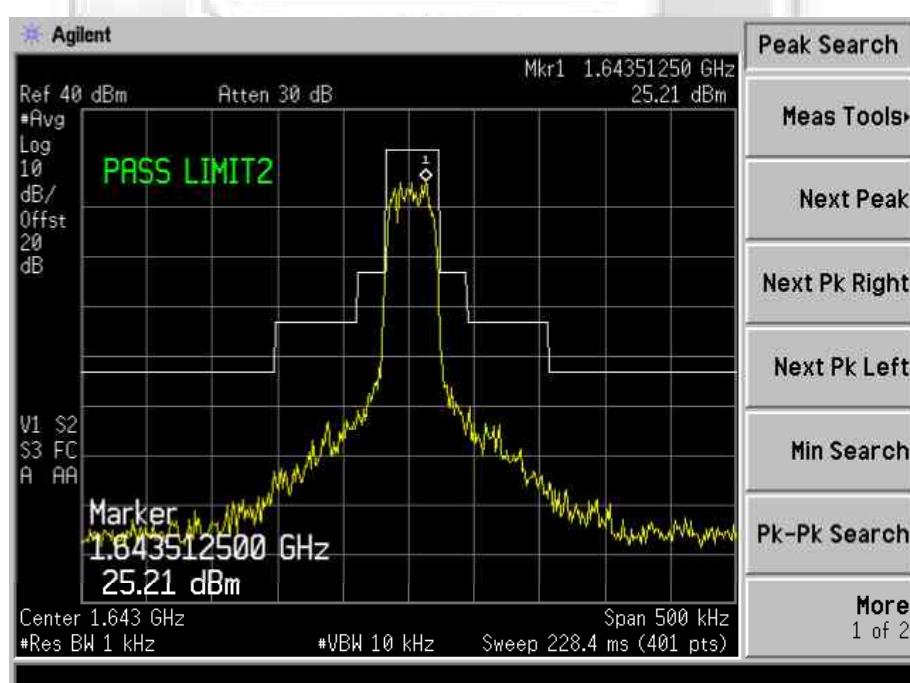
Plot 39 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 11)



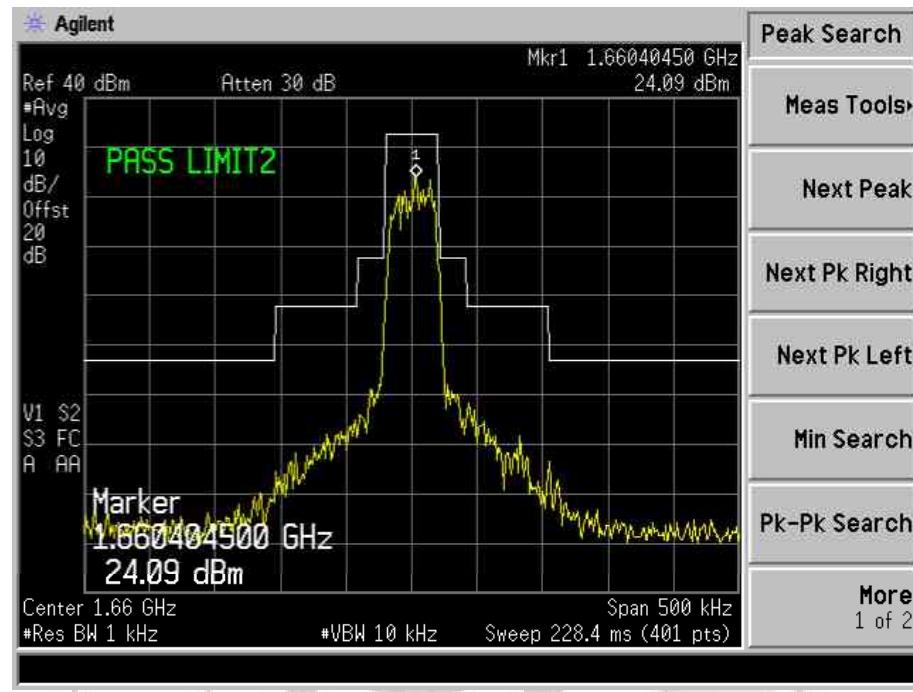
Plot 40 – Lower Channel



Plot 41 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

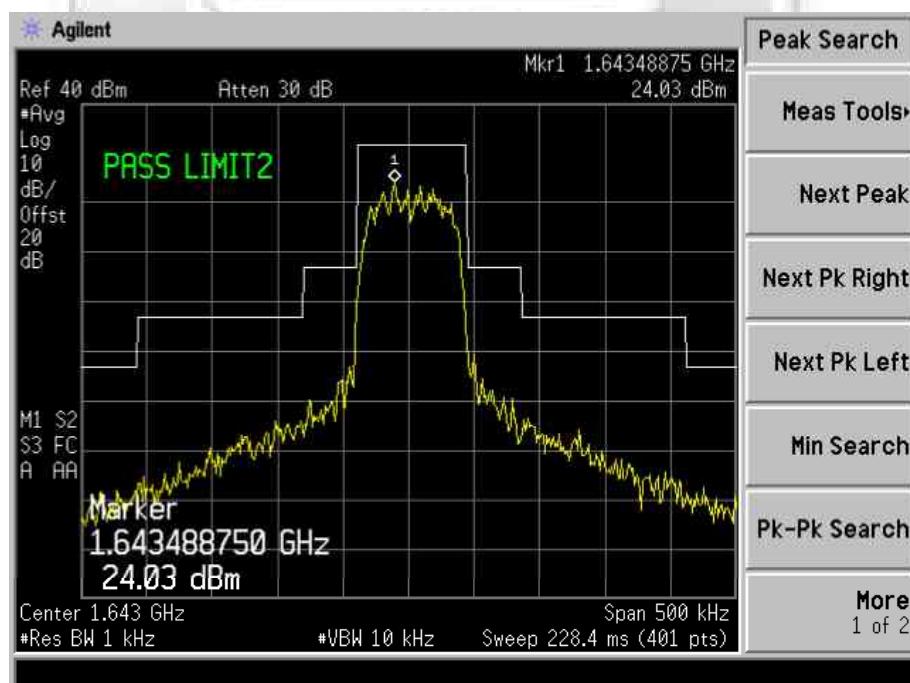
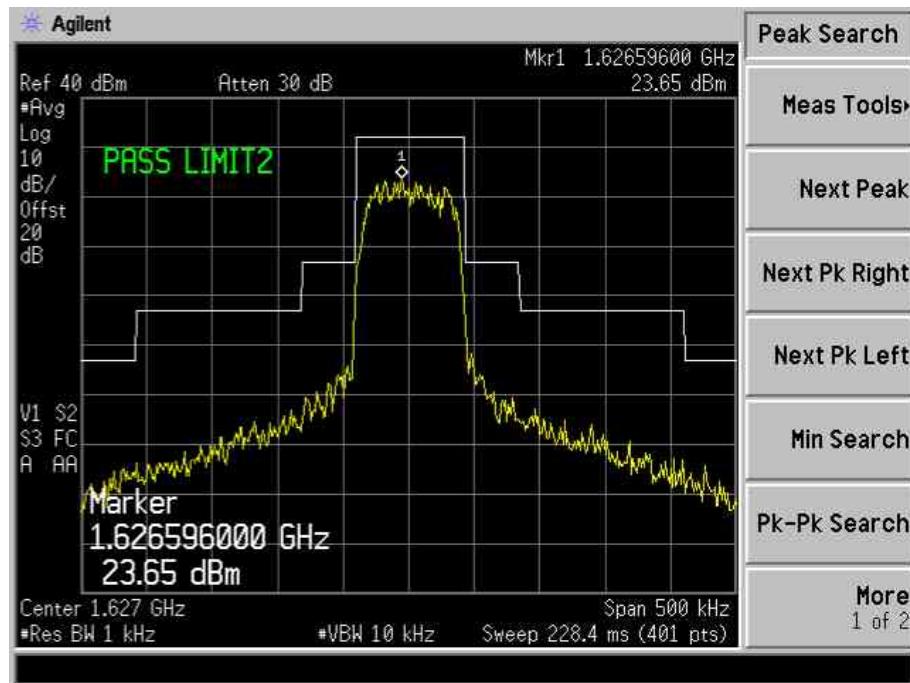
In Band Emissions Plots (Bearer Type: 11)



Plot 42 – High Channel

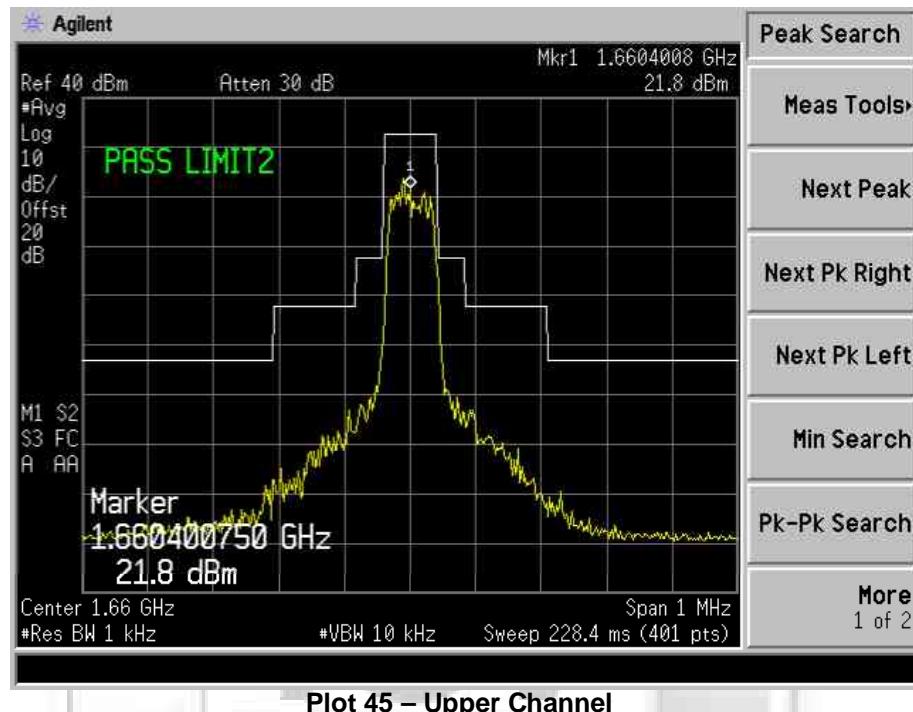
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 13)



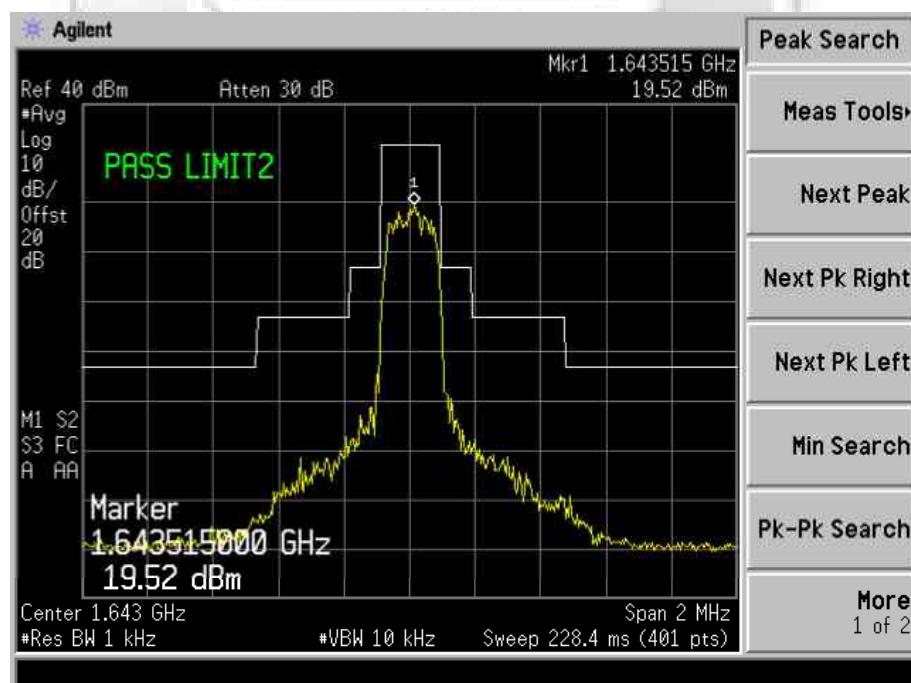
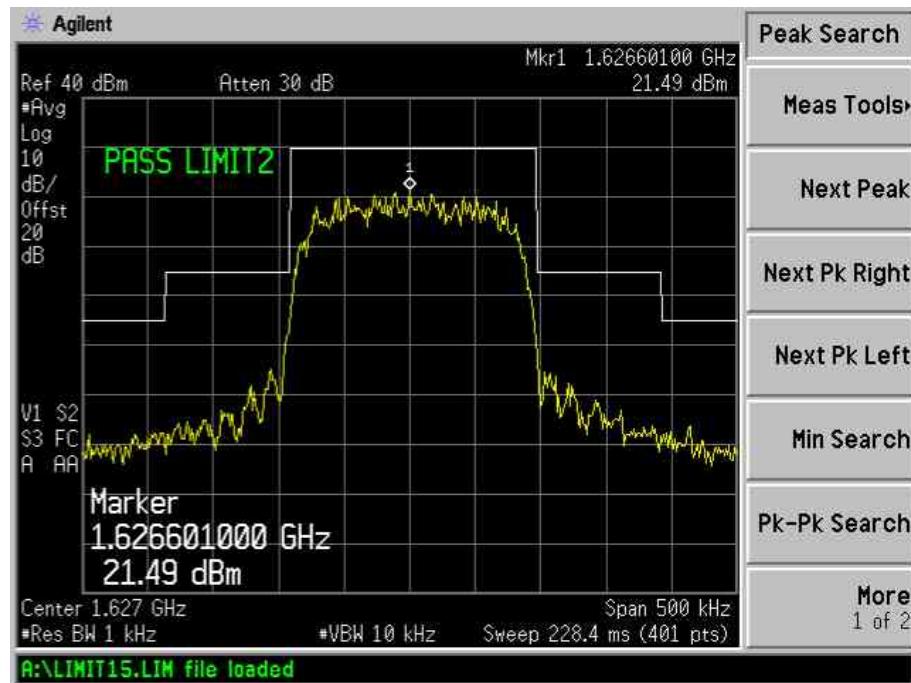
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 13)



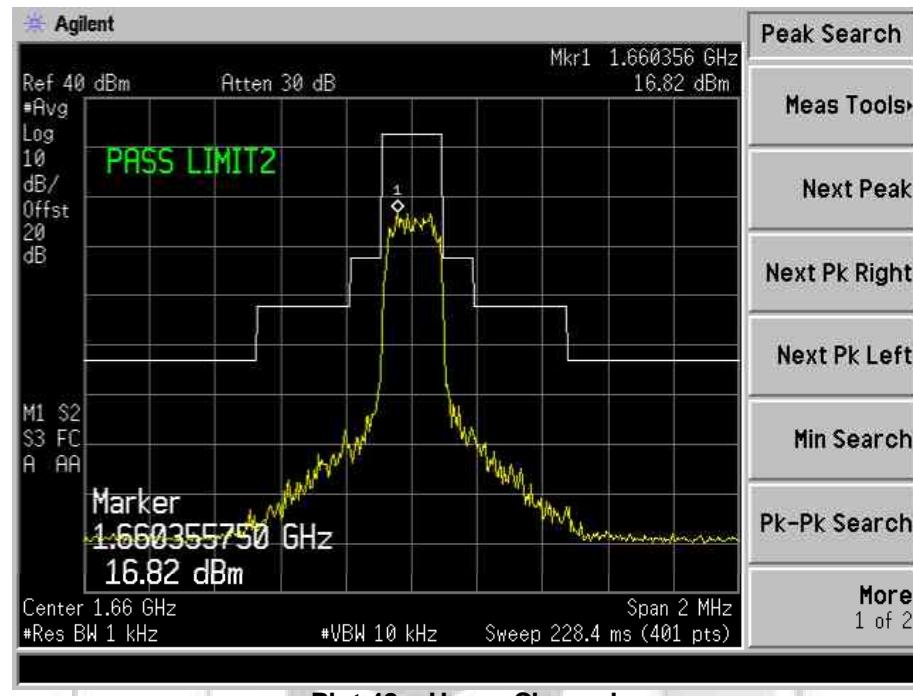
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 15)



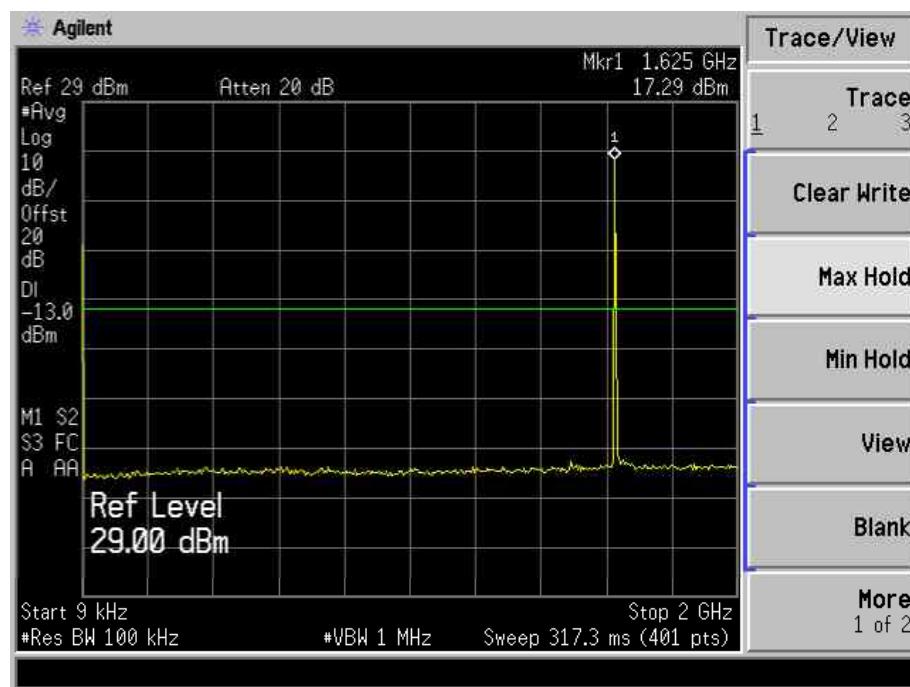
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 15)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



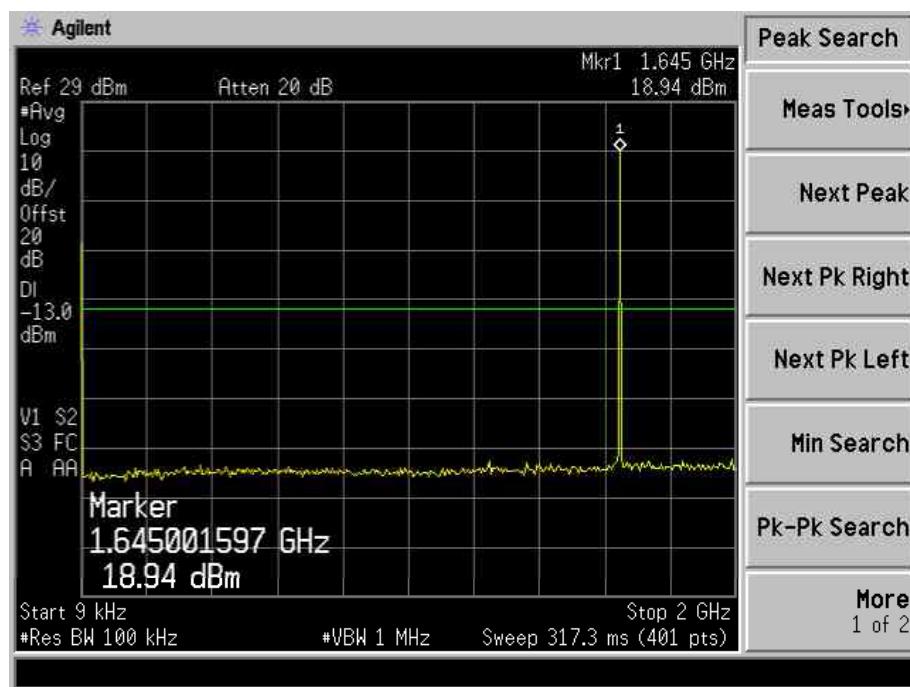
Plot 49 – Lower Channel



Plot 50 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



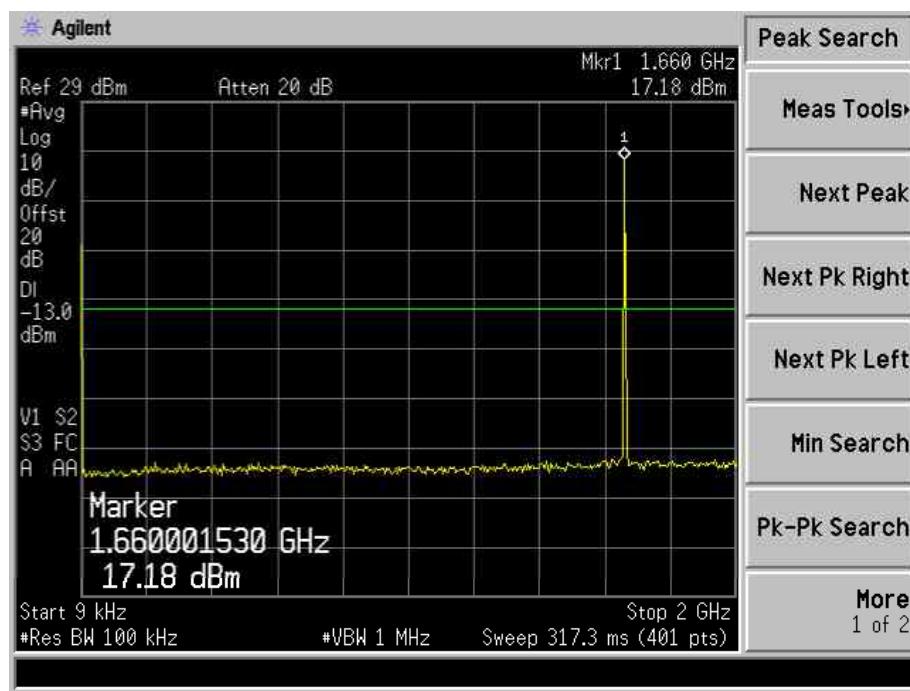
Plot 51 – Middle Channel



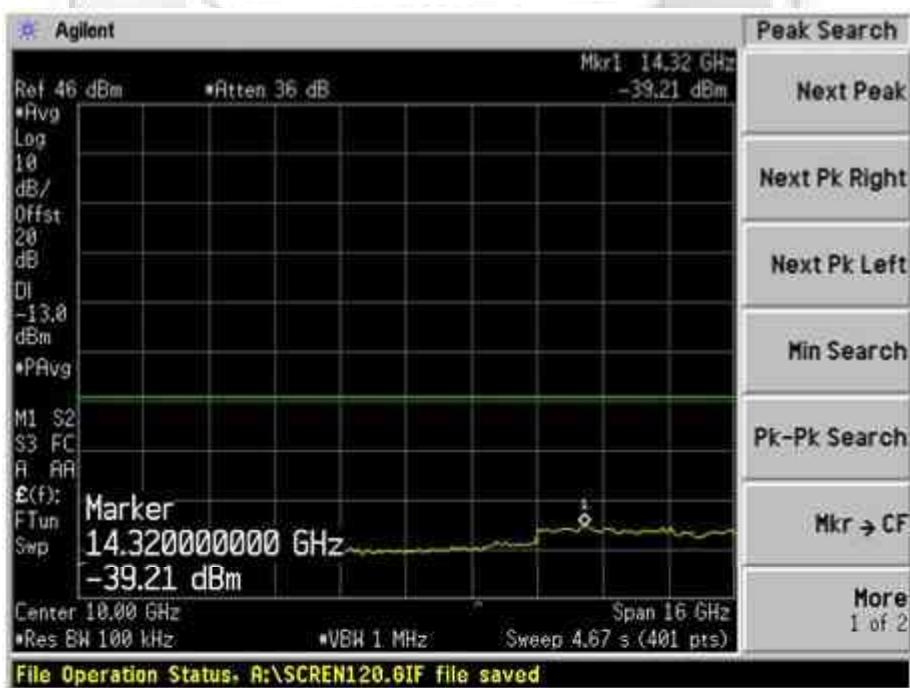
Plot 52 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



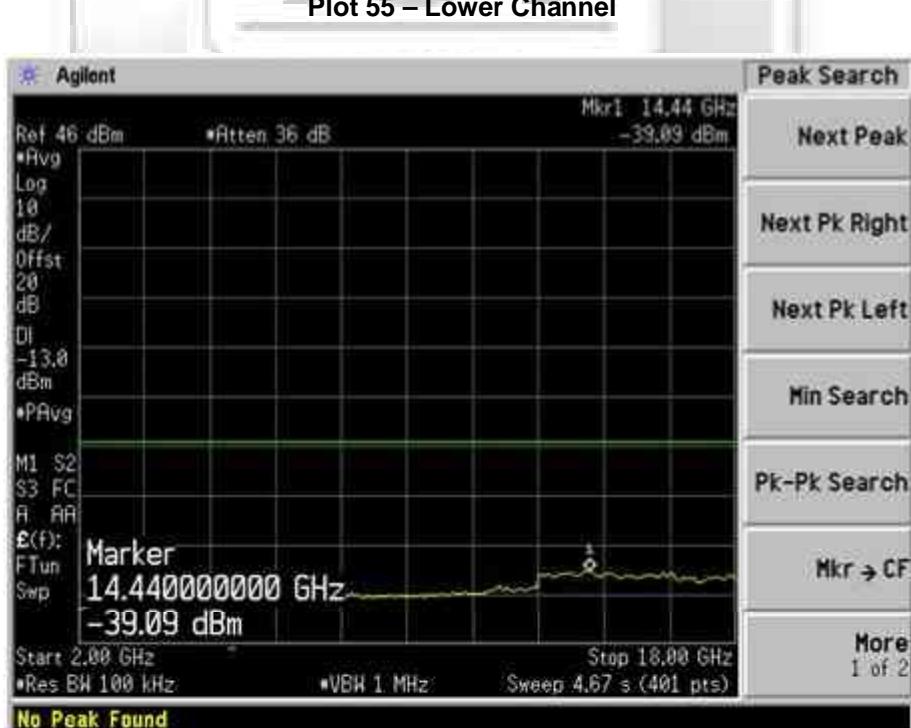
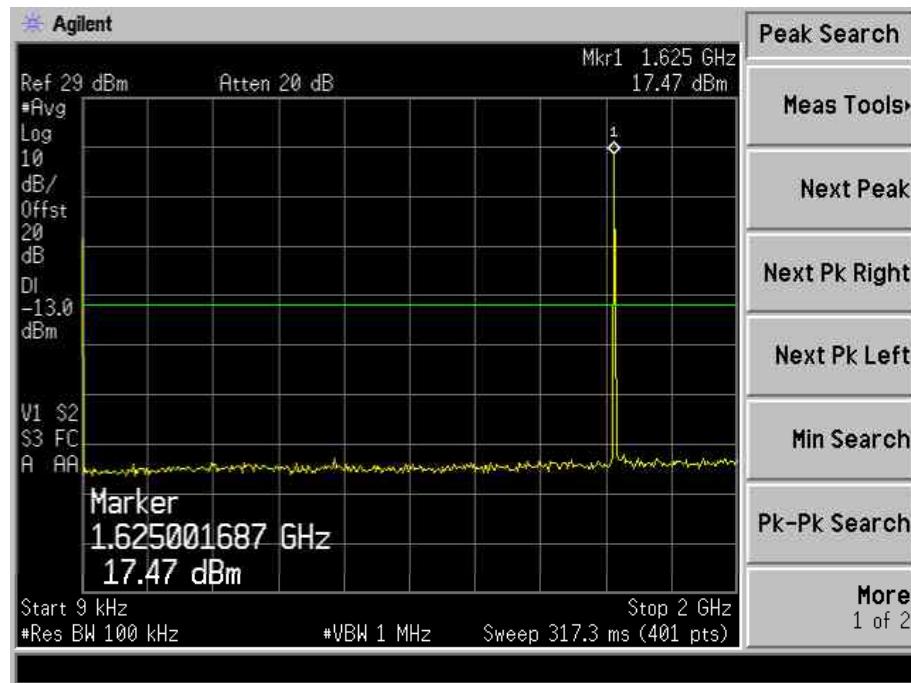
Plot 53 – Upper Channel



Plot 54 – Upper Channel

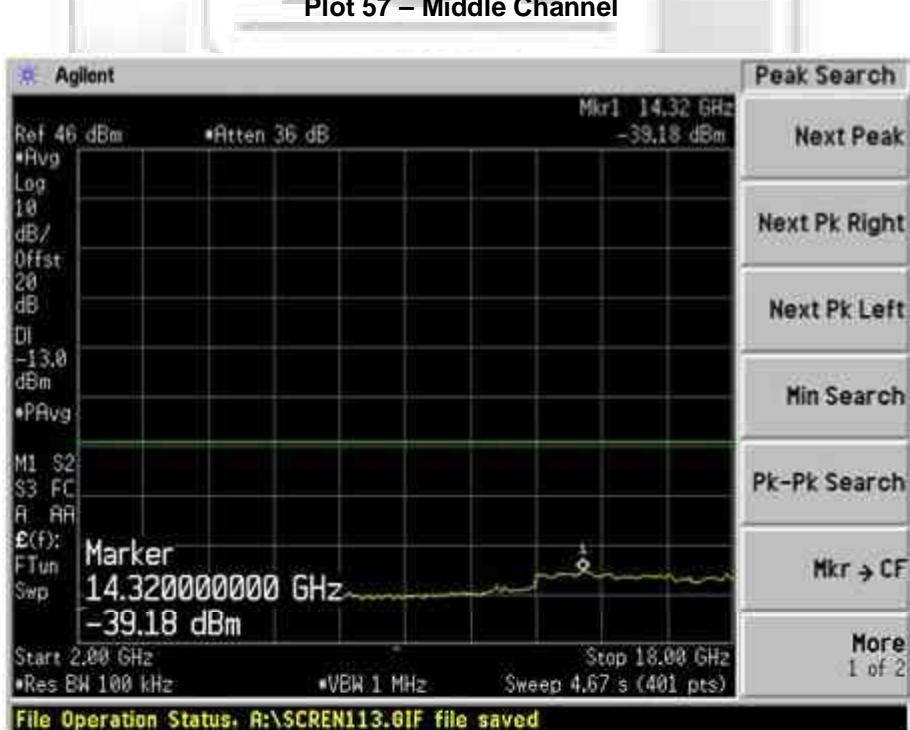
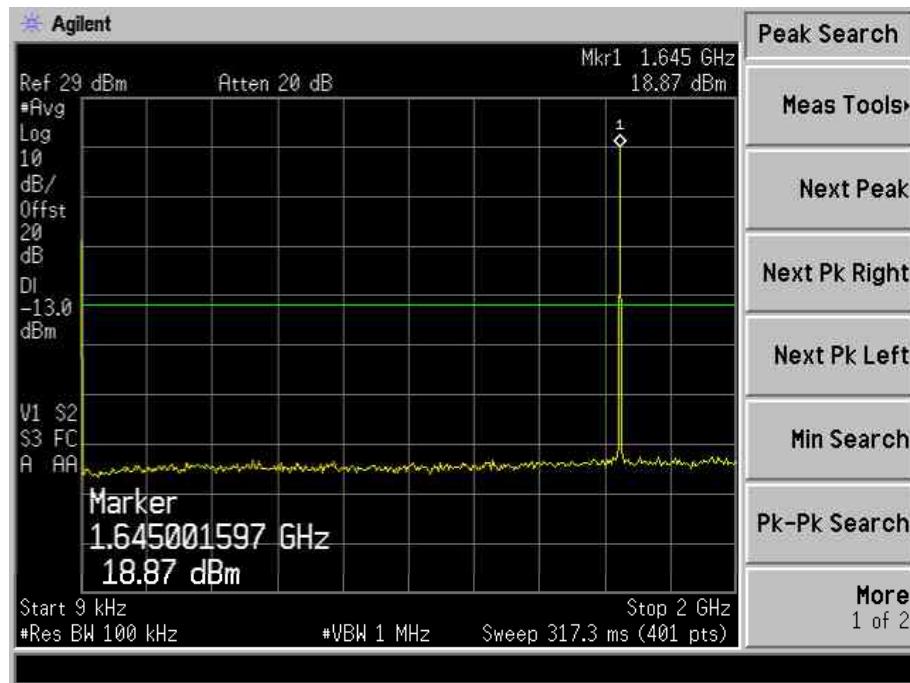
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)



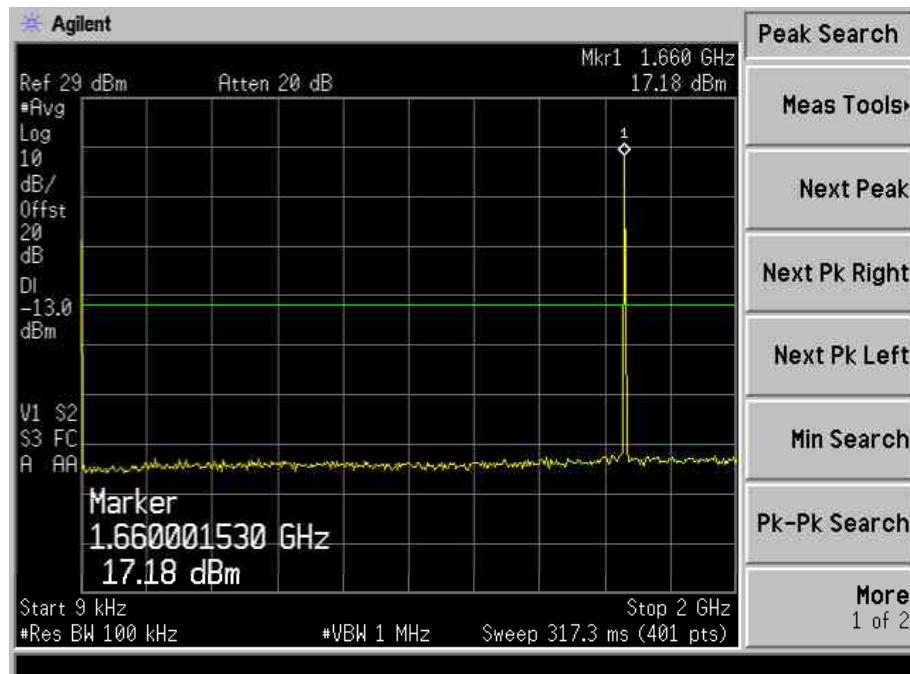
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)

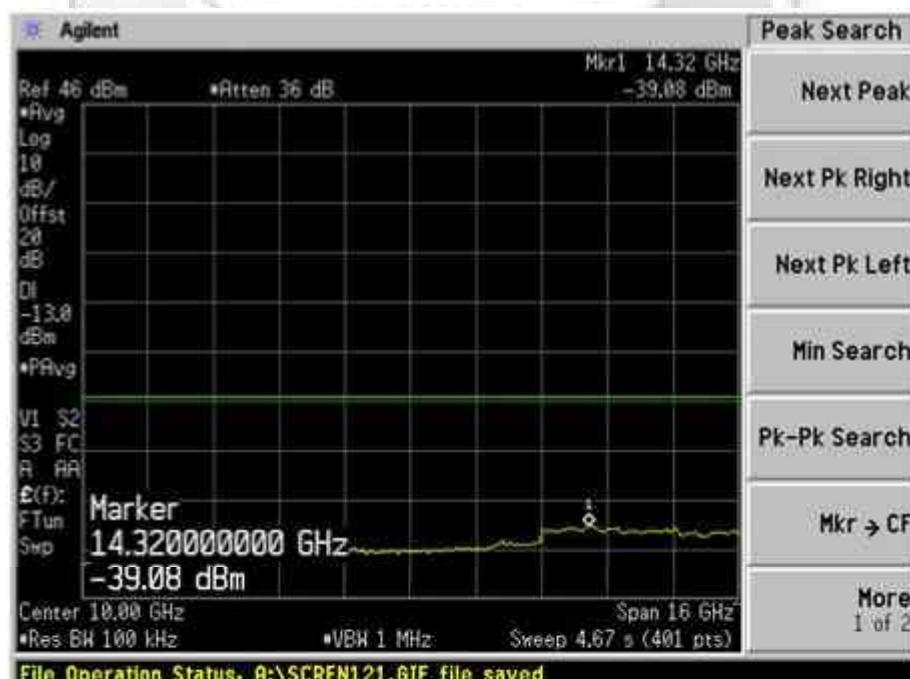


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)



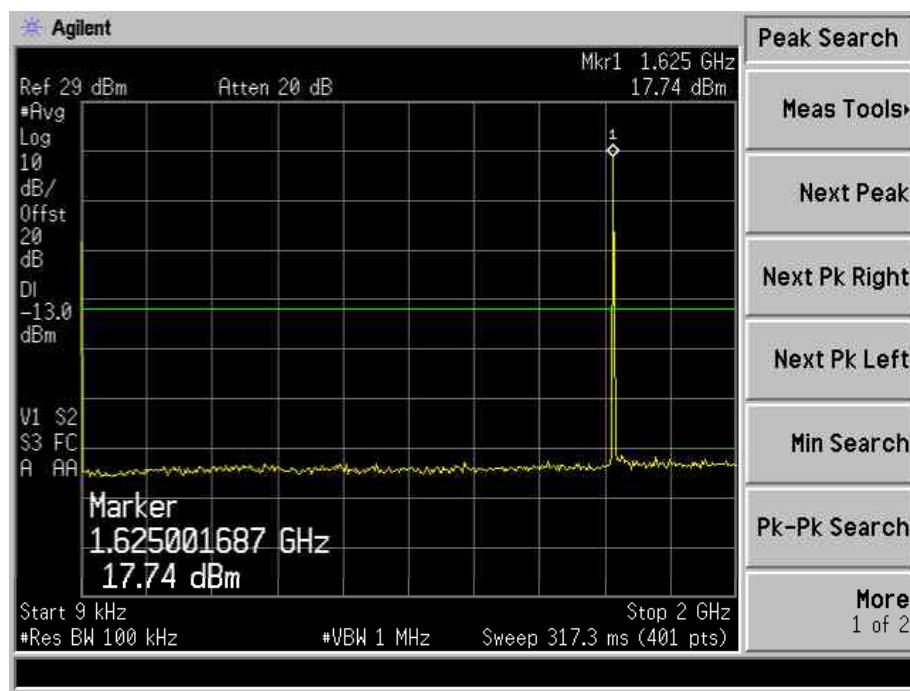
Plot 59 – Upper Channel



Plot 60 – Upper Channel

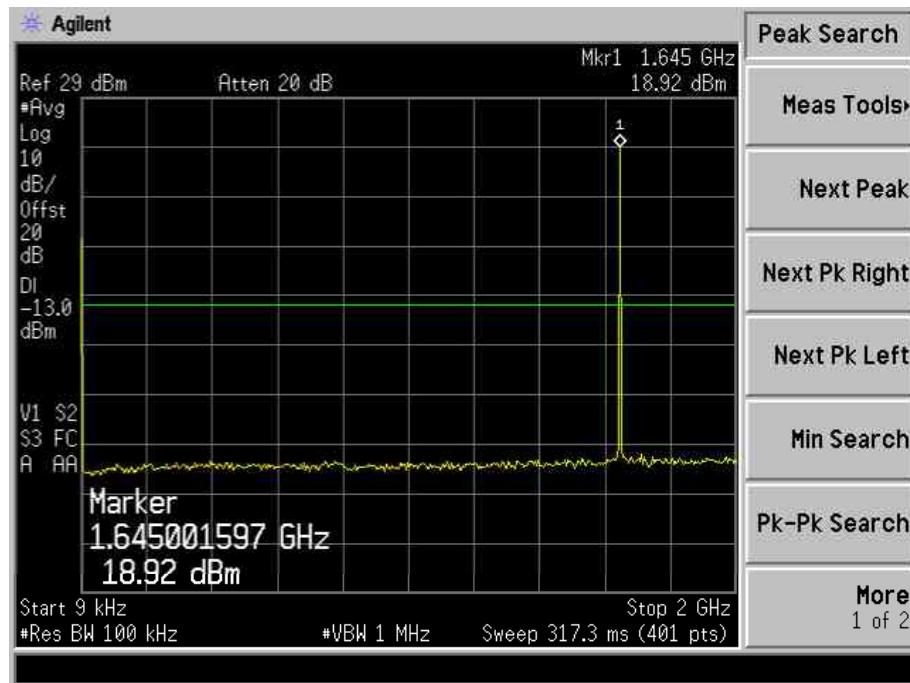
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



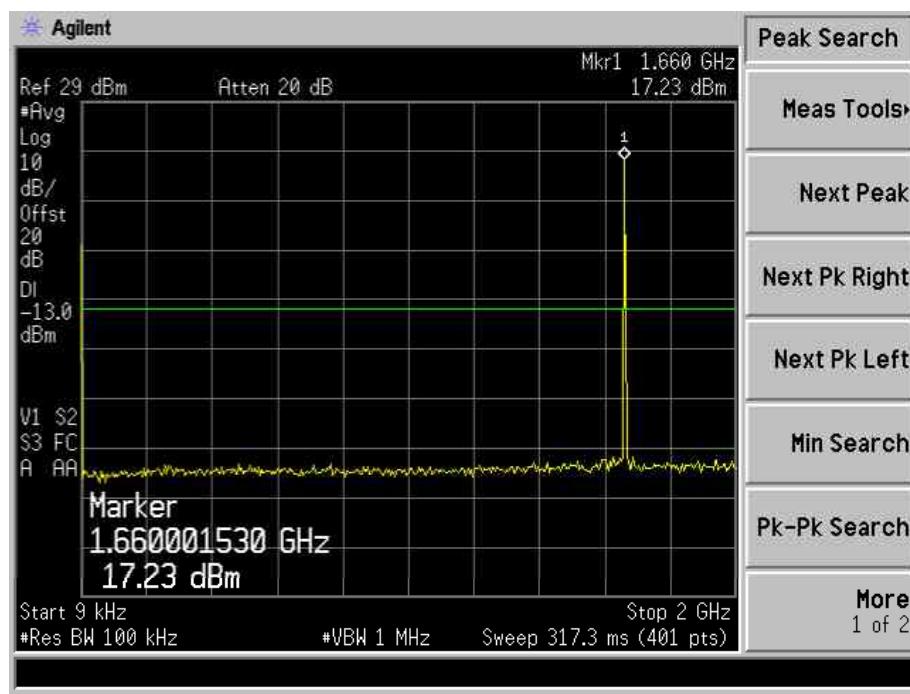
Plot 63 – Middle Channel



Plot 64 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



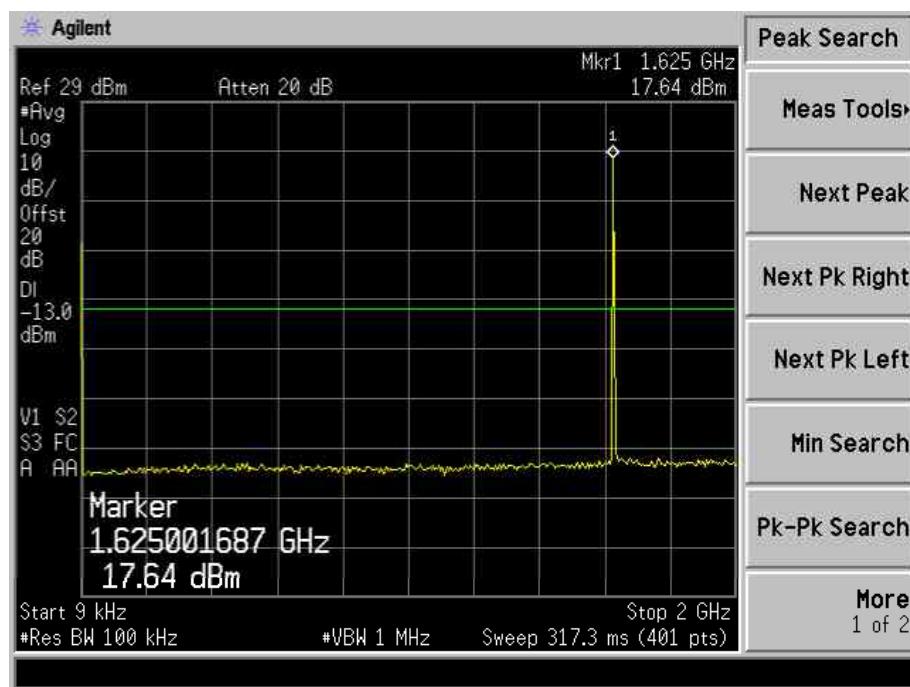
Plot 65 – Upper Channel



Plot 66 – Upper Channel

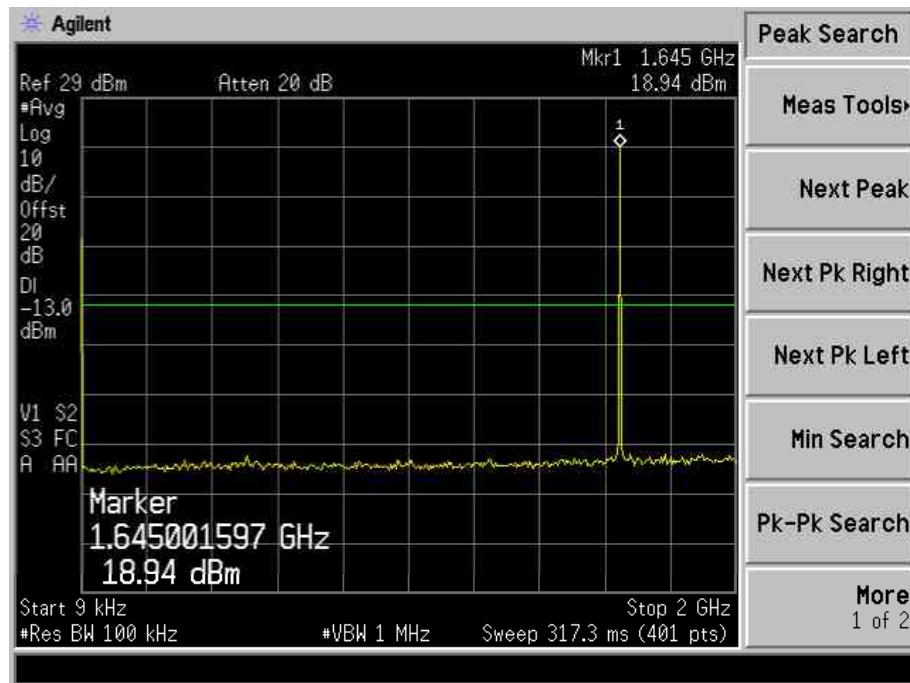
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



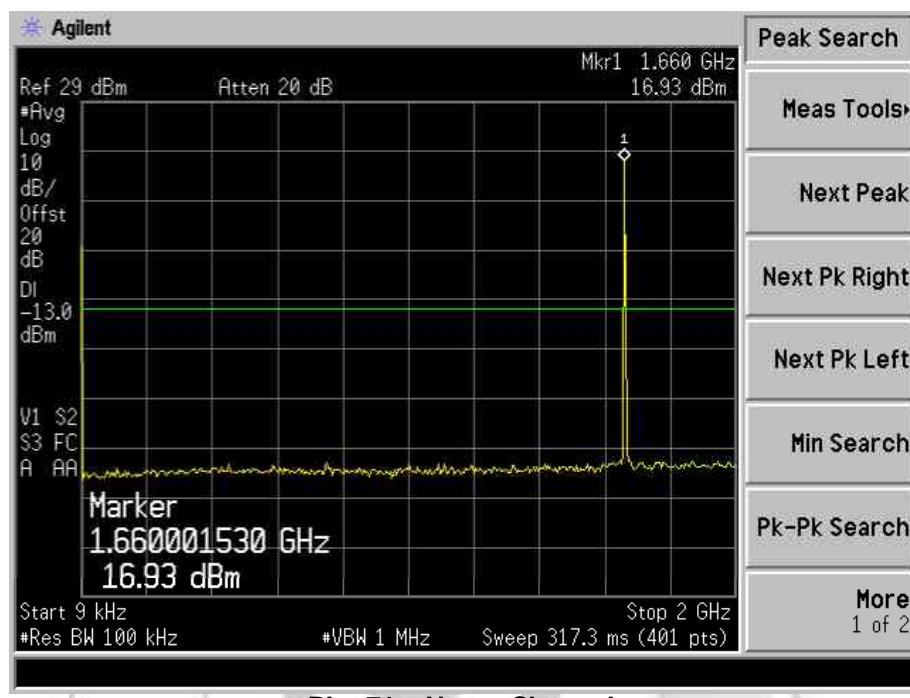
Plot 69 – Middle Channel



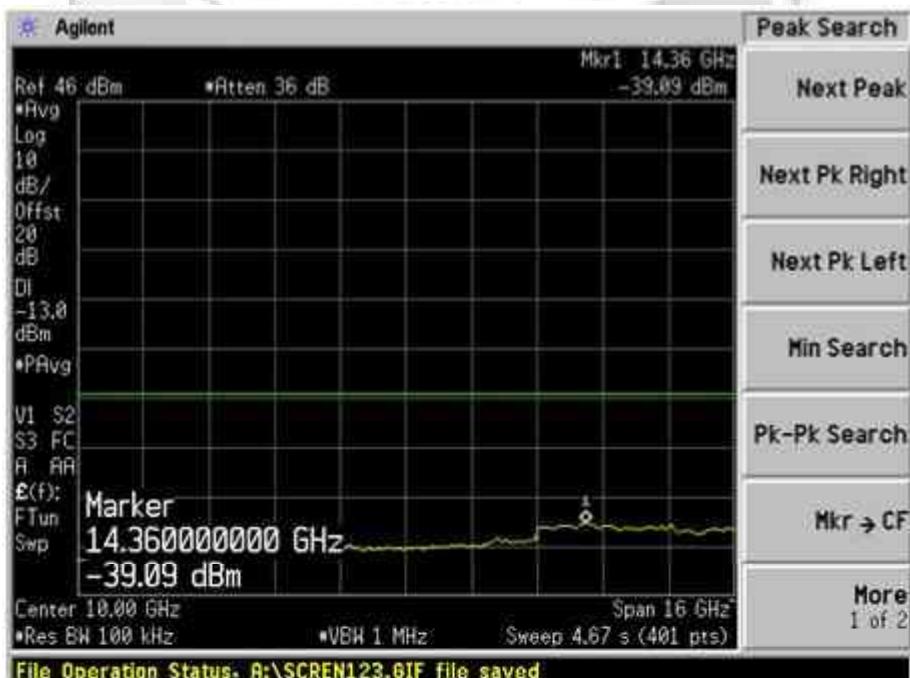
Plot 70 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



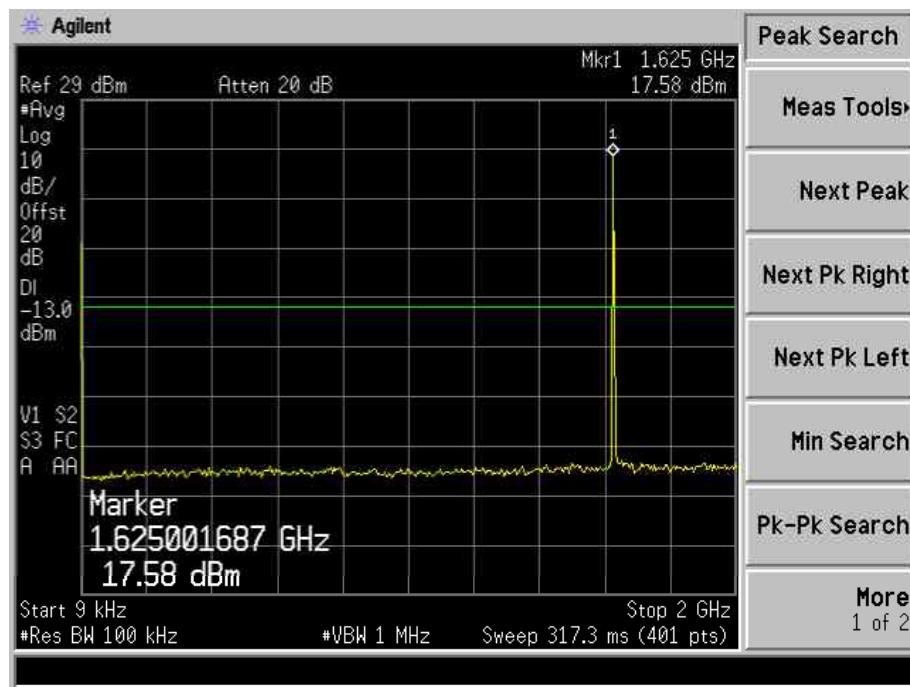
Plot 71 – Upper Channel



Plot 72 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



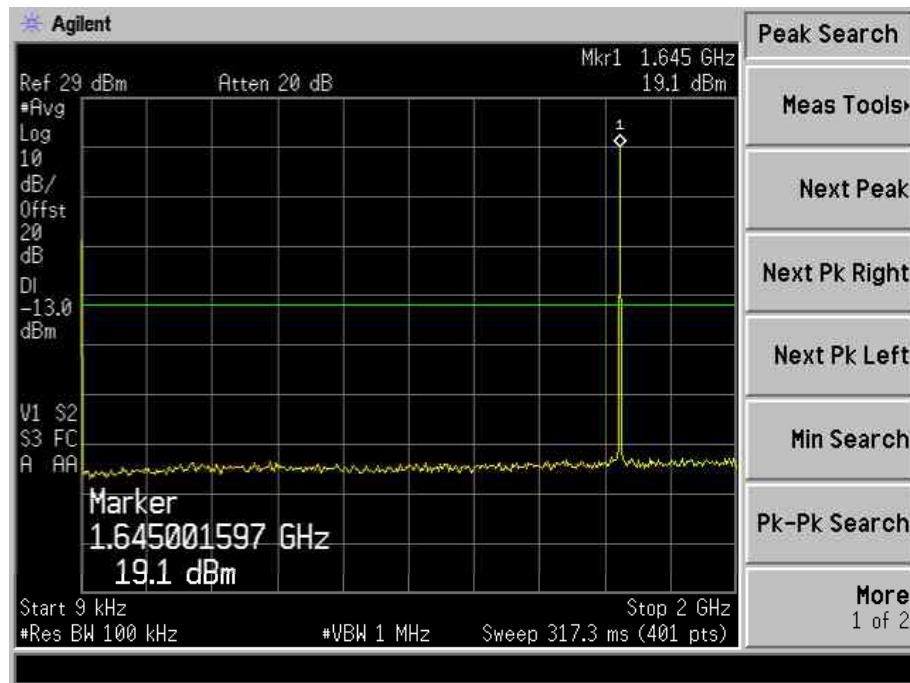
Plot 73 – Lower Channel



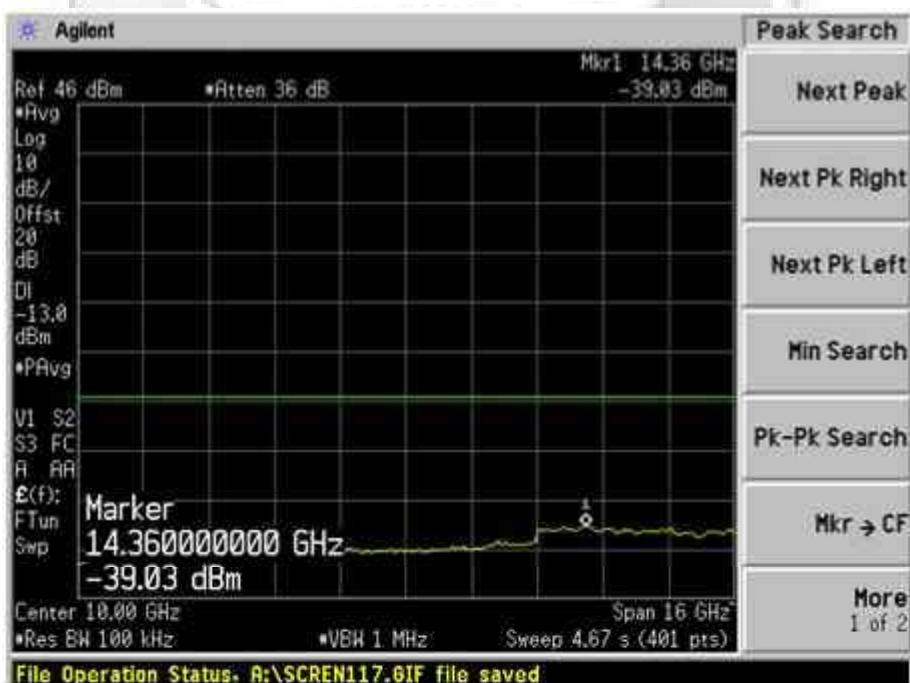
Plot 74 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



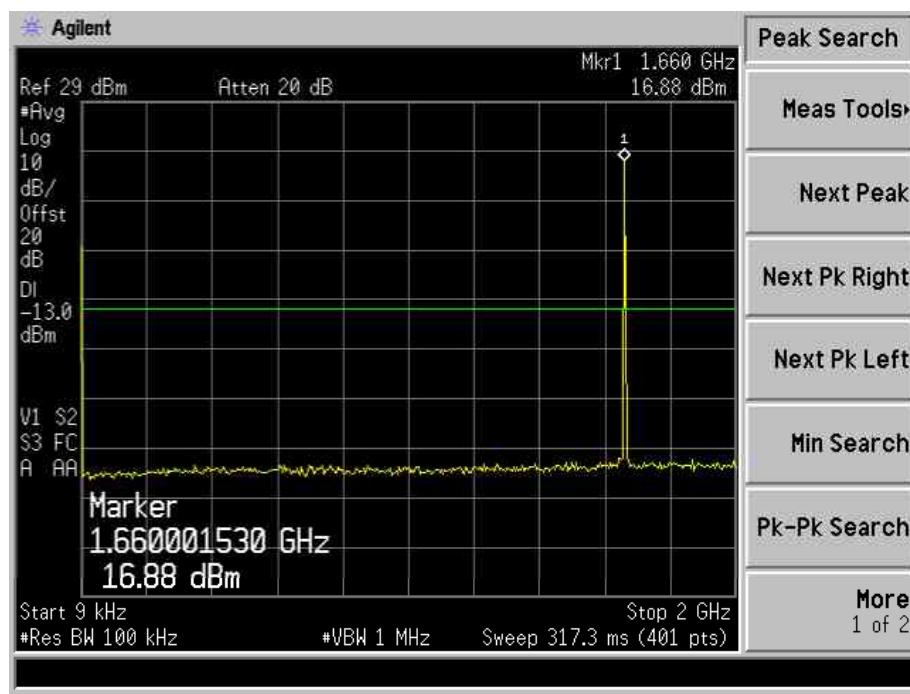
Plot 75 – Middle Channel



Plot 76 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



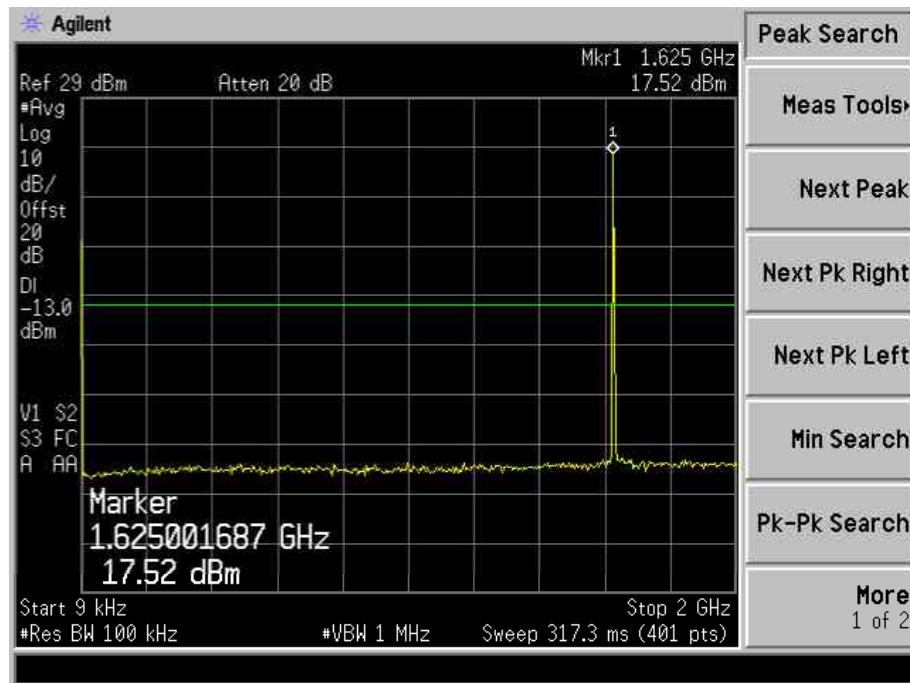
Plot 77 – Upper Channel



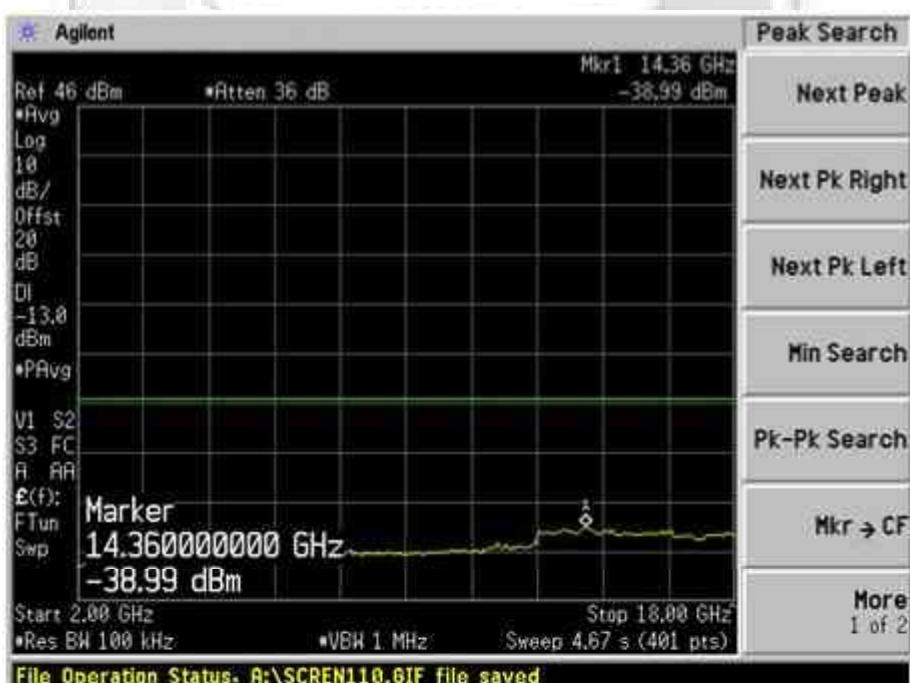
Plot 78 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 13)



Plot 79 – Lower Channel

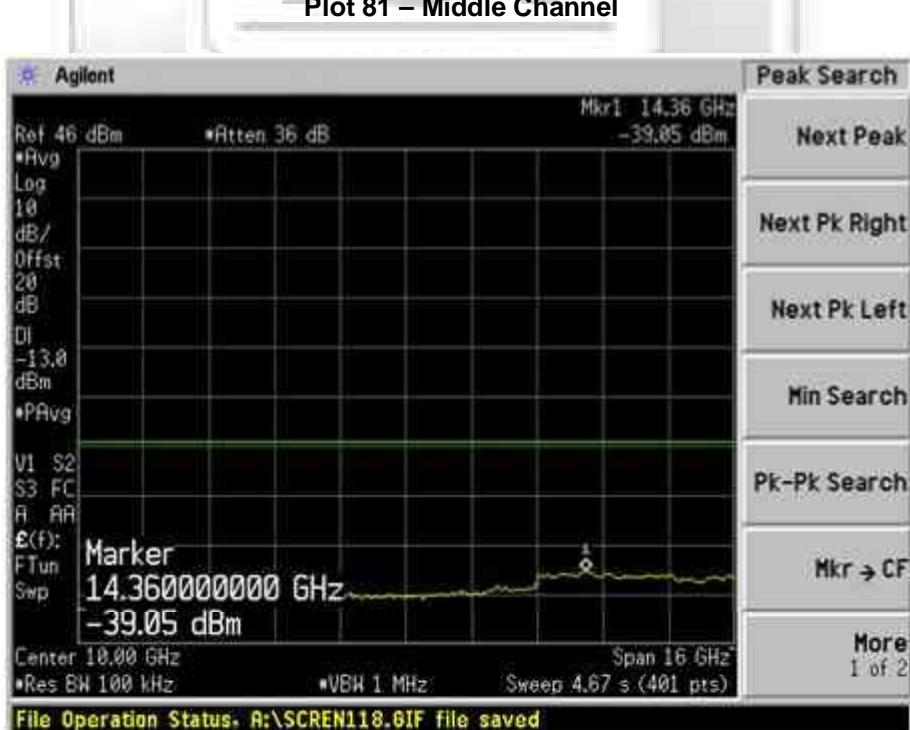
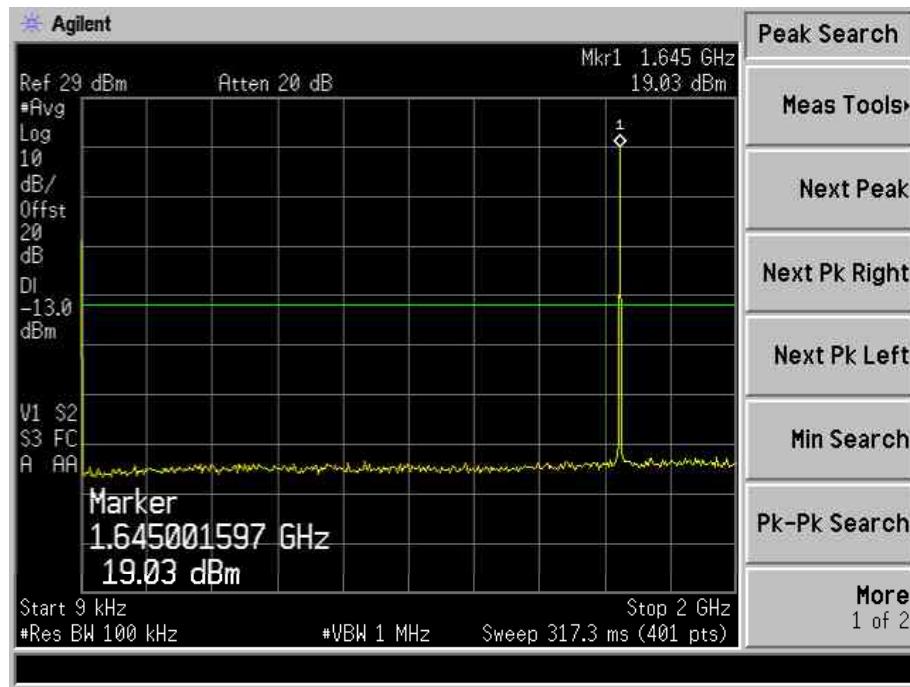


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Plot 80 – Lower Channel

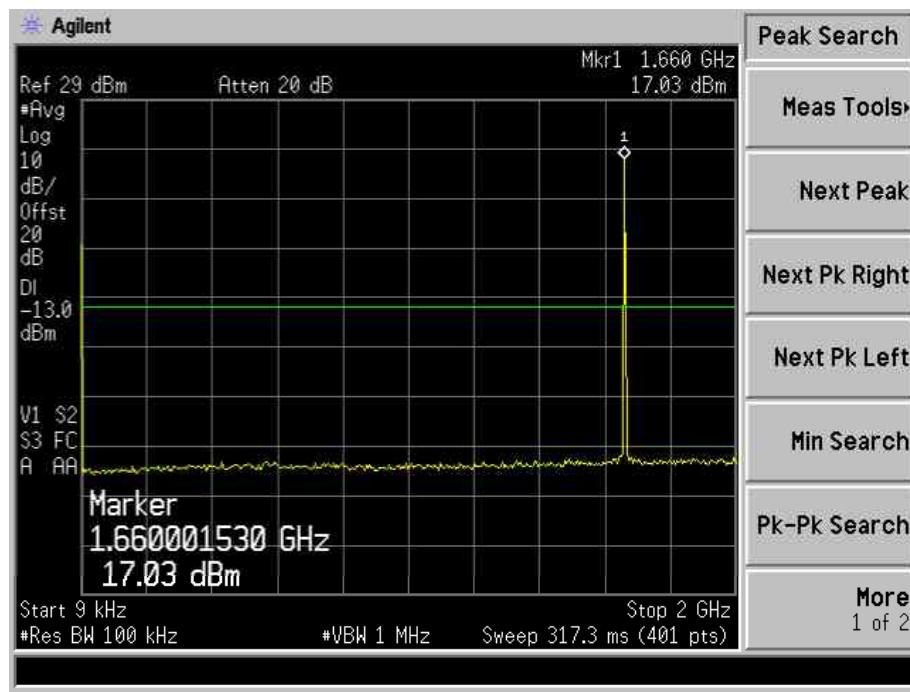
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 13)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 13)



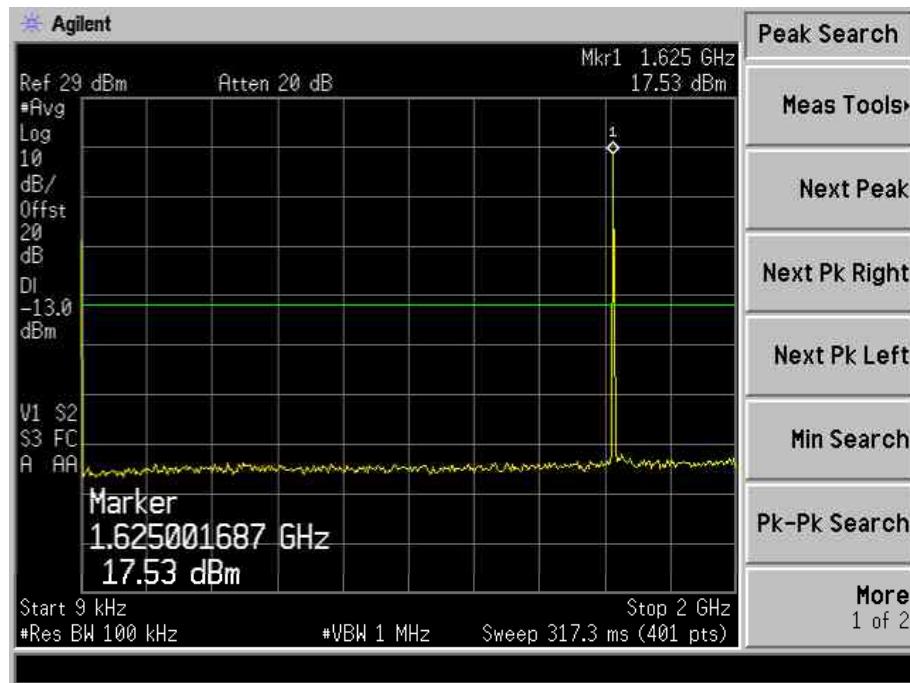
Plot 83 – Upper Channel



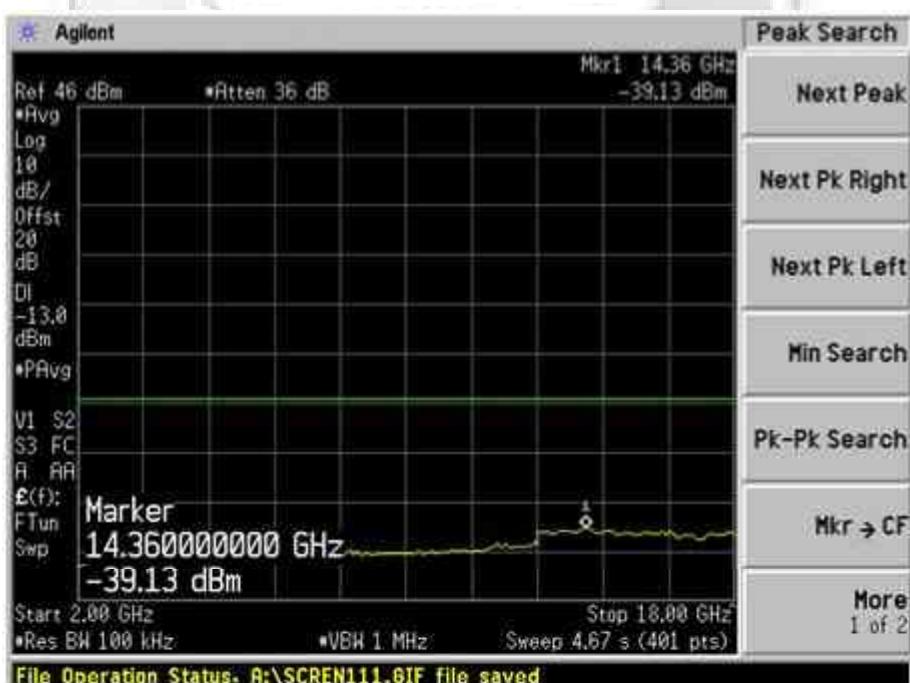
Plot 84 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 15)



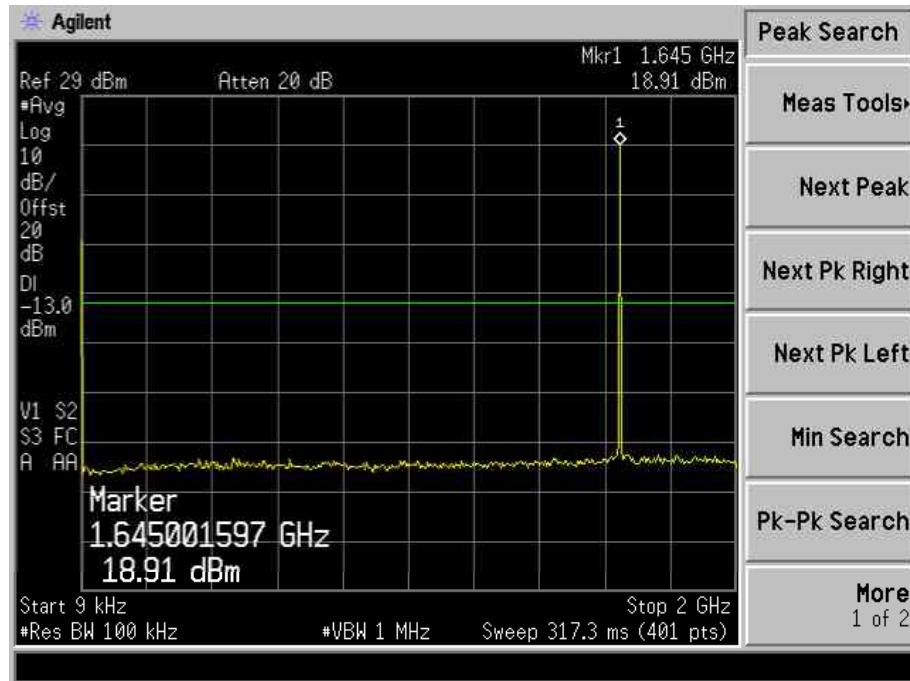
Plot 85 – Lower Channel



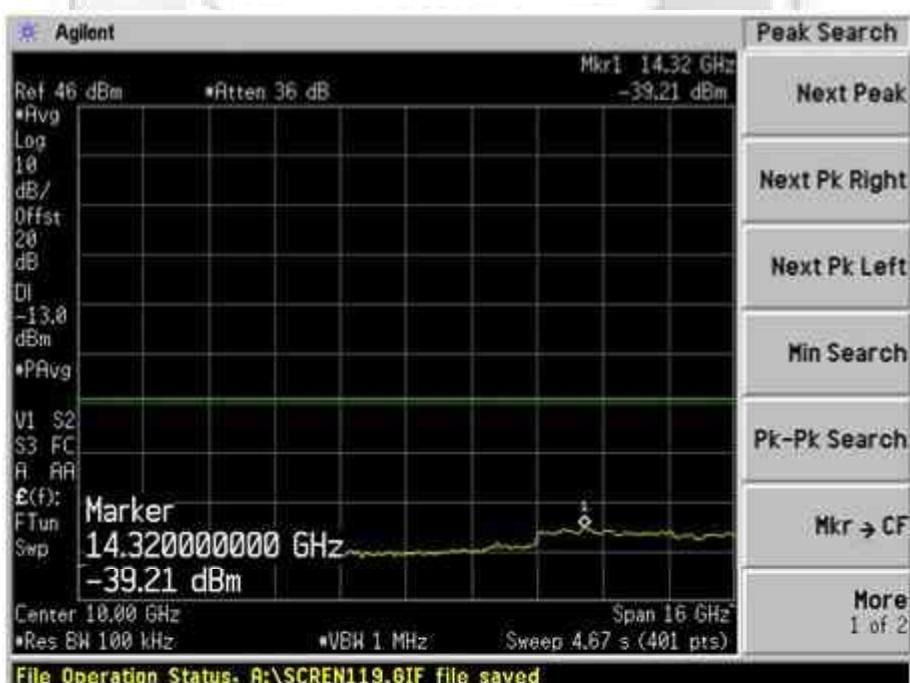
Plot 86 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 15)



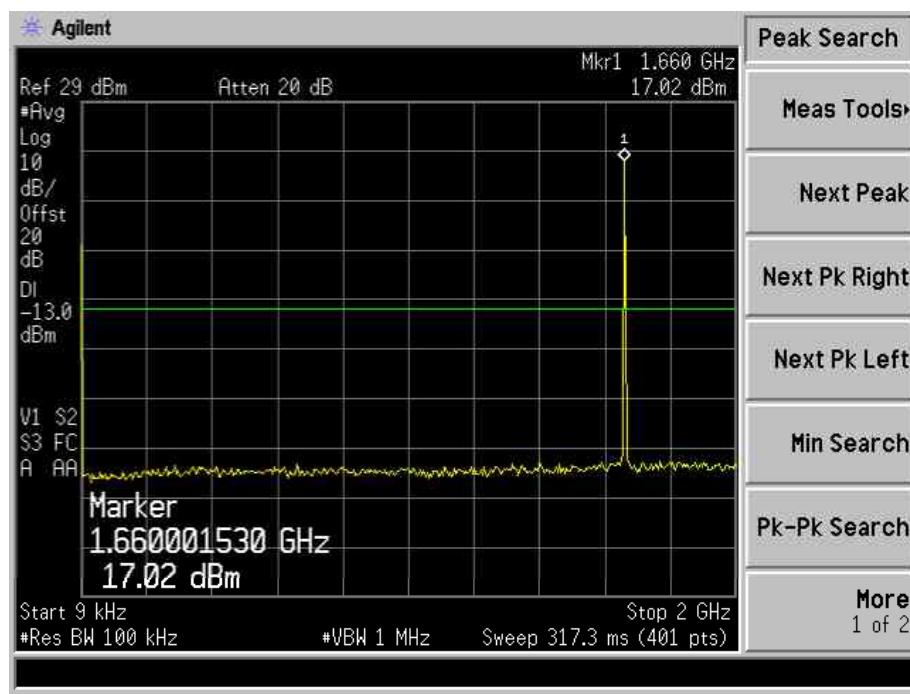
Plot 87 – Middle Channel



Plot 88 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 15)



Plot 89 – Upper Channel



Plot 90 – Upper Channel

RADIATED SPURIOUS EMISSION TEST

47 CFR 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 from 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer	E7405A	US40240195	16 Mar 2013
K&L Microwave BandReject Filter	3TNF-1000/2000-N/N	436	Output Monitor
Schaffner Bilog Antenna -(30MHz-2GHz) BL3 (Ref)	CBL6112B	2549	19 Jan 2013
EMCO Horn Antenna – H15	3115	0003-6088	20 May 2013
HP Synthesized Signal Generator – SG4	8665B	3744A01346	07 Nov 2012
Schaffner Bilog Antenna -(30MHz-2GHz) BL4	CBL6112B	2593	19 Jan 2013
EMCO Horn Antenna – H2	3115	9403-4250	20 May 2013
Bird 20dB Attenuator	25-A-MFN-20	0209	25 May 2013

RADIATED SPURIOUS EMISSION TEST

47 CFR 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

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

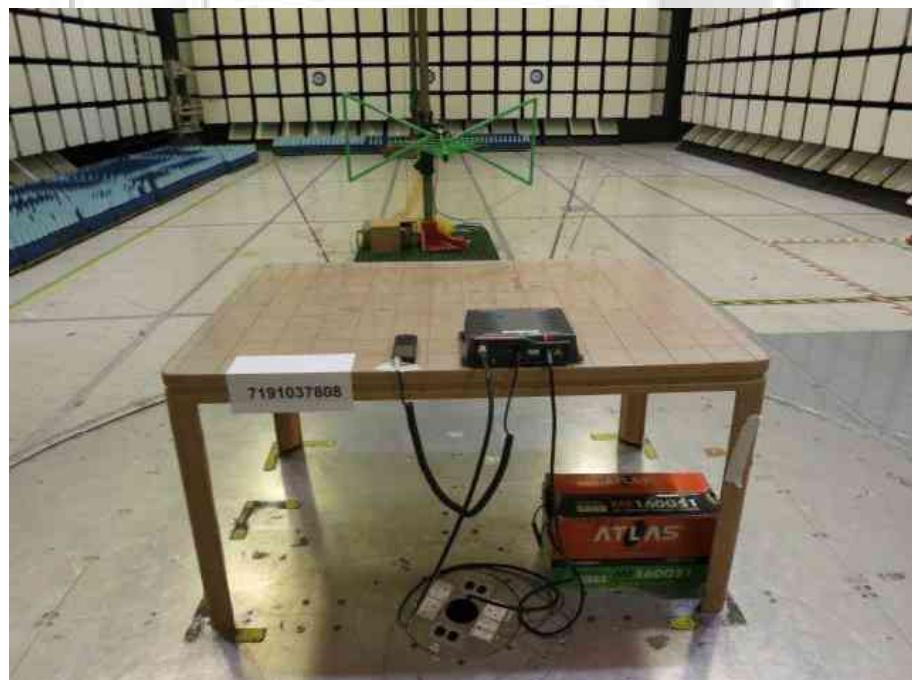
1. The EUT was set to transmit at the maximum power at the lower channel with the modulation on at normal test condition.
2. The receiving antenna (test antenna) was set at vertical polarization with the height of 1m.
3. With the spectrum analyser was set to max hold enabled (peak detector mode), the 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 360° 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:
$$P \text{ (e.i.r.p)} = B - C - D + E$$

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 10th 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 EMISSION TEST



Radiated Spurious Emissions Test Setup (Front View)



Radiated Spurious Emissions Test Setup (Rear View)



PSB Singapore

RADIATED SPURIOUS EMISSIONS TEST

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

Operating Mode	Continuous Satellite transmission.	Temperature	24°C
Test Input Power	12Vdc (Worst Voltage)	Relative Humidity	60%
Test Distance	3m (30MHz – 1GHz)	Atmospheric Pressure	1030mbar
Type Bearer	15 (Worst Bearer)	Tested By	Lim Kay Tak

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
83.8835	-50.9	-13.0
206.3460	-39.6	-13.0
399.8368	-54.3	-13.0
468.4158	-57.9	-13.0
480.6620	-55.5	-13.0
960.7150	-56.6	-13.0

Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
83.8835	-49.7	-13.0
145.1148	-57.9	-13.0
203.8968	-38.7	-13.0
399.8368	-55.1	-13.0
480.6620	-55.2	-13.0
960.7150	-55.8	-13.0

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
83.3500	-48.9	-13.0
207.0250	-39.2	-13.0
398.6000	-53.2	-13.0
481.0500	-54.2	-13.0
531.9750	-59.2	-13.0
961.2000	-55.3	-13.0

RADIATED SPURIOUS EMISSIONS TEST

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

Operating Mode	Continuous Satellite transmission.	Temperature	24°C
Test Input Power	12Vdc (Worst Voltage)	Relative Humidity	60%
Test Distance	3m (1GHz – 17GHz)	Atmospheric Pressure	1030mbar
Type Bearer	15 (Worst Bearer)	Tested By	Lim Kay Tak

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
2416.5250	-40.6	-13.0
7352.9000	-38.0	-13.0
13319.4750	-40.7	-13.0
--	--	--
--	--	--
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Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
2416.5250	-55.4	-13.0
7395.8250	-55.3	-13.0
13319.4750	-51.8	-13.0
--	--	--
--	--	--
--	--	--

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
8254.3250	-39.3	-13.0
13491.1750	-36.7	-13.0
14263.8250	-36.9	-13.0
--	--	--
--	--	--
--	--	--

RADIATED SPURIOUS EMISSIONS TEST

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured. All other emissions were relatively insignificant.
2. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3. "--" indicates no emissions were found and shows compliance to the limits.
4. The Resolution Bandwidth (RBW) was corrected from 4kHz by $10\log_{10}[(\text{used RBW}) / 4\text{kHz}]$.
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% - = $P - 25 + CF$
100% authorised bandwidth)
 - b. Emissions Limits (dBm) (100% - = $P - 35 + CF$
250% authorised bandwidth)
 - c. Emissions Limits (dBm) (> 250% = $P - [43 + 10 \log_{10} P_w] + 30 + CF$
authorised bandwidth)
where P = Measured mean power in dBm
 P_w = Measured mean power in W
 CF = RBW correction factor (see Note 4)
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 – 25GHz is $\pm 4.0\text{dB}$.

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer	E7405A	US40240195	16 Mar 2013
EMCO Horn Antenna – H15	3115	0003-6088	20 May 2013
Bird 20dB Attenuator	25-A-MFN-20	0209	25 May 2013

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

47 CFR 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

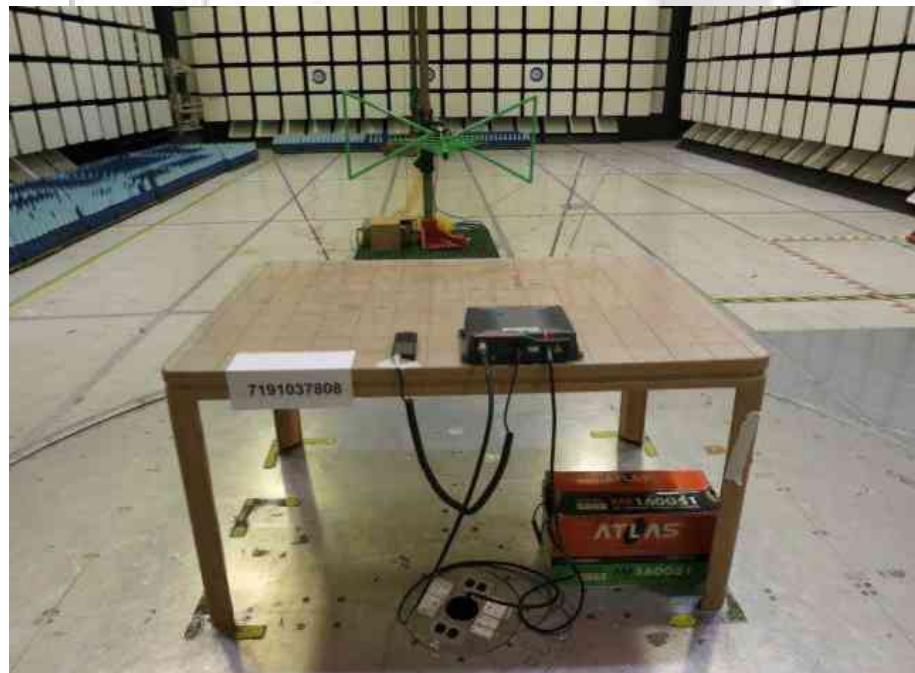
47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Method

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)



PSB Singapore

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

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

Operating Mode	Continuous Satellite transmission	Temperature	24°C
Test Input Power	12Vdc (Worst Voltage)	Relative Humidity	60%
Test Distance	3m	Atmospheric Pressure	1030mbar
Attached Plots	91 – 111	Tested By	Dylan Lin, Zechs Ng

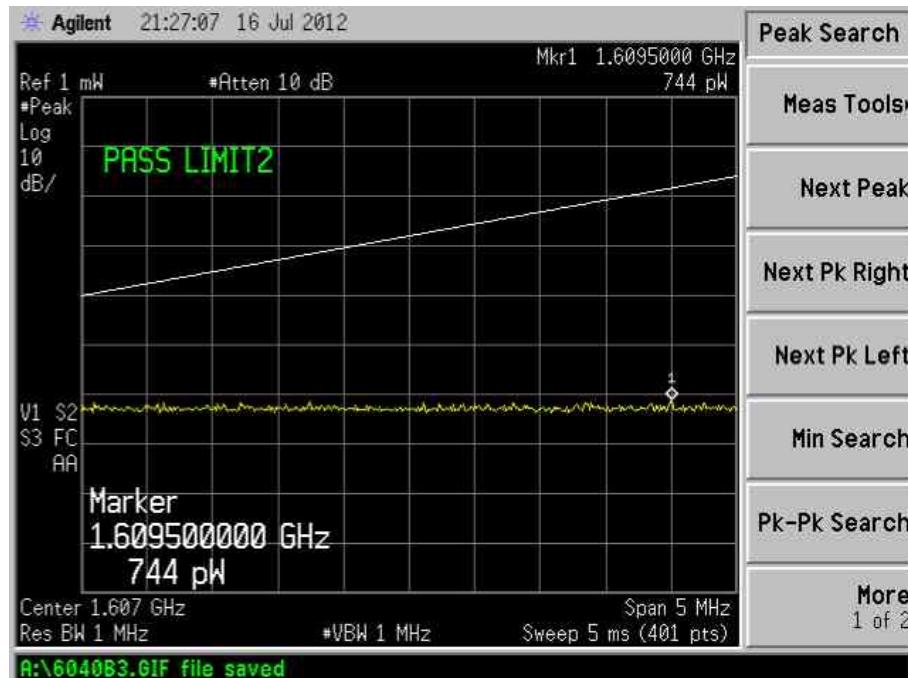
All spurious signals found were below the specified limit. Please refer to the attached plots.

Operating Mode	Satellite off (Standby)	Temperature	24°C
Test Input Power	12Vdc (Worst Voltage)	Relative Humidity	60%
Test Distance	3m	Atmospheric Pressure	1030mbar
Attached Plots	112	Tested By	Dylan Lin, Zechs Ng

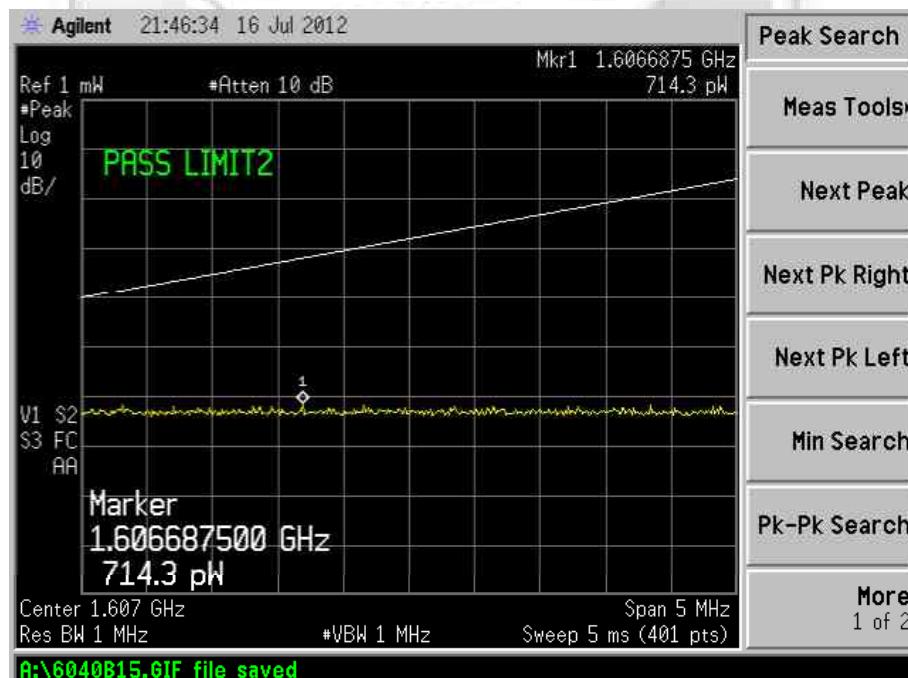
All spurious signals found were below the specified limit. Please refer to the attached plots.

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 0 - Transmitter On



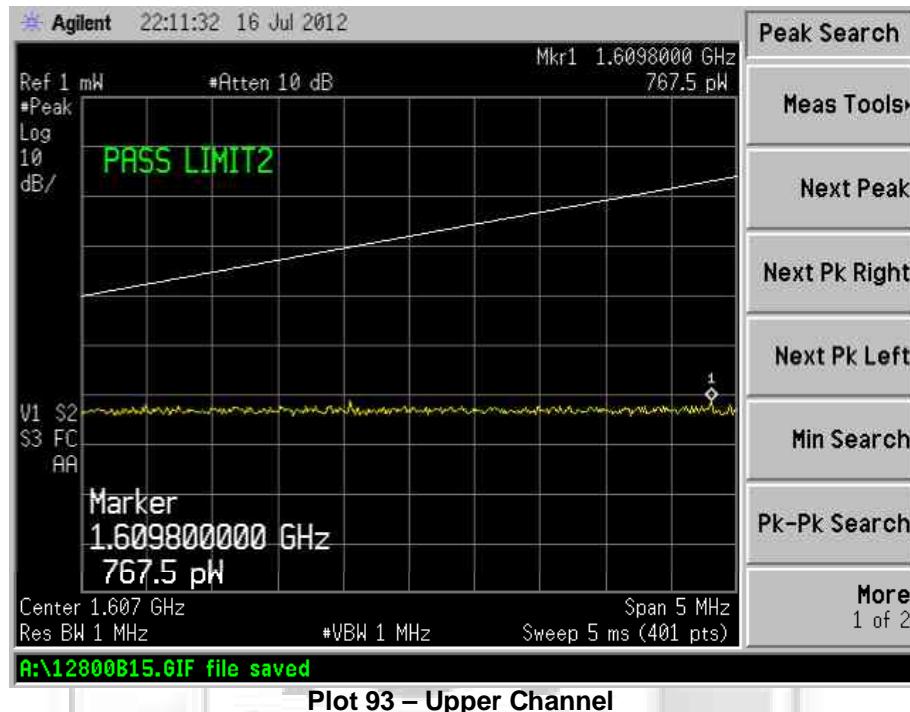
Plot 91 – Lower Channel



Plot 92 – Middle Channel

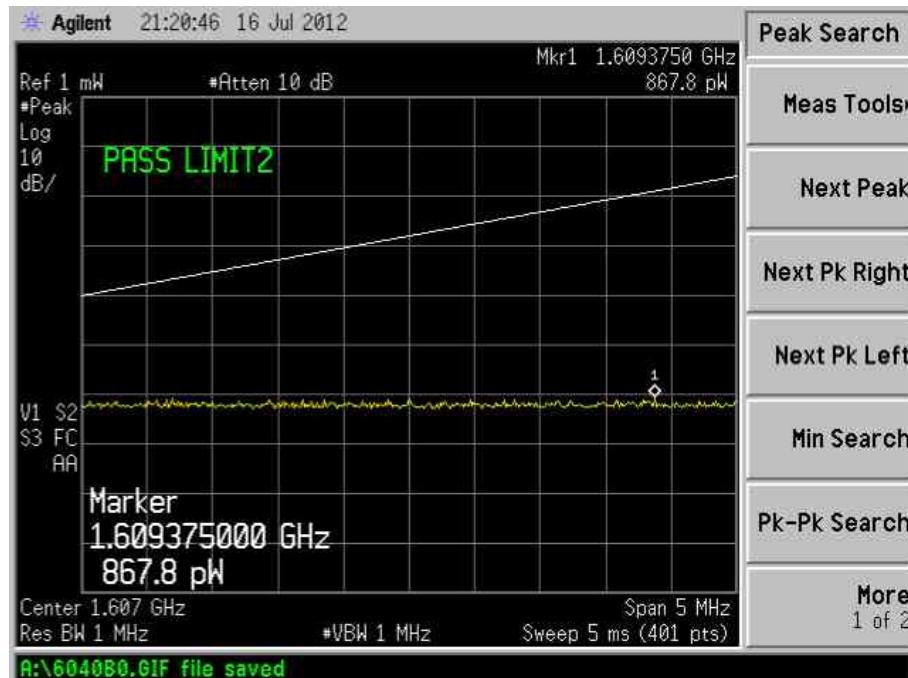
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 0 - Transmitter On

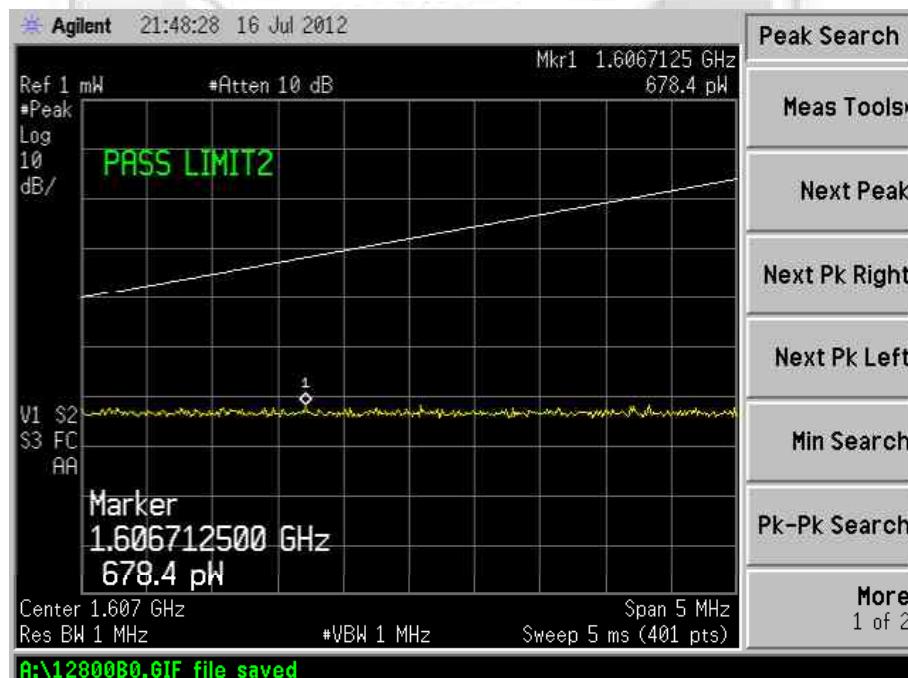


PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 3 - Transmitter On



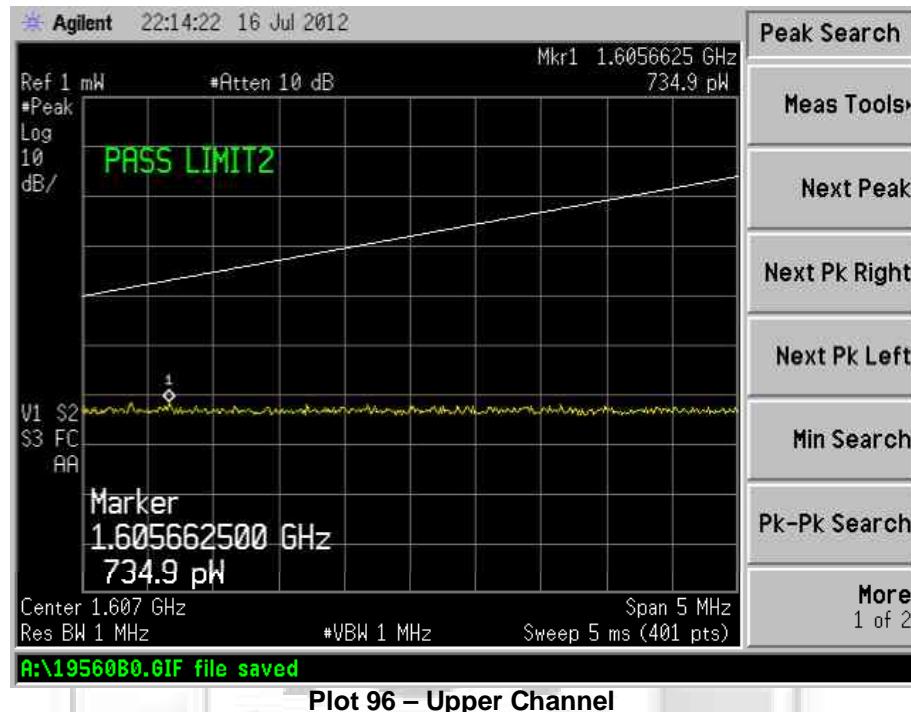
Plot 94 – Lower Channel



Plot 95 – Middle Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 3 - Transmitter On

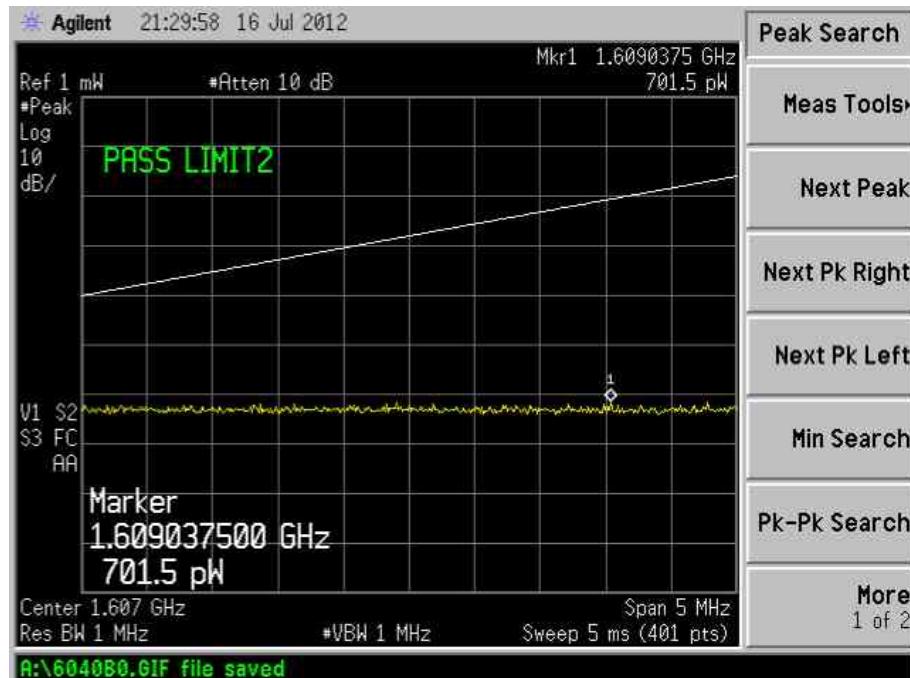




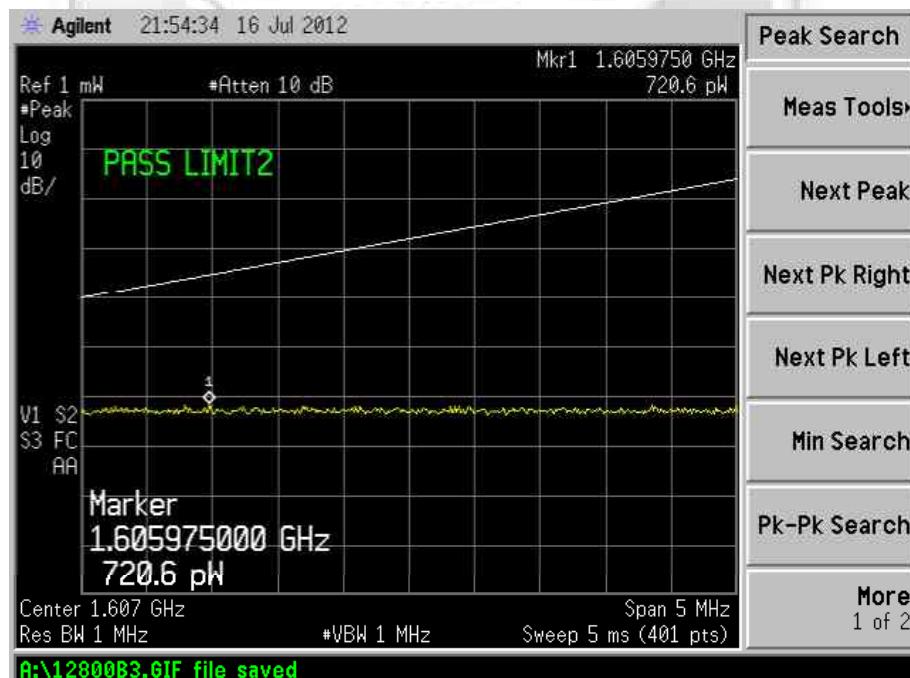
PSB Singapore

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 5 - Transmitter On



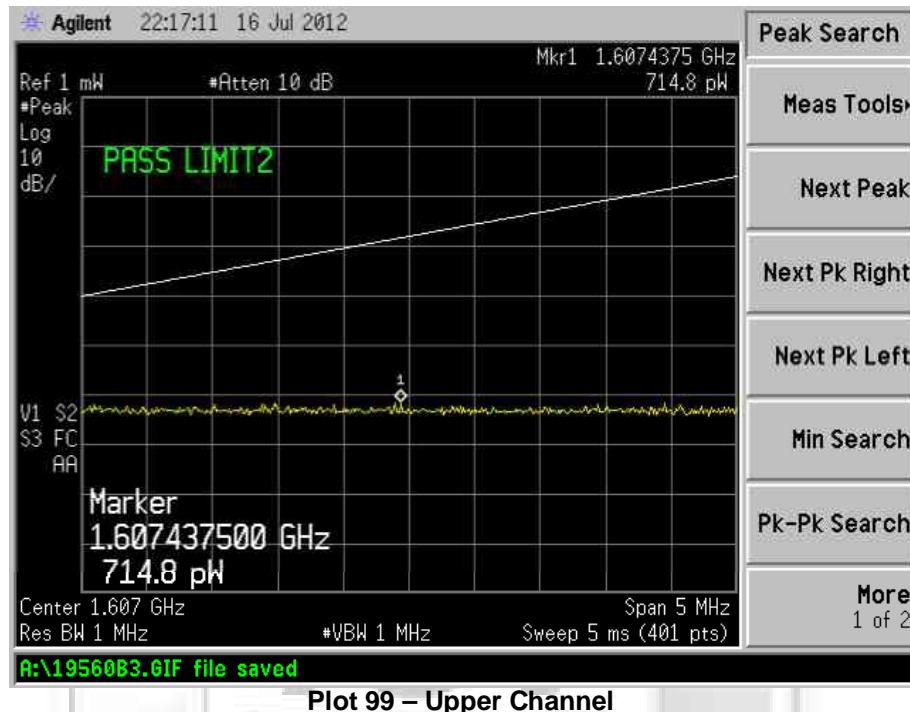
Plot 97 – Lower Channel



Plot 98 – Middle Channel

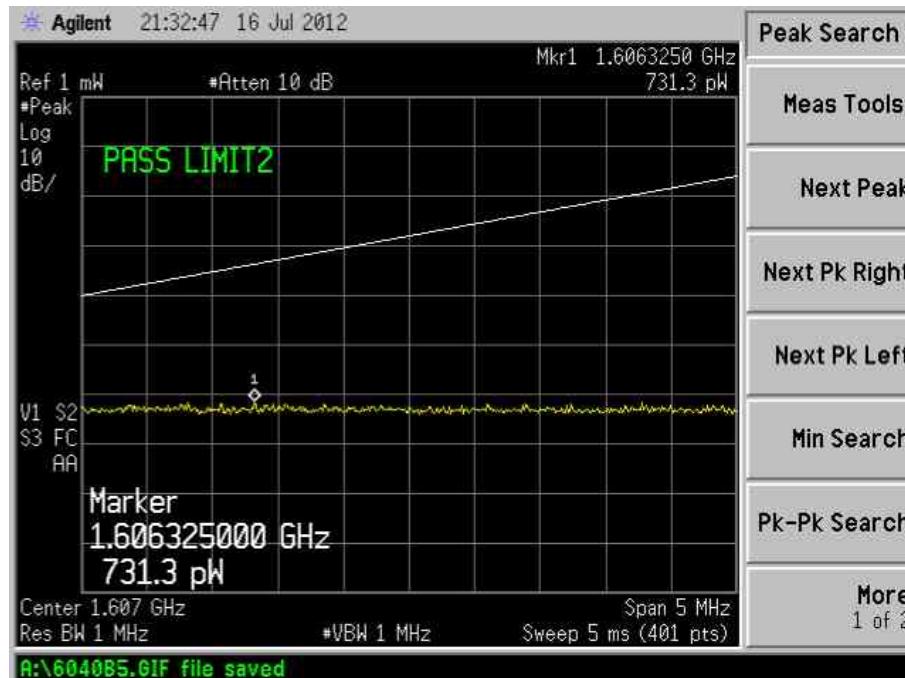
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 5 - Transmitter On

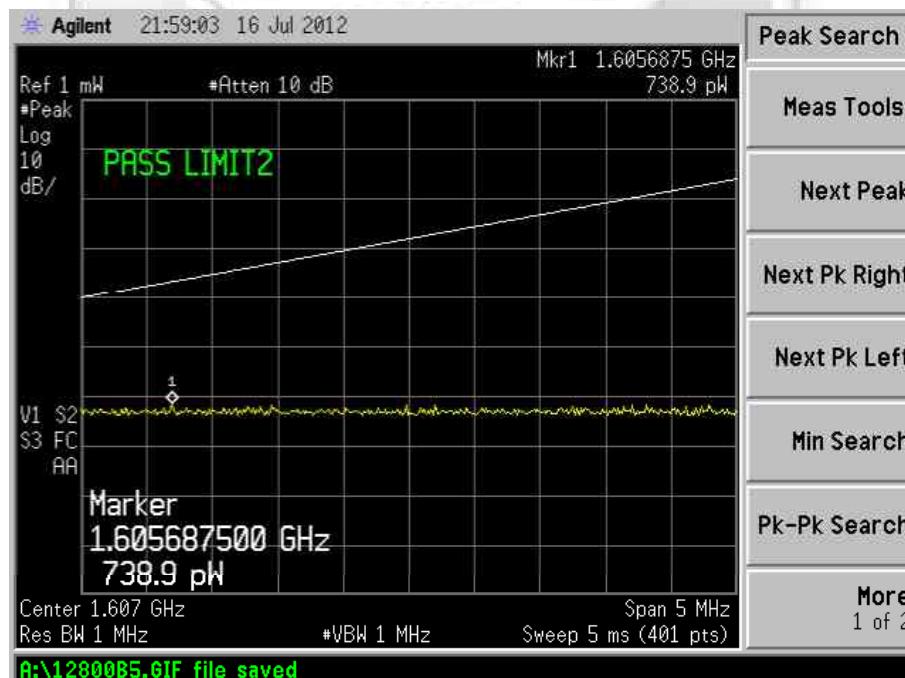


PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 7 - Transmitter On



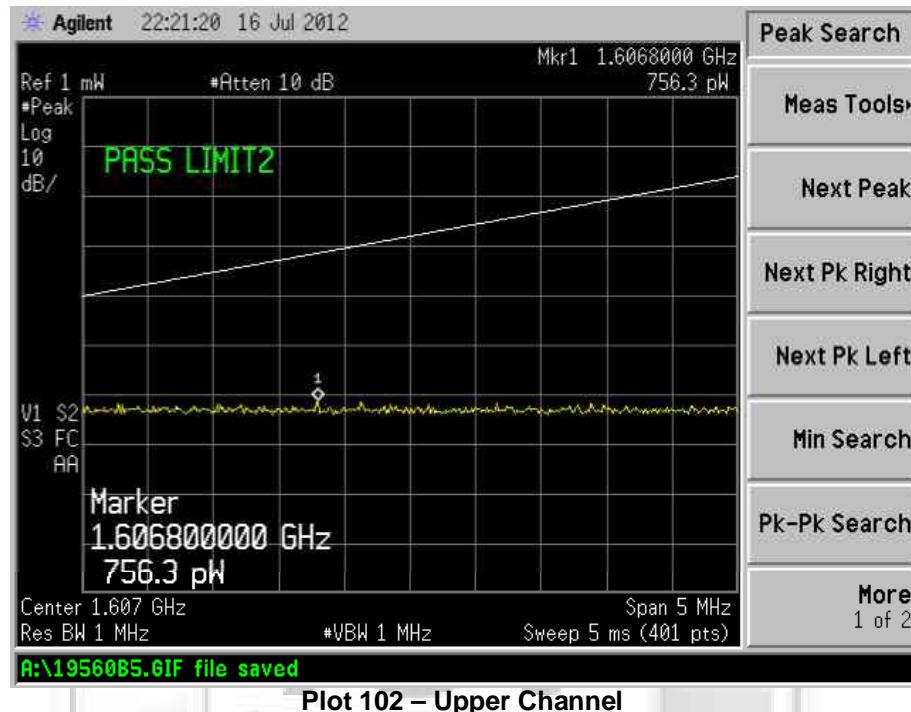
Plot 100 – Lower Channel



Plot 101 – Middle Channel

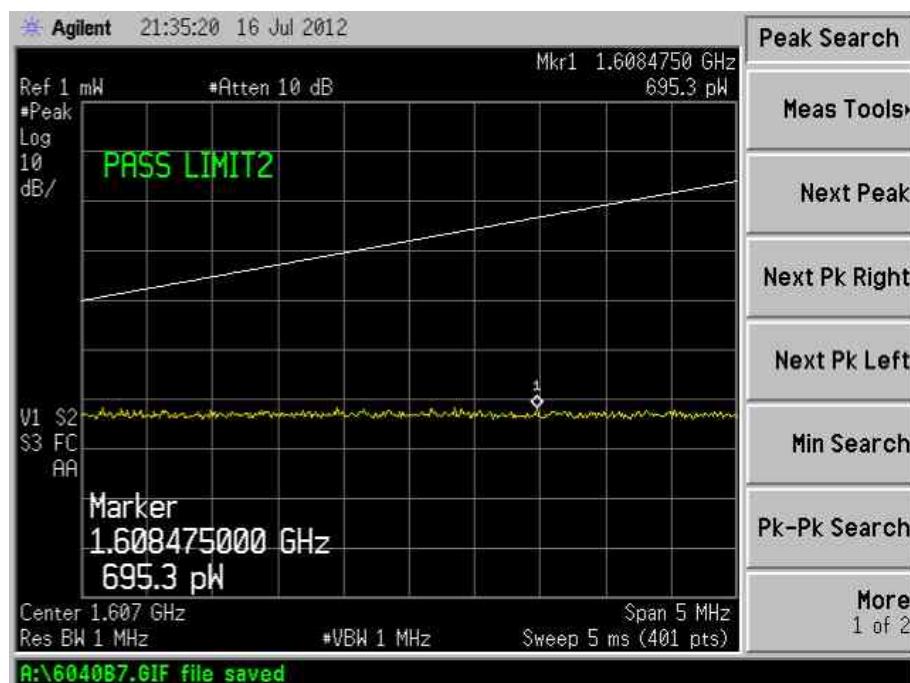
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 7 - Transmitter On

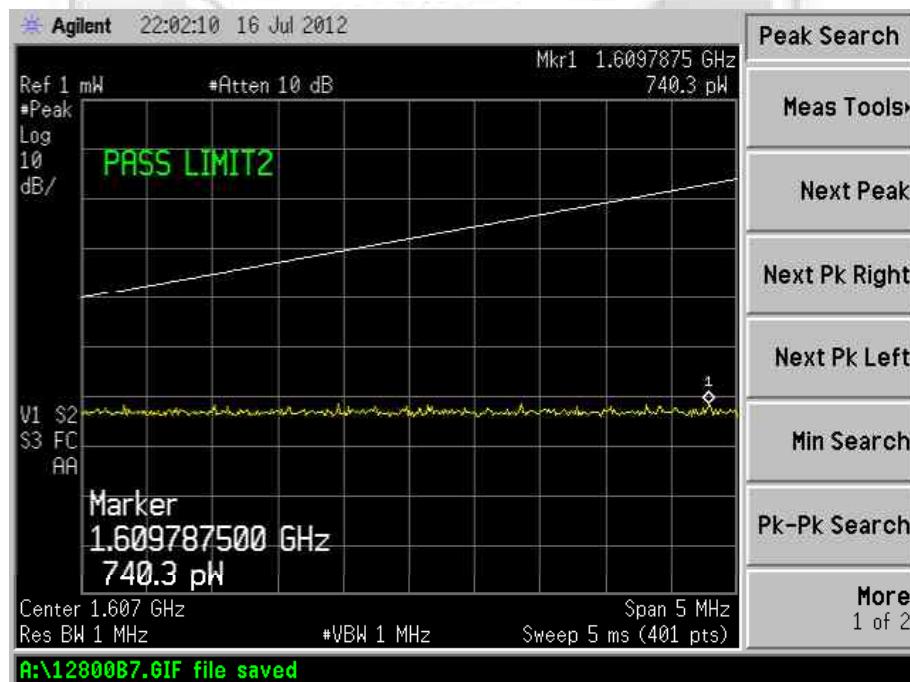


PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 11 - Transmitter On



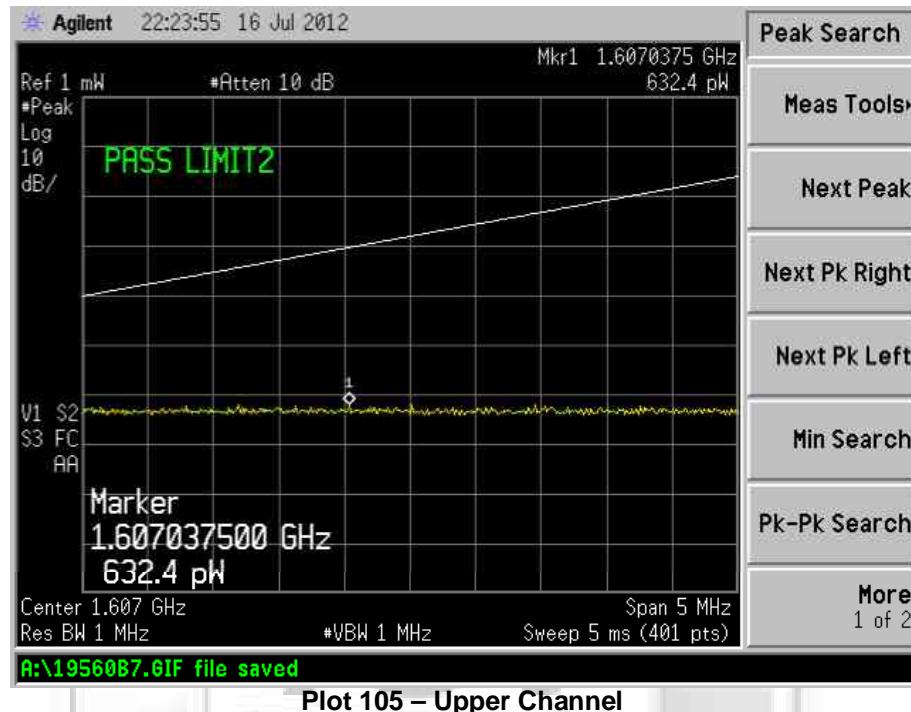
Plot 103 – Lower Channel



Plot 104 – Middle Channel

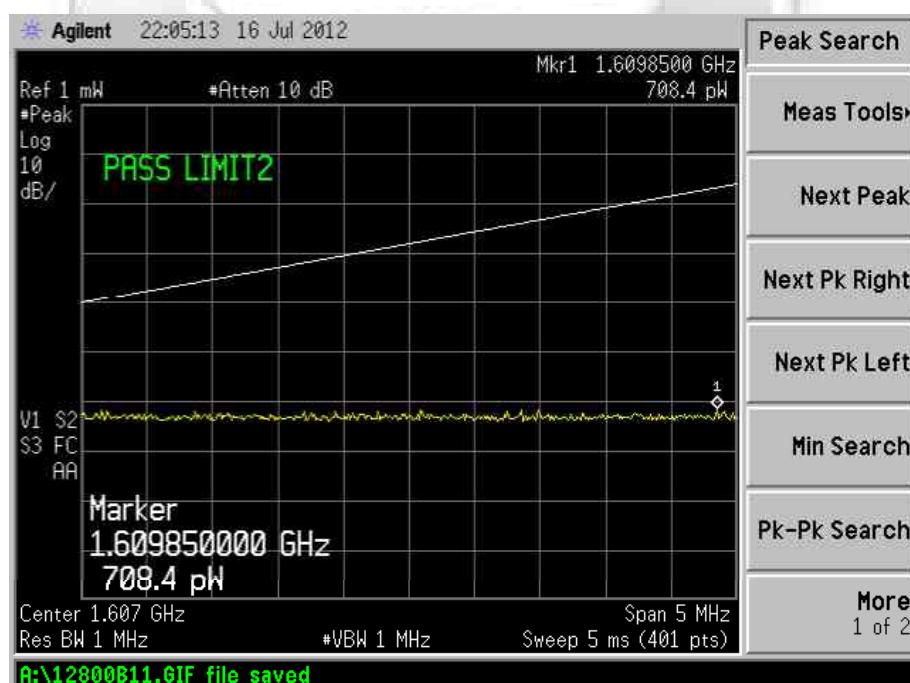
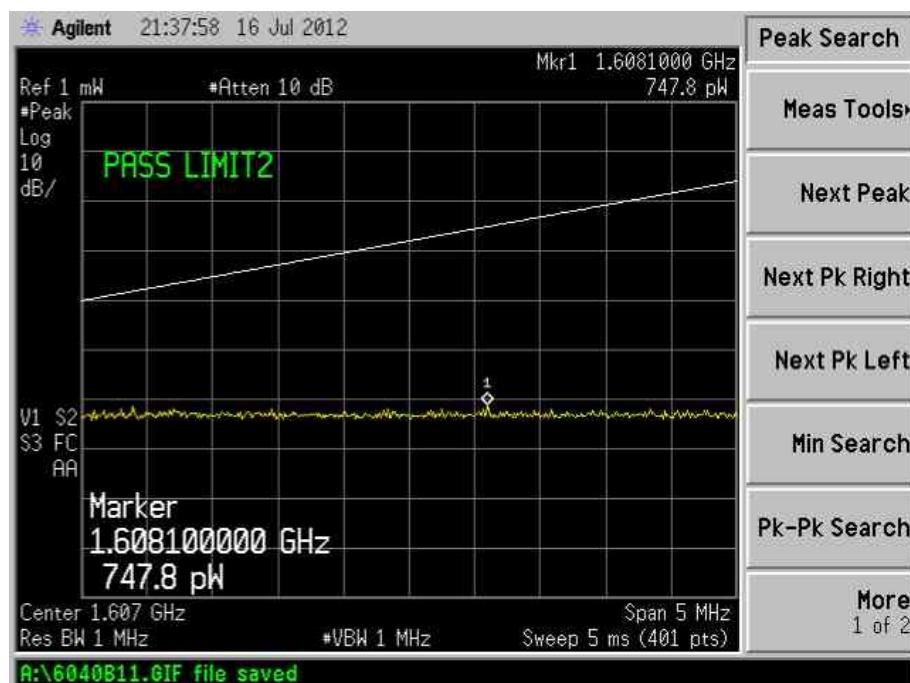
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 11 - Transmitter On



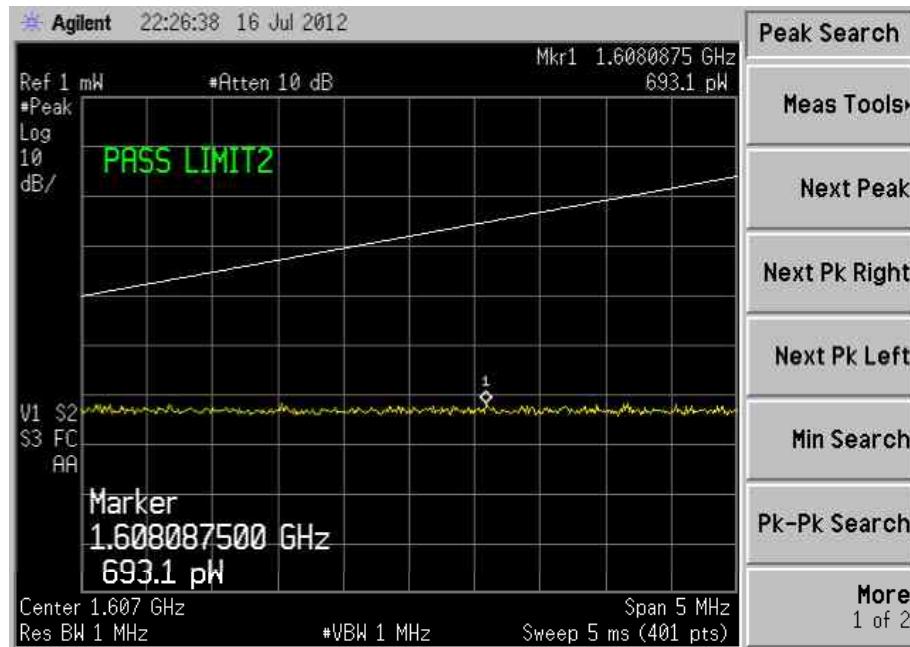
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 13 - Transmitter On



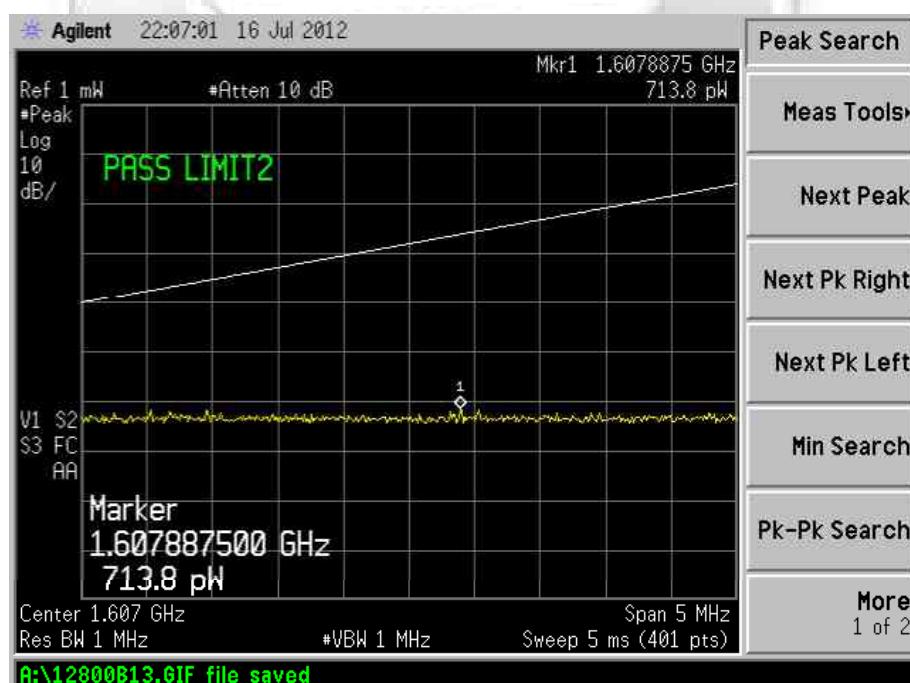
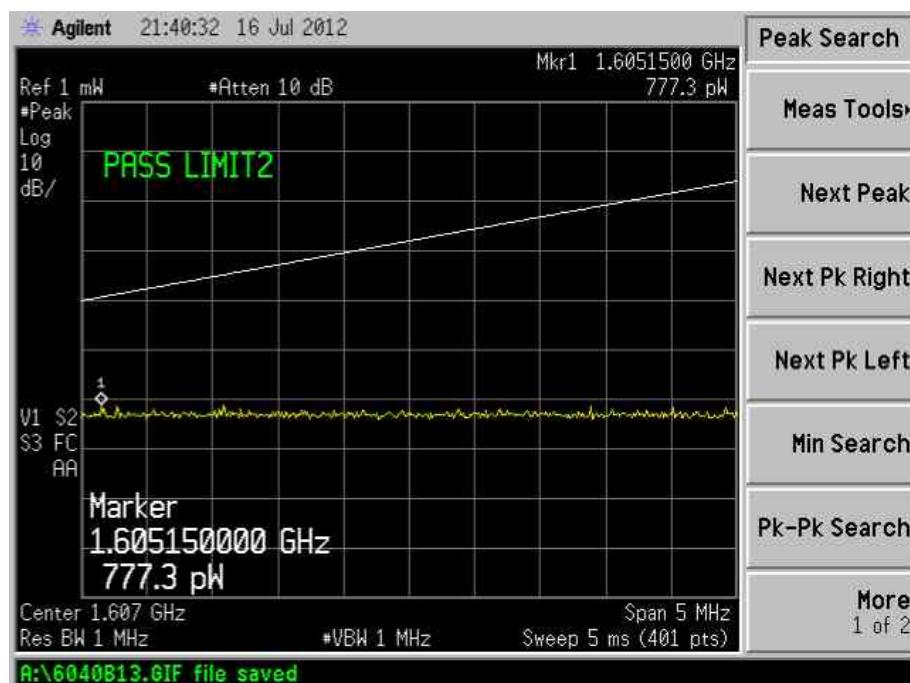
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 13 - Transmitter On



PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 15 - Transmitter On



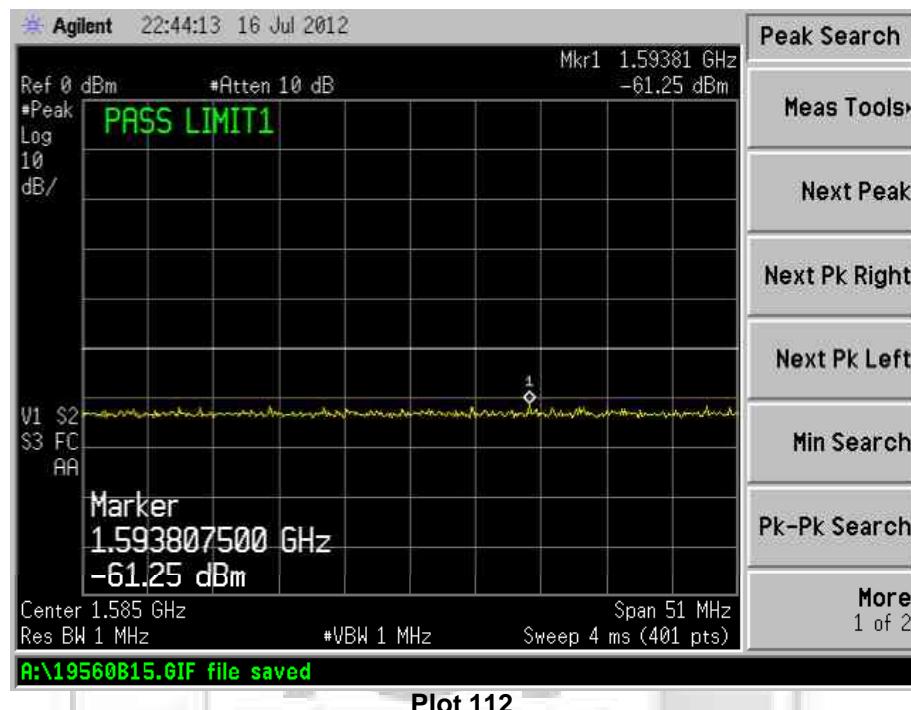
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 15 - Transmitter On



PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Carrier Off



FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent Universal Counter <small>*See Note 1</small>	53132A	3736A0628	25 May 2012
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor
GW Insteek Programmable Power Supply	PSH-3630A	RK200168	30 Jan 2013

*Note 1: This test was conducted on 3rd May 2012.

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

47 CFR 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.

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

1. The temperature chamber was set at 20°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°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°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°C step until the temperature reached 50°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

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

Operating Mode	Continuous Satellite Transmission.	Temperature	See table below
Test Input Power	24Vdc (Worst Voltage)	Relative Humidity	70%
		Atmospheric Pressure	1030mbar
		Tested By	Kyaw Soe Hein

Lower Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.626600870	1.626600000	870.000000	+/-16266
-20	1.626600907	1.626600000	907.000000	+/-16266
-10	1.626600590	1.626600000	590.000000	+/-16266
0	1.626600892	1.626600000	892.000000	+/-16266
10	1.626600264	1.626600000	264.000000	+/-16266
20	1.626600490	1.626600000	490.000000	+/-16266
30	1.626600107	1.626600000	107.000000	+/-16266
40	1.626600178	1.626600000	178.000000	+/-16266
50	1.626600245	1.626600000	245.000000	+/-16266



FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

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

Operating Mode	Continuous Satellite Transmission.	Temperature	See table below
Test Input Power	24Vdc (Worst Voltage)	Relative Humidity	70%
		Atmospheric Pressure	1030mbar
		Tested By	Kyaw Soe Hein

Middle Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.643500475	1.643500000	475.000000	+/-16435
-20	1.643500899	1.643500000	899.000000	+/-16435
-10	1.643500106	1.643500000	106.200000	+/-16435
0	1.643500136	1.643500000	135.600000	+/-16435
10	1.643500169	1.643500000	169.000000	+/-16435
20	1.643500590	1.643500000	590.000000	+/-16435
30	1.643500973	1.643500000	973.000000	+/-16435
40	1.643500710	1.643500000	710.000000	+/-16435
50	1.643500474	1.643500000	474.000000	+/-16435

Upper Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.660400480	1.660400000	480.000000	+/-16604
-20	1.660400871	1.660400000	871.000000	+/-16604
-10	1.660400110	1.660400000	110.000000	+/-16604
0	1.660400478	1.660400000	478.000000	+/-16604
10	1.660400198	1.660400000	198.100000	+/-16604
20	1.660400447	1.660400000	447.000000	+/-16604
30	1.660400441	1.660400000	440.500000	+/-16604
40	1.660400170	1.660400000	170.000000	+/-16604
50	1.660400604	1.660400000	604.000000	+/-16604

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent Universal Counter <small>*See Note 1</small>	53132A	3736A0628	25 May 2012
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor
GW Insteek Programmable Power Supply	PSH-3630A	RK200168	30 Jan 2013

*Note 1: This test was conducted on 3rd May 2012.

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

47 CFR 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.

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

1. The temperature chamber was set at 20°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





PSB Singapore

FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

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

Operating Mode	Continuous Satellite Transmission	Temperature	20°C
Test Input Power	See table below	Relative Humidity	70%
		Atmospheric Pressure	1030mbar
		Tested By	Kyaw Soe Hein

Lower Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.8	1.626600212	1.626600000	212.000000	+/-16266
24.0	1.626600091	1.626600000	91.000000	+/-16266
31.2	1.626600131	1.626600000	131.000000	+/-16266

Middle Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.8	1.643500106	1.643500000	106.000000	+/-16435
24.0	1.643500096	1.643500000	96.000000	+/-16435
31.2	1.643500056	1.643500000	56.100000	+/-16435

Upper Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.8	1.660400226	1.660400000	226.000000	+/-16604
24.0	1.660400247	1.660400000	247.000000	+/-16604
31.2	1.660400209	1.660400000	209.000000	+/-16604

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

47 CFR 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

47 CFR FCC Part 1.1310 Maximum Permissible Exposure Computation

The minimum distance to the EUT was computed from the following formula:

$$\begin{aligned} S &= (30GP) / (377d^2) \\ \text{where } S &= 10W/m^2 \\ P &= 1.9275W \\ d &= \text{Test distance} \\ G &= \text{Numerical isotropic gain, 10.0 (10.0dBi)} \end{aligned}$$

Substituting the relevant parameters into the formula:

$$\begin{aligned} d &= \sqrt{(30GP) / 377S} \\ &= \sqrt{(30 \times 1.9275) / (377 \times 10)} \\ &= 0.40m \end{aligned}$$

∴ The EUT shall maintain at least at 0.40m from operators to comply to MPE criteria.

Please note that this Report is issued under the following terms :

1. 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. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
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5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS



ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS FOR SKIPPER 150X (TESTED)



Front View



Rear View

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS – HANDSET (TESTED)



Front View



Rear View

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS FOR SATELLITE COMMUNICATION SYSTEM FLEET ONE (DECLARED)



Front View



Rear View

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS – HANDSET (DECLARED)



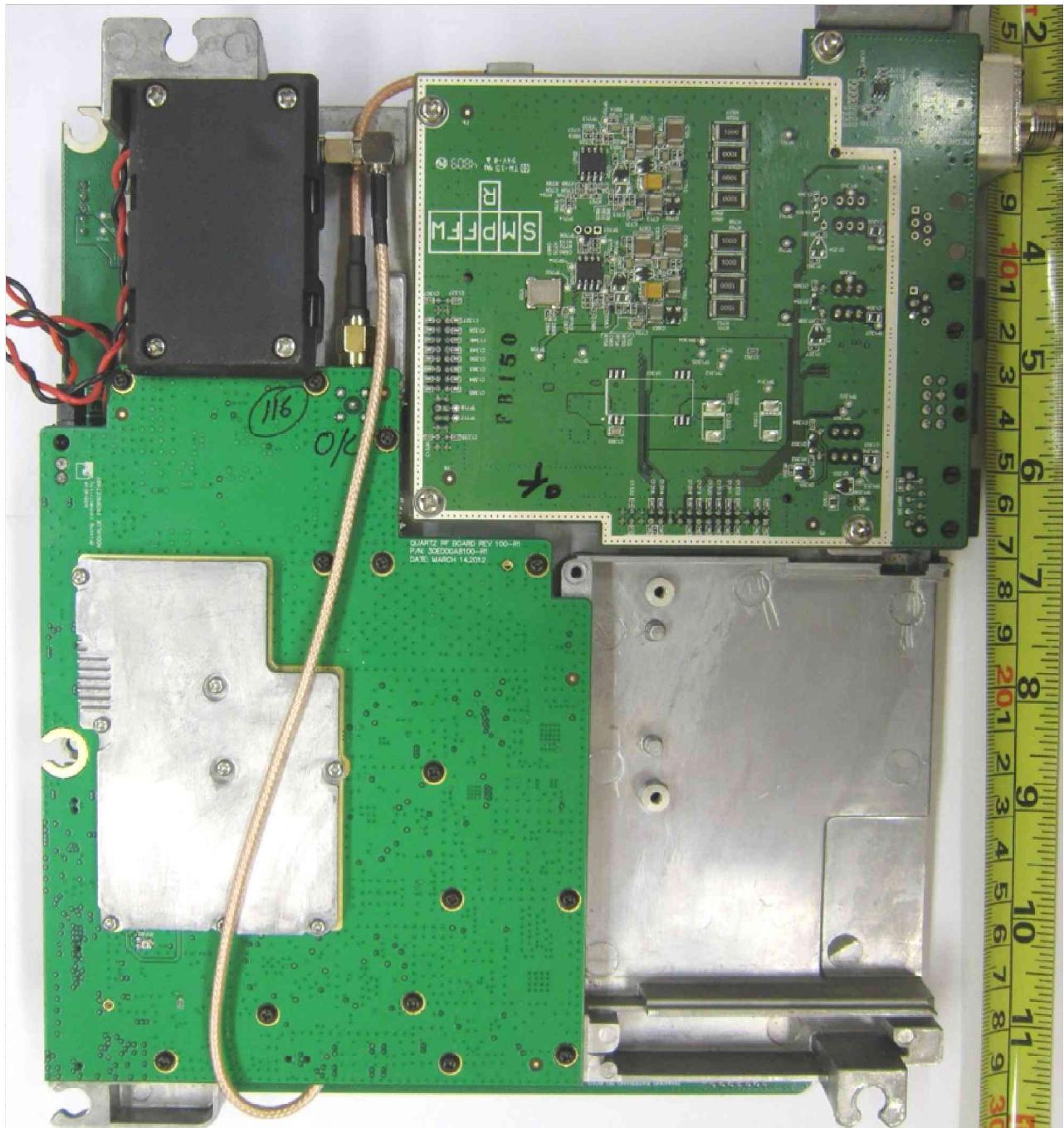
Front View



Rear View

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS



Internal View 1

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

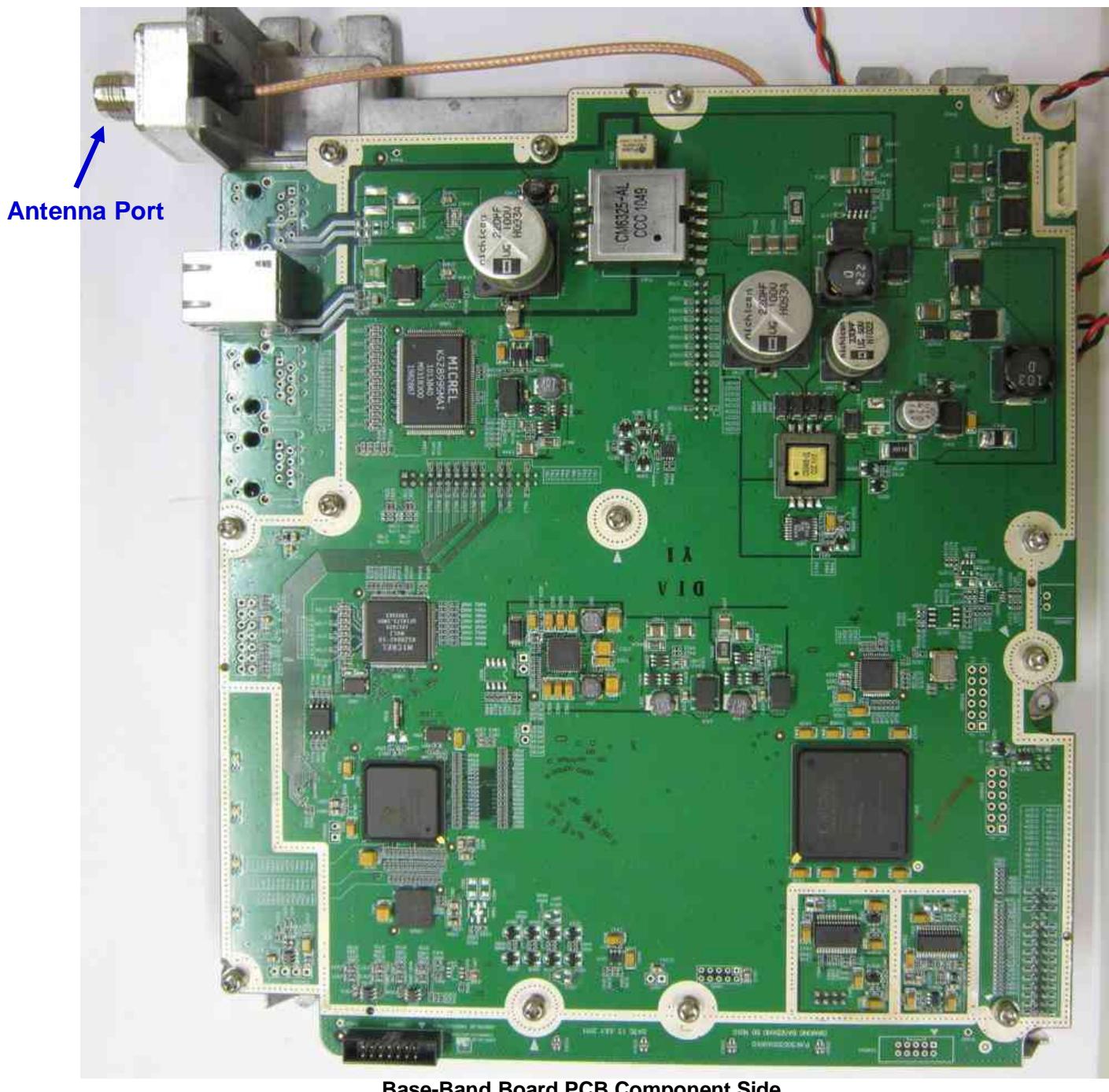
EUT PHOTOGRAPHS



Internal View 2

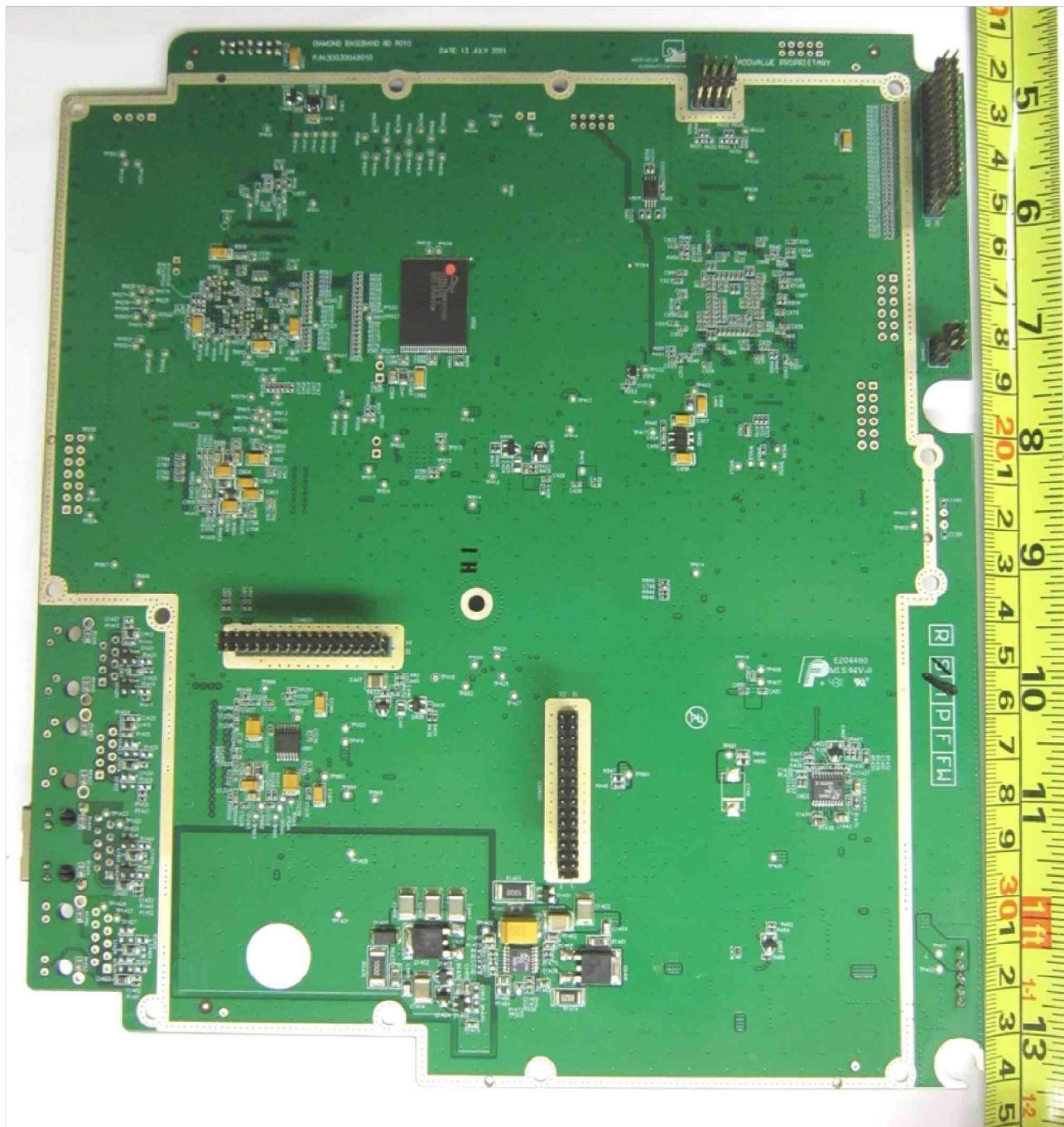
ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS



ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

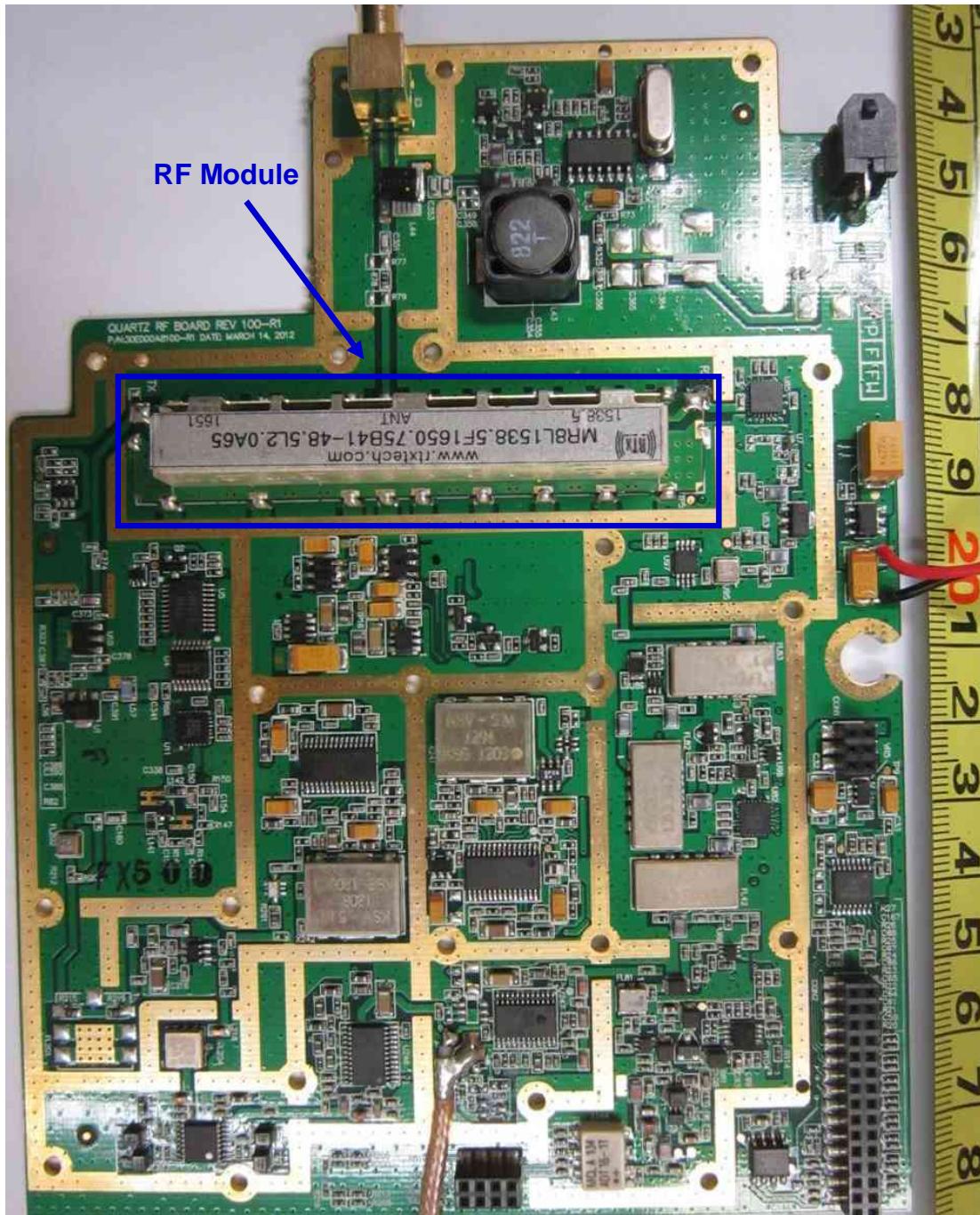
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Base-Band Board PCB Trace Side

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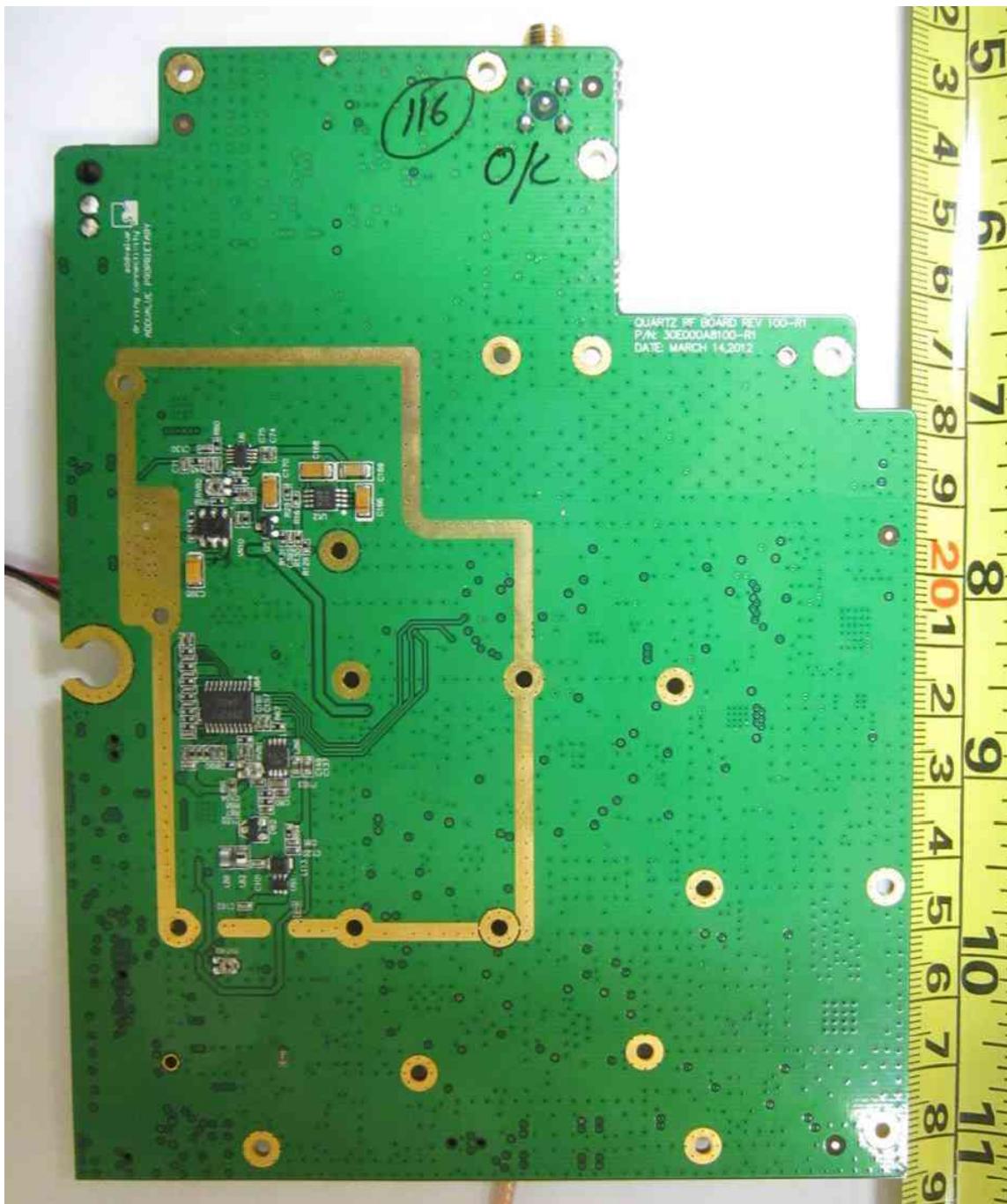
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RF Module Board PCB Component Side

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

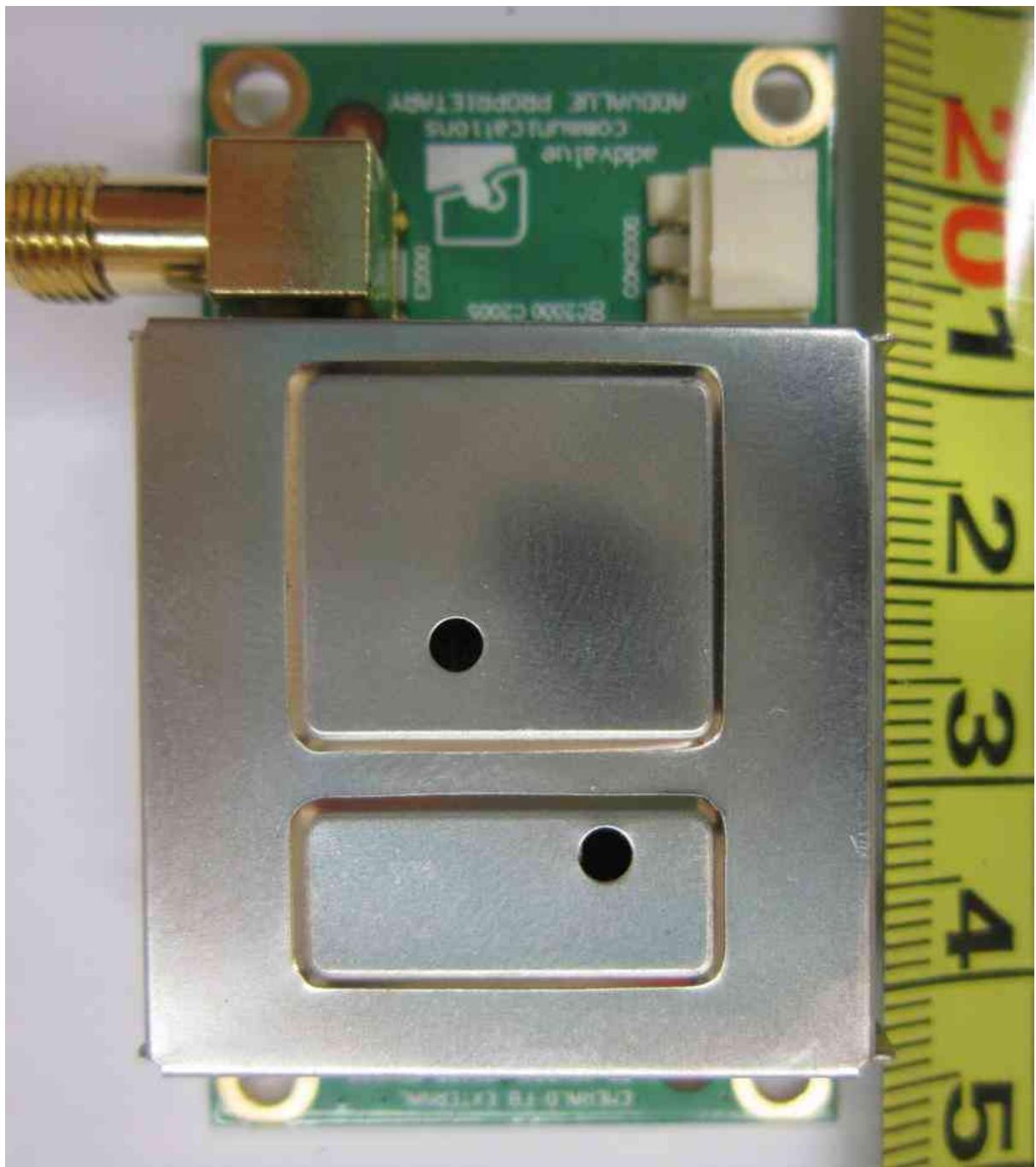
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RF Module Board PCB Trace Side

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

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Crystal Board PCB Component Side

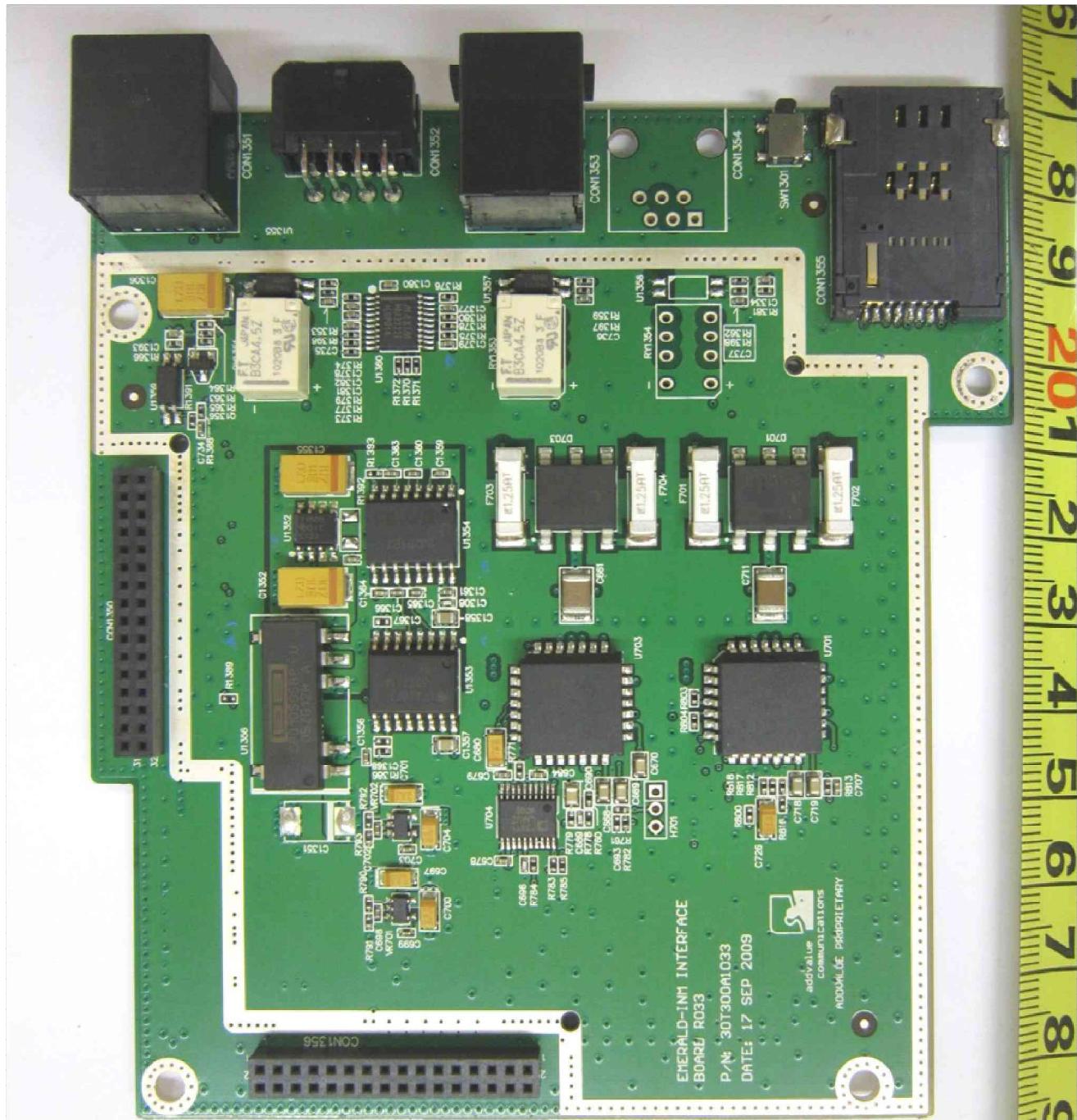
ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS



ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

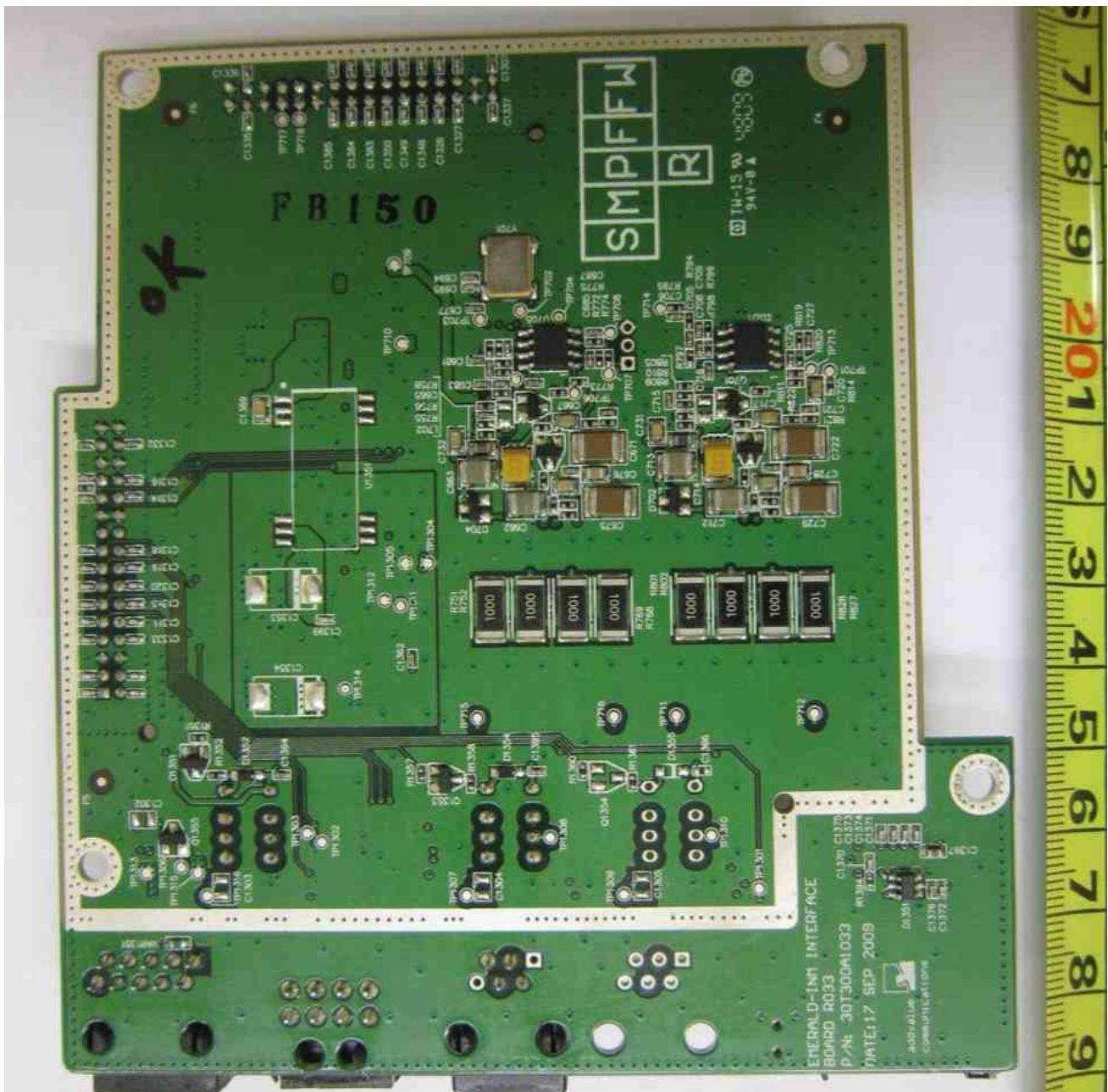
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Interface Board PCB Component Side

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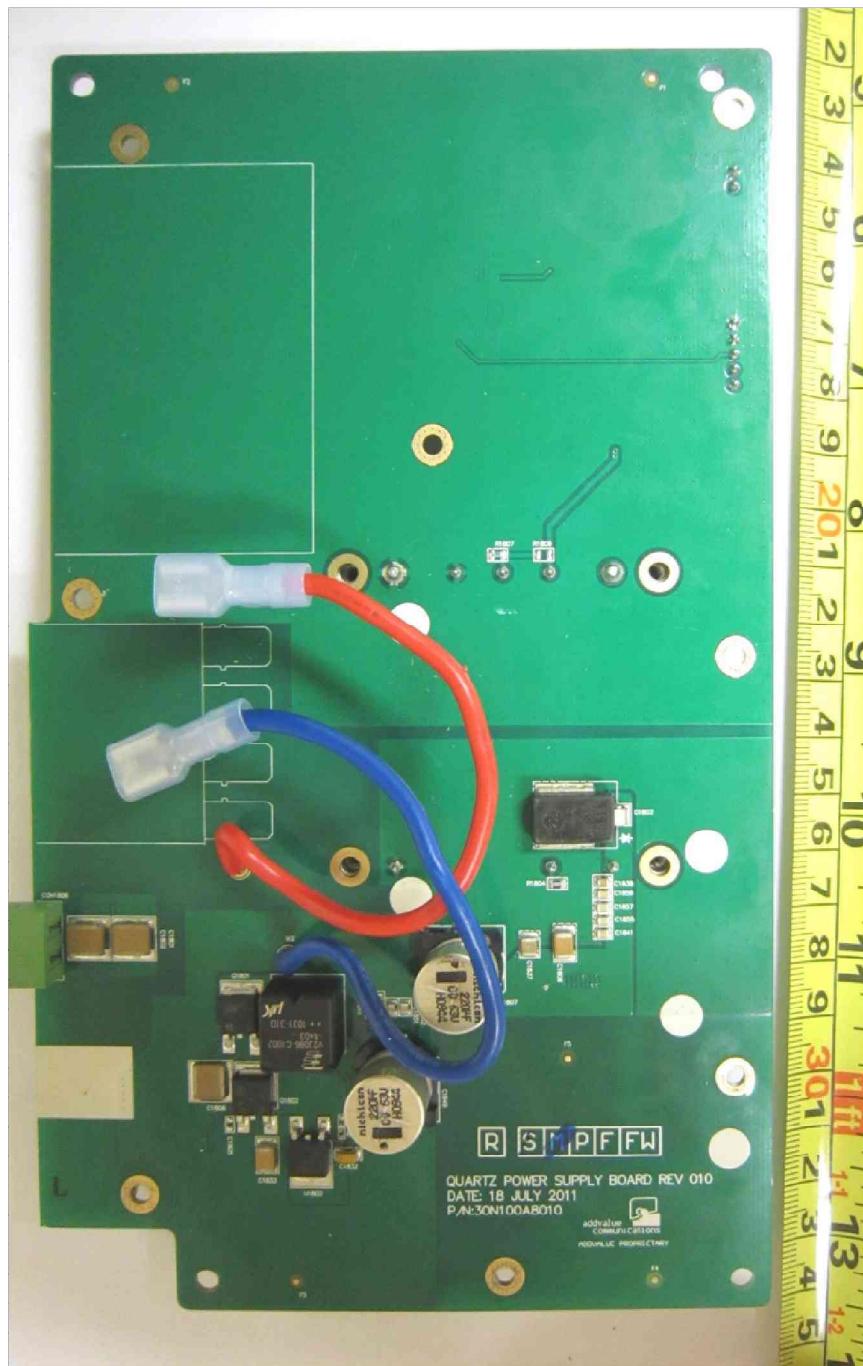
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Interface Board PCB Trace Side

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

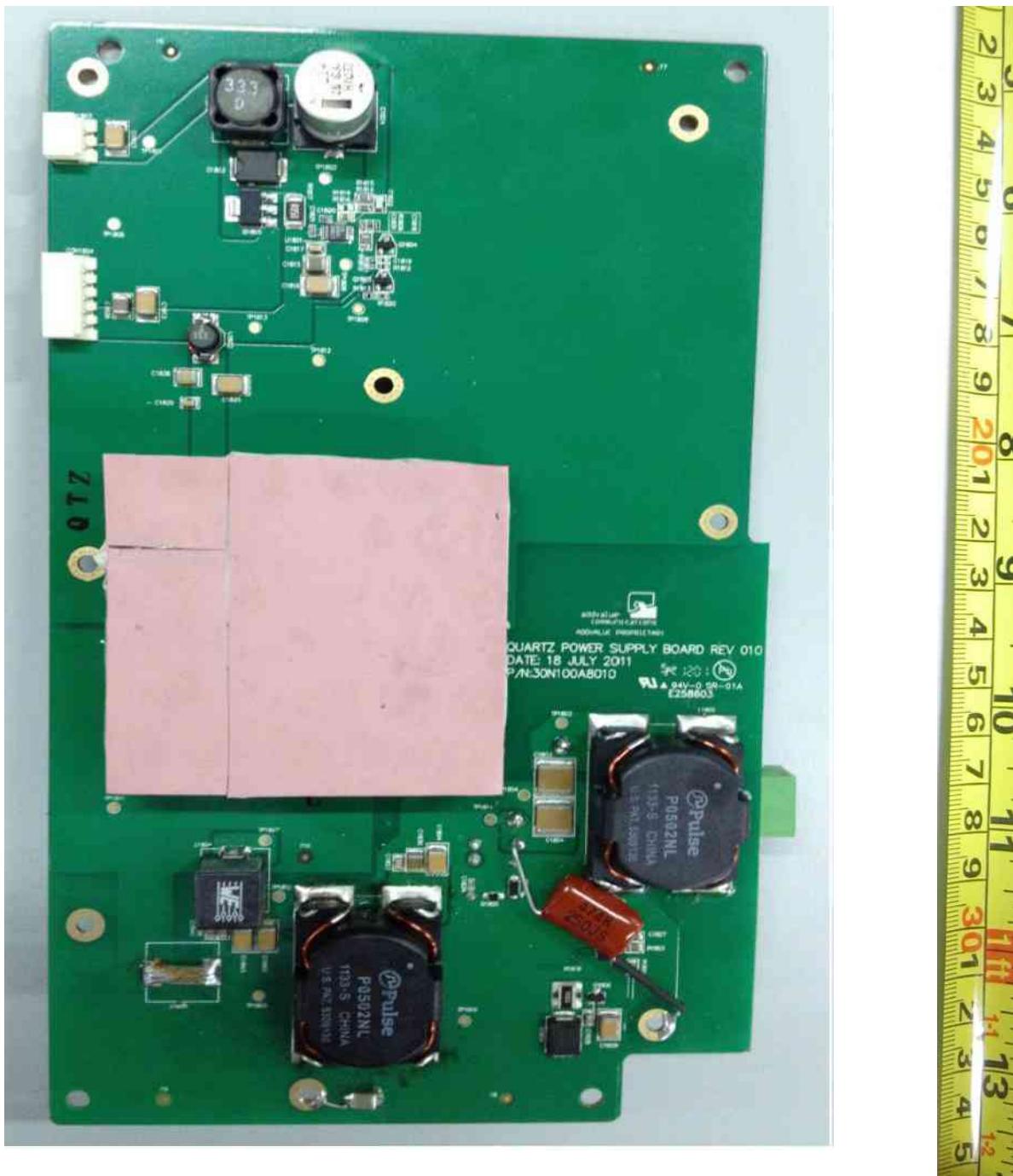
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Power Supply Board PCB Component Side

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

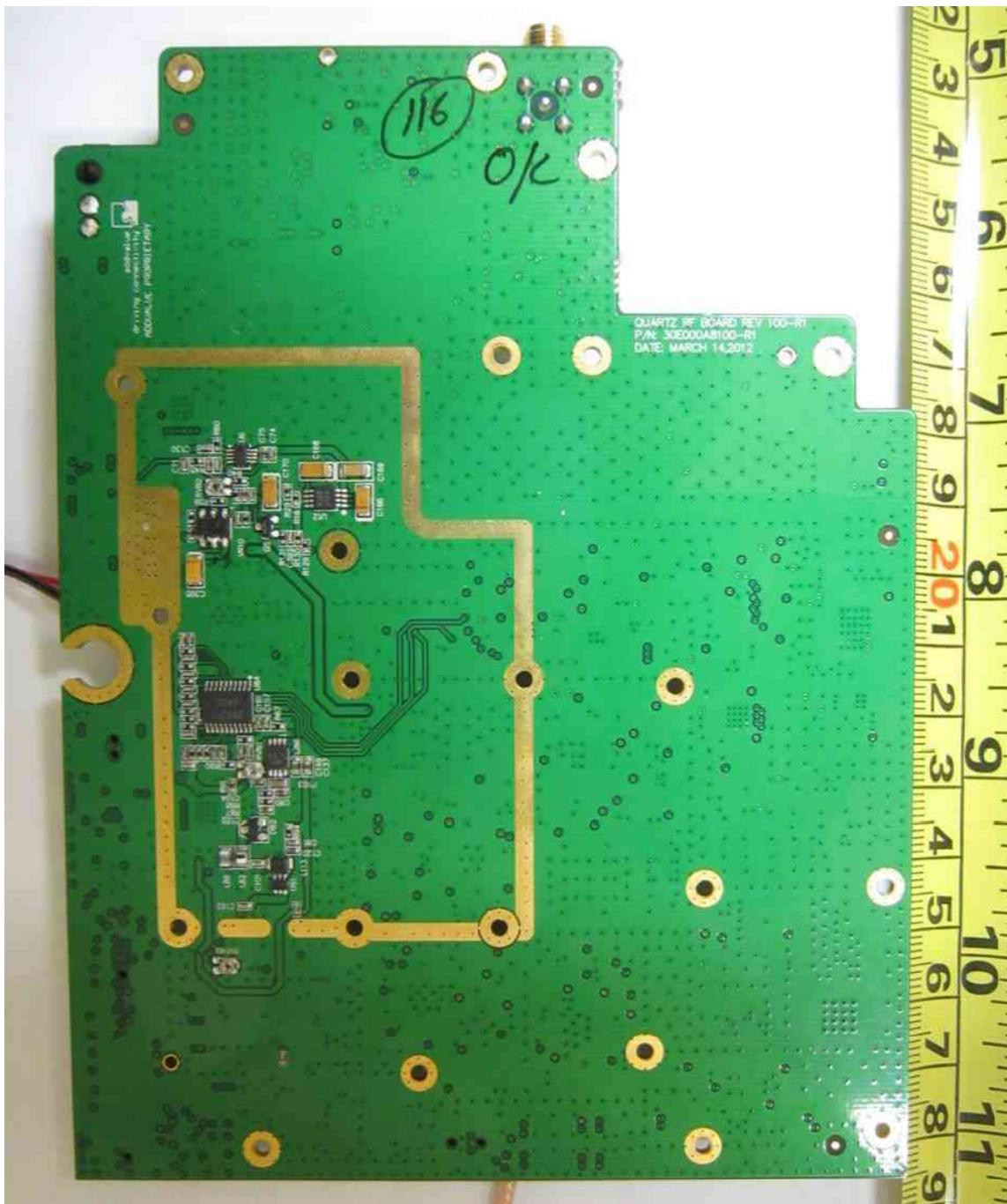
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Power Supply Board PCB Trace Side

ANNEX A EUT PHOTOGRAPHS / DIAGRAMS

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RF Module Circuit with RF Shield Removed

ANNEX B USER MANUALTECHNICAL DESCRIPTION BLOCK & CIRCUIT DIAGRAMS



ANNEX C FCC LABEL & POSITION



ANNEX C FCC LABEL & POSITION

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