FCC CFR47 PART 22H AND 24E
CERTIFICATION TEST REPORT

FOR

TABLET WITH CELLULAR GSM/GPRS/EGPRS/WCDMA/HSPA+/DC- HSDPA/LTE IEEE 802.11A/B/G/N (MIMO 2X2) AND BLUETOOTH RADIO

MODEL NUMBER: A1491

FCC ID: BCGA1491

REPORT NUMBER: 13U16583-1, REVISION A

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Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
	01/23/14	Initial Issue	T. Chan
A	02/14/14	Address TCB's Questions	C. Pang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.
EUT DESCRIPTION:	Tablet with cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE/IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth Radio
MODEL:	A1491
SERIAL NUMBER:	10510 (CONDUCTED) & 13647 (RADIATED)
DATE TESTED:	NOVEMBER 18, 2013 - JANUARY 10, 2014 AND FEBRUARY 14, 2014

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 22H AND 24E	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

Thu Chan
WiSE Operations Manager
UL Verification Services Inc.

Tested By:

Mona Hua
WiSE Lab Technician
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA-603-C, FCC CFR 47 Part 2, FCC CFR 47 Part 22 and Part 24.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☒ Chamber D
☐ Chamber B	☒ Chamber E
☐ Chamber C	☐ Chamber F

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a tablet device with cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE/IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth radio.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted and ERP / EIRP output powers; average detector is used for UMTS mode of Cellular band, while peak detector is used for GSM mode of Cellular and all GSM/UMTS PCS bands as follows:

GSM MODES

Part 22/24					
Frequency range (MHz)	Modulation	Conducted (Peak)		ERP/EIRP (Peak)	
		dBm	mW	dBm	mW
824.2 - 848.8	GPRS	33.60	2290.9	29.42	875.0
	EGPRS	31.80	1513.6	28.32	679.2
1850.2-1909.8	GPRS	30.90	1230.3	32.43	1749.8
	EGPRS	30.80	1202.3	32.15	1640.6

WCDMA

Part 22/24		Conducted				ERP/EIRP			
Frequency range (MHz)	Modulation	Peak		Average		Peak		Average	
		dBm	mW	dBm	mW	dBm	mW	dBm	mW
826.4-846.6	REL 99			24.45	278.6			21.38	137.4
826.4-846.6	HSDPA			23.50	223.9			20.48	111.7
1852.4 - 1907.6	REL 99	26.20	416.9			28.07	641.2		
1852.4 - 1907.6	HSDPA	25.67	369.0			27.07	509.3		

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a band gap type integral antenna for the following bands with a maximum peak gain as follow:

Frequency (MHz)	Gain (dBi)
Cell, 824 - 849	-2.95
PCS, 1850 - 1910	2.15

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 4324b5_roml.

The EUT is linked with CMW500 Test Set.

5.5. WORST-CASE CONFIGURATION AND MODE

For the fundamental investigation, since the EUT is a portable device that has three orientations; an X, Y and Z orientations and with AC/DC adapter and headset have been investigated. The worst case was found to be at X-position without AC/DC adapter and headset for Cell and Y-position for PCS band.

For the device, all tests were performed as below,
Both conducted and radiated emissions measurement with all bands.

- For Cellular and PCS band: GPRS and EGPRS
- For Cellular and PCS band: UMTS, REL 99 and HSDPA

5.6. DESCRIPTION OF TEST SETUP

I/O CABLES (RF CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	DC	Un-Shielded	0.5m	NA
2	RF In/Out	1	Directional Coupler	Un-Shielded	0.2m	NA
3	RF In/Out	1	Spectrum Analyzer	Un-Shielded	1m	NA
4	RF In/Out	1	Call Box	Un-Shielded	None	NA

I/O CABLES (RF RADIATED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	DC	Un-Shielded	1.2m	NA
2	Jack	1	Headset	Un-Shielded	1m	NA
3	RF In/Out	1	Horn	Un-Shielded	5m	NA

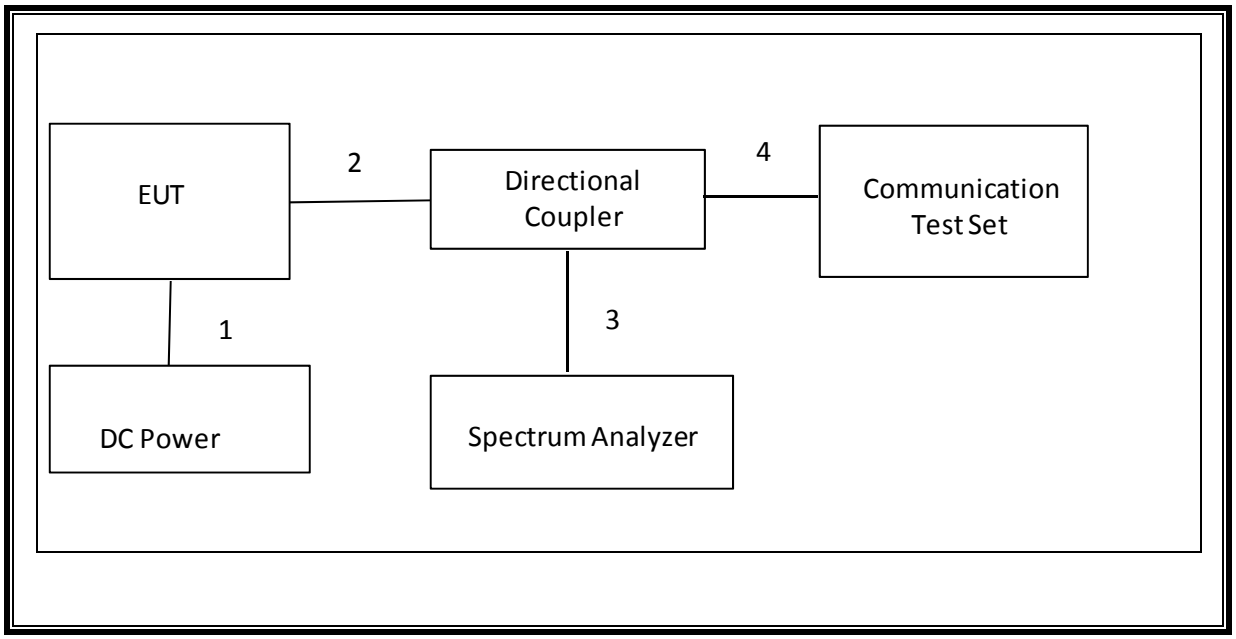
SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	Apple	A1357	A/12981EA	DoC
Earphone	Apple	NA	NA	NA

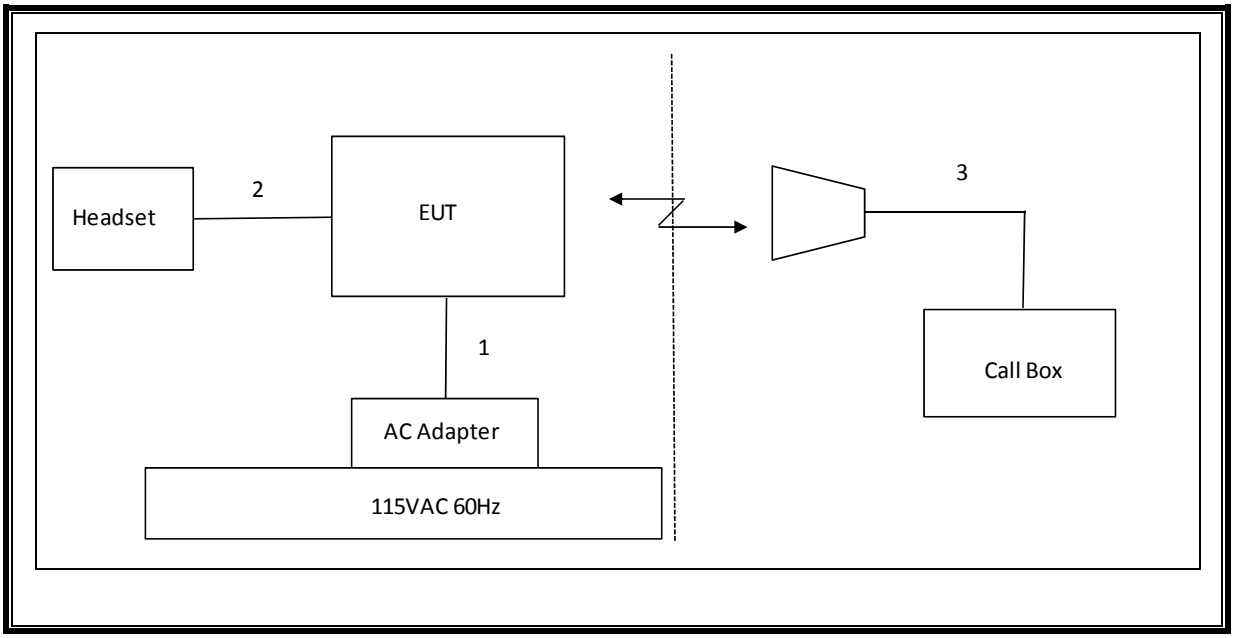
TEST SETUP

The EUT is a stand-alone device. The Communication test set exercised the EUT.

CONDUCTED SETUP



RADIATED SETUP



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
Directional Coupler	Krytar	1817	N02656	CNR
Communication Test Set	Agilent / HP	E5515C	C01086	11/10/14
Communication Test Set	R & S	CMW500	F00014	02/21/14
Spectrum Analyzer, 44GHz	Agilent	N9030A	F00129	02/21/14
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	06/27/14
Bilog, 30-1GHz	Sunol Science	A0222813-1	F00168	03/07/14
Horn Antenna	ETS Lindgren	3117	C00872	02/19/14
Signal generator, 6 GHz	Agilent / HP	8665B	F00066	05/07/14
EMCO	3115	C00943	41611	12/03/14
Antenna, Tuned Dipole 400~1000 MHz	ETS Lindgren	3121C DB4	C00994	07/12/14
Peak Power Meter	Boonton	4541	C01189	06/20/14
Peak Power Sensor	Boonton	57006	C01202	05/29/14
Vector signal generator, 6 GHz	Agilent / HP	E4438C	F00037	07/06/14
Highpass Filter, 2.7 GHz	Micro-Tronics	HPM13194	N02686	CNR
Highpass Filter, 1.5 GHz	Micro-Tronics	HPM13193	N02688	CNR
PreAmp 1-18GHz	Agilent/HP	8449B	F0018	03/18/14
PreAmp 30-1000MHz	Sonama	310	F0009	11/06/14

7. RF POWER OUTPUT VERIFICATION

7.1. GSM

TEST PROCEDURE

GPRS/EGPRS

Function: Menu select > GSM Mobile Station > GSM 850/900/1800/1900
Press Connection control to choose the different menus
Press RESET > choose all to reset all settings
Connection Press Signal Off to turn off the signal and change settings
Network Support > GSM+GPRS or GSM+EGPRS
Main Service > Packet Data
Service selection > Test Mode A – Auto Slot Config. off
MS Signal Press Slot Config bottom on the right twice to select and change the number of time slots and power setting
> Slot configuration > Uplink/Gamma
> 33 dBm for GPRS 850/900
> 27 dBm for EGPRS 850/900
> 30 dBm for GPRS1800/1900
> 26 dBm for EGPRS1800/1900
BS Signal Enter the same channel number for TCH channel (test channel) and BCCH channel
Frequency Offset > + 0 Hz
Mode > BCCH and TCH
BCCH Level > -85 dBm (May need to adjust if link is not stable)
BCCH Channel > choose desire test channel [Enter the same channel number for TCH channel (test channel) and BCCH channel]
Channel Type > Off
P0> 4 dB
Slot Config > Unchanged (if already set under MS Signal)
TCH > choose desired test channel
Hopping > Off
Main Timeslot > 3 (Default)
Network Coding Scheme > CS4 (GPRS) and MCS9 (EGPRS)
Bit Stream > 2E9-1PSR Bit Pattern
AF/RF Enter appropriate offsets for Ext. Att. Output and Ext. Att. Input
Connection Press Signal On to turn on the signal and change settings

RESULTS

GSM

Mode	Ch.	f (MHz)	1 time slot		2 time slots	
			Peak	Average	Peak	Average
GPRS	128	824.2	33.40	33.10	32.60	32.41
	190	836.6	33.50	33.20	32.60	32.40
	251	848.8	**33.60**	**33.30**	32.63	32.43
EGPRS	128	824.2	31.50	28.80	31.50	28.70
	190	836.6	31.60	28.90	31.60	28.80
	251	848.8	**31.80**	**29.00**	31.70	28.90

Mode	Ch.	f (MHz)	1 time slot		2 time slots	
			Peak	Average	Peak	Average
GPRS	512	1850.2	30.80	30.71	29.45	29.20
	661	1880.0	**30.90**	**30.75**	29.60	29.40
	810	1909.8	30.80	30.70	29.50	29.30
EGPRS	512	1850.2	**30.80**	**28.00**	30.30	27.98
	661	1880.0	30.75	27.96	30.25	27.92
	810	1909.8	30.70	27.91	30.10	27.90

7.2. UMTS REL99

TEST PROCEDURE

The following summary of these settings are illustrated below:

	Mode	Rel99
	Subtest	-
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	HSDPA FRC	Not Applicable
	HSUPA Test	Not Applicable
	Power Control Algorithm	Algorithm2
	βc	Not Applicable
	βd	Not Applicable
	βec	Not Applicable
	βc/βd	8/15
	βhs	Not Applicable
	βed	Not Applicable

RESULTS

UMTS REL99

Band	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
				Peak	Average
5	4132	4357	826.4	27.30	24.43
	4180	4405	836.0	27.28	**24.45**
	4230	4455	846.6	27.37	24.42

Band	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
				Peak	Average
2	9262	9662	1852.4	26.10	22.97
	9400	9800	1880.0	26.17	22.99
	9538	9938	1907.6	**26.20**	23.00

7.3. UMTS Rel 5 HSDPA

TEST PROCEDURE

The following summary of these settings are illustrated below:

	Mode	Rel5 HSDPA	Rel5 HSDPA	Rel5 HSDPA	Rel5 HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set1			
	HSUPA Test	Not Applicable			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	12/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	βec	-	-	-	-
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	βed	Not Applicable			
HSDPA Specific Settings	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs = βhs/βc	30/15			

RESULT

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS850 (Band V)	1	4132	4357	826.4	27.84	**23.50**
		4183	4408	836.0	27.87	23.46
		4233	4458	846.6	27.97	23.48
	2	4132	4357	826.4	27.84	23.18
		4183	4408	836.0	27.96	23.10
		4233	4458	846.6	27.86	23.28
	3	4132	4357	826.4	27.92	23.10
		4183	4408	836.0	27.87	23.03
		4233	4458	846.6	27.94	23.14
	4	4132	4357	826.4	27.86	23.10
		4183	4408	836.0	27.91	23.00
		4233	4458	846.6	27.77	23.10

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS1900 (Band II)	1	9262	9662	1852.4	25.34	21.91
		9400	9800	1880.0	25.40	22.00
		9538	9938	1907.6	25.36	21.96
	2	9262	9662	1852.4	25.24	21.88
		9400	9800	1880.0	25.38	22.00
		9538	9938	1907.6	25.40	22.00
	3	9262	9662	1852.4	25.50	21.52
		9400	9800	1880.0	25.34	21.55
		9538	9938	1907.6	**25.67**	21.72
	4	9262	9662	1852.4	25.40	21.67
		9400	9800	1880.0	25.48	21.51
		9538	9938	1907.6	25.30	21.58

7.4. UMTS Rel 6 HSPA (HSDPA & HSUPA)

TEST PROCEDURE

The following summary of these settings are illustrated below:

	Mode	Rel6 HSUPA	Rel6 HSUPA	Rel6 HSUPA	Rel6 HSUPA	Rel6 HSUPA
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set1				
	HSUPA Test	HSUPA Loopback				
	Power Control Algorithm	Algorithm2				
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	0
	βec	209/225	12/15	30/15	2/15	5/15
	βc/βd	11/15	6/15	15/9	2/15	-
	βhs	22/15	12/15	30/15	4/15	5/15
	βed	1309/225	94/75	47/15 47/15	56/75	47/15
HSDPA Specific Settings	DACK	8				
	DNAK	8				
	DCQI	8				
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	Ahs = βhs/βc	30/15				
HSUPA Specific Settings	D E-DPCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	12
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	67
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E_TFCIs	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27		E-TFCI 11 E-TFCI PO 4 E-TFCI 92 E-TFCI PO 18	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27	

RESULTS

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS850 (Band V)	1	4132	4357	826.4	27.65	23.49
		4180	4405	836.0	27.80	**23.50**
		4230	4455	846.6	27.72	23.47
	2	4132	4357	826.4	27.76	23.26
		4180	4405	836.0	27.79	23.33
		4230	4455	846.6	27.74	23.40
	3	4132	4357	826.4	27.77	23.31
		4180	4405	836.0	27.67	23.28
		4230	4455	846.6	27.75	23.46
	4	4132	4357	826.4	27.65	23.24
		4180	4405	836.0	27.76	23.29
		4230	4455	846.6	27.60	23.32
	5	4132	4357	826.4	27.63	23.30
		4180	4405	836.0	27.61	23.35
		4230	4455	846.6	27.64	23.33

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS1900 (Band II)	1	9262	9662	1852.4	25.20	21.82
		9400	9800	1880.0	25.25	21.92
		9538	9938	1907.6	25.30	21.89
	2	9262	9662	1852.4	25.35	21.80
		9400	9800	1880.0	25.30	21.75
		9538	9938	1907.6	25.32	21.78
	3	9262	9662	1852.4	25.30	21.69
		9400	9800	1880.0	25.34	21.76
		9538	9938	1907.6	25.42	21.80
	4	9262	9662	1852.4	25.34	21.61
		9400	9800	1880.0	25.40	21.70
		9538	9938	1907.6	25.30	21.85
	5	9262	9662	1852.4	25.25	21.88
		9400	9800	1880.0	**25.40**	21.95
		9538	9938	1907.6	25.36	21.75

7.5. UMTS DUAL CARRIER HSDPA

TEST PROCEDURE

In DC-HSDPA operation, there are dual carriers that are spaced 5 MHz apart in the downlink. The UE must be capable of processing these carriers simultaneously along with a single carrier in the uplink. This poses new requirements for testing the UE's ability to process two carriers in the downlink; consequently, it results in new test cases for characterizing the UE's receiver

UE that supports DC-HSDPA must meet both minimum requirements as well as additional requirements for DC-HSDPA. For all additional requirements for DCHSDPA, as included in chapter 6 of 34.121, "Fixed Reference Channel H-Set 12" is to be used unless otherwise specified

The properties of H-Set 12 are described in detail in C.8.1.12 of TS 34.121, and the physical channel is setup in line with table E.5.4B of TS 34.121. The cells are to transmit with identical parameters, and the maximum number of transmissions is to be limited to 1 (i.e. no retransmissions are allowed).

Fixed reference channel H-Set 12		
Parameter	**Unit**	**Value**
Nominal avg. inf. bit rate	kbps	600
Inter-TTI distance	TTIs	1
Number of HARQ processes	Processes	6
Information bit payload (NINF)	Bits	120
Number of code blocks	Blocks	1
Binary channel bits per TTI	Bits	960
Total available SMLs in UE		19200
Number of SMLs per HARQ proc.	SMLs	3200
Coding rate		0.15
Number of physical channel codes	codes	1
Modulation		QPSK

The following steps prepare the CMW500 for DC-HSDPA testing:

1. Configure the R&S®CMW500 to transmit on adjacent dual carriers that are 5 MHz apart.
2. Set the operating band, frequency and levels for different physical channels, for both carriers.
3. The two DL carriers from the R&S®CMW500 are routed through the two RF ports, which are combined using an external combiner.* The external attenuation due to the combiner and RF cables needs to be compensated appropriately for both ports.
4. Set the relevant H-Set to enable DC-HSDPA operation.
5. Prepare the “Go to” soft keys to navigate to the "Receiver Measurement" application to check the BLER results for both the carriers

RESULT

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS850 (Band V)	1	4132	4357	826.4	27.10	**23.32**
		4183	4408	836.0	27.00	23.24
		4233	4458	846.6	**27.25**	23.30
	2	4132	4357	826.4	27.20	23.13
		4183	4408	836.0	27.12	23.25
		4233	4458	846.6	27.21	23.23
	3	4132	4357	826.4	26.98	23.00
		4183	4408	836.0	27.21	22.70
		4233	4458	846.6	26.94	22.81
	4	4132	4357	826.4	26.78	22.80
		4183	4408	836.0	27.10	22.70
		4233	4458	846.6	26.97	22.90

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted Output Power (dBm)	
					Peak	Average
UMTS1900 (Band II)	1	9262	9662	1852.4	25.30	21.83
		9400	9800	1880.0	25.34	**21.94**
		9538	9938	1907.6	25.24	21.85
	2	9262	9662	1852.4	25.19	21.74
		9400	9800	1880.0	25.27	21.87
		9538	9938	1907.6	25.34	21.82
	3	9262	9662	1852.4	25.32	21.22
		9400	9800	1880.0	25.31	21.31
		9538	9938	1907.6	**25.46**	21.67
	4	9262	9662	1852.4	25.27	21.54
		9400	9800	1880.0	25.26	21.45
		9538	9938	1907.6	25.25	21.49

HSPA+

Since 16QAM is not used for uplink, the uplink Category and release is same as HSUPA, i.e., CAT 6 Rel 6. Therefore, the RF conducted power is not measured

8. CONDUCTED TEST RESULTS

8.1. OCCUPIED BANDWIDTH

RULE PART(S)

FCC: §2.1049

LIMITS

For reporting purposes only

TEST PROCEDURE

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the low, middle and high channel in each band. The -26dB bandwidth was also measured and recorded.

MODES TESTED

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

RESULTS

GSM-GPRS MODE

Part 22 850MHz Band					
Band	Mode	Channel	f (MHz)	99% BW (kHz)	-26dB BW (kHz)
CELL	GPRS	128	824.2	240.61	296.8
		190	836.6	247.07	318.3
		251	848.8	239.92	311.1

Part 24 1900MHz Band					
Band	Mode	Channel	f (MHz)	99% BW (kHz)	-26dB BW (kHz)
PCS	GPRS	512	1850.2	250.80	293.4
		661	1880.0	243.75	304.5
		810	1909.8	244.93	311.8

GSM-EGPRS MODE

Part 22 850MHz Band					
Band	Mode	Channel	f (MHz)	99% BW (kHz)	-26dB BW (kHz)
CELL	EGPRS	128	824.2	258.93	306.70
		190	836.6	268.59	311.00
		251	848.8	247.57	308.20

Part 24 1900MHz Band					
Band	Mode	Channel	f (MHz)	99% BW (kHz)	-26dB BW (kHz)
PCS	EGPRS	512	1850.2	237.87	305.70
		661	1880.0	227.23	273.70
		810	1909.8	239.31	272.50

WCDMA REL99 MODE

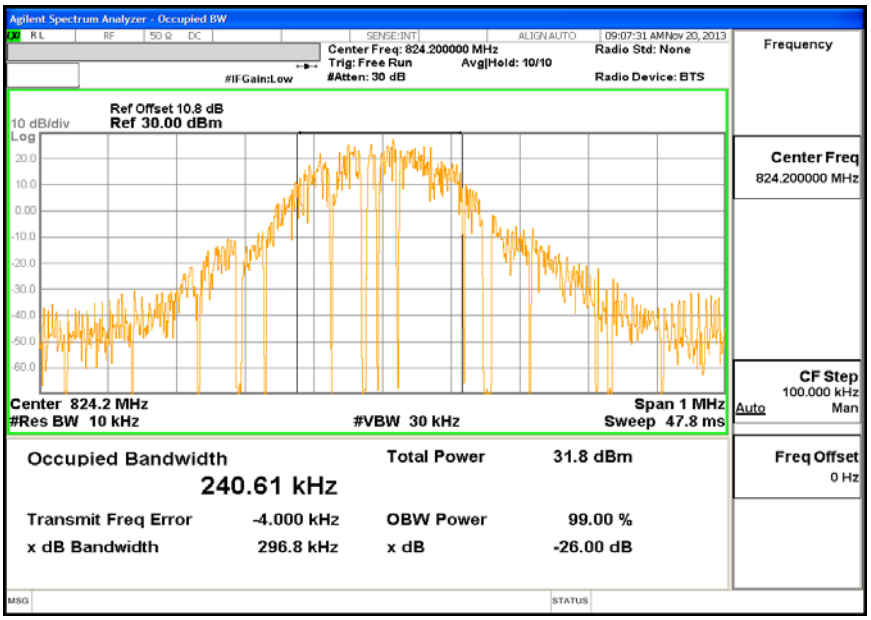
PART 22 and 24					
Band	Mode	DL Channel	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
850MHz	UMTS Rel. 99	4357	826.4	4.1818	4.5700
		4408	836.0	4.1558	4.6140
		4458	846.6	4.1979	4.6000
1900MHz		9662	1852.4	4.1981	4.6310
		9800	1880.0	4.1818	4.6410
		9938	1907.6	4.1569	4.6100

WCDMA HSDPA MODE

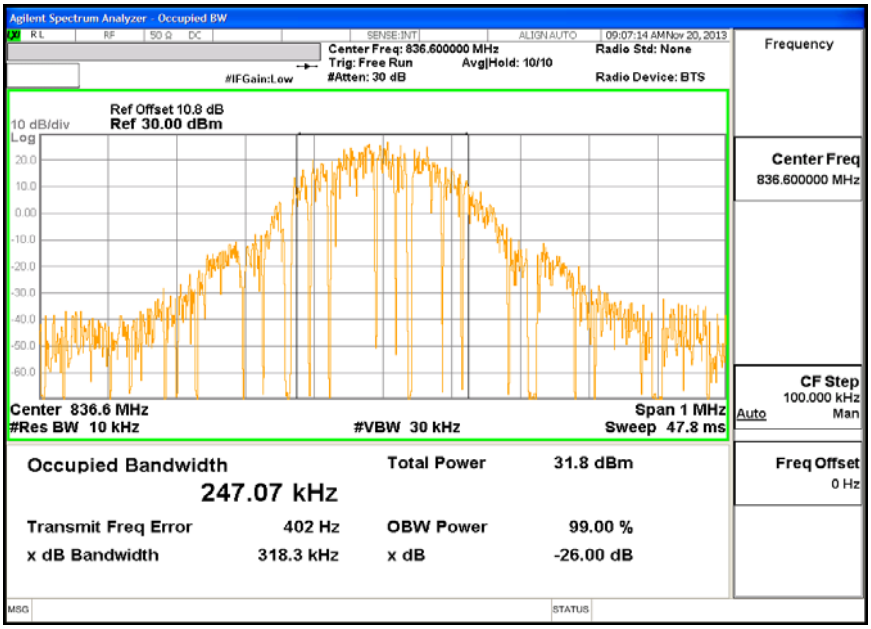
PART 22 and 24					
Band	Mode	DL Channel	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
850MHz	UMTS HSDPA	4357	826.4	4.1726	4.6160
		4408	836.0	4.1734	4.6170
		4458	846.6	4.1445	4.5970
1900MHz		9662	1852.4	4.1850	4.5730
		9800	1880.0	4.1634	4.5810
		9938	1907.6	4.1831	4.5800

GSM-GPRS 850MHz BAND

LOW CH



MID CH



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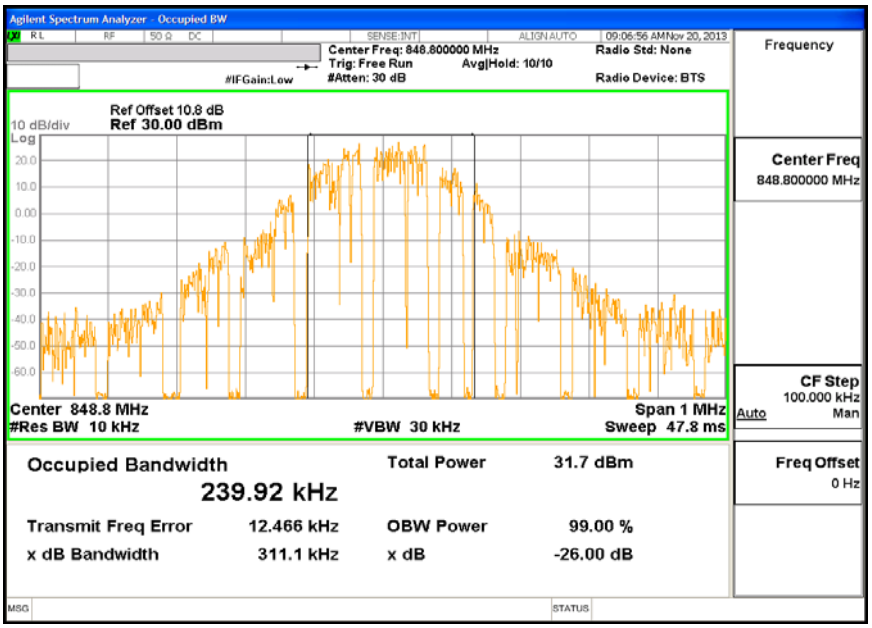
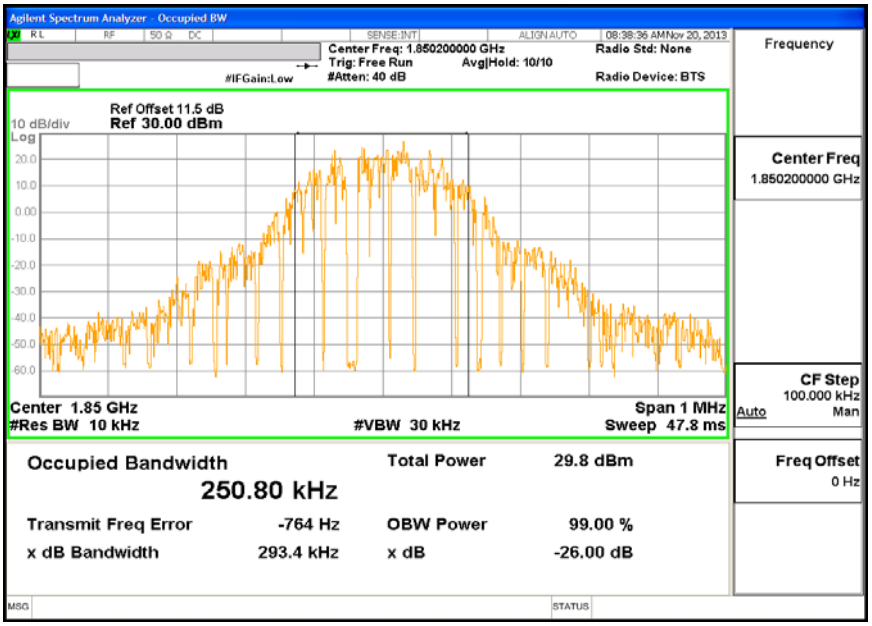


GSM-GPRS 1900MHz BAND

LOW CH



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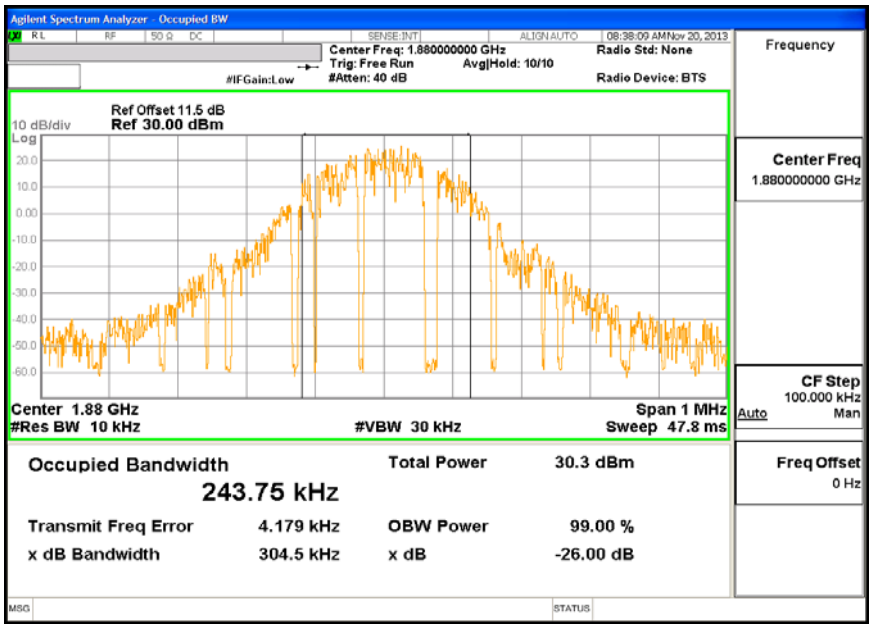

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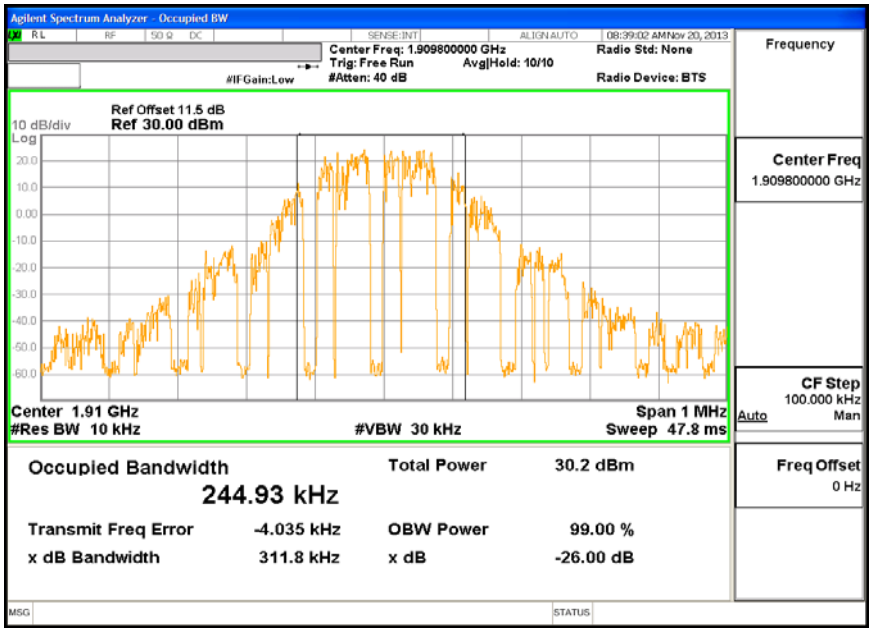
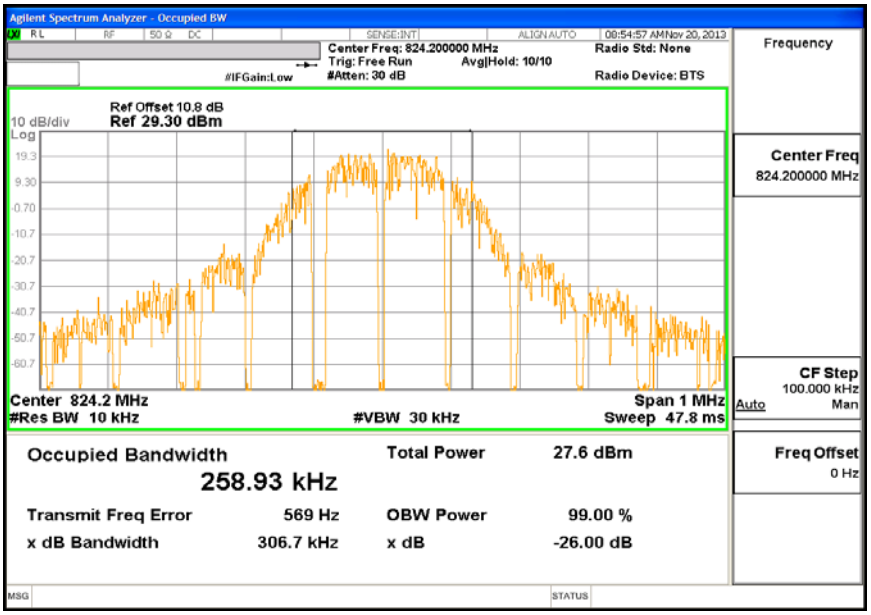


GSM-EGPRS 850MHz BAND

LOW CH



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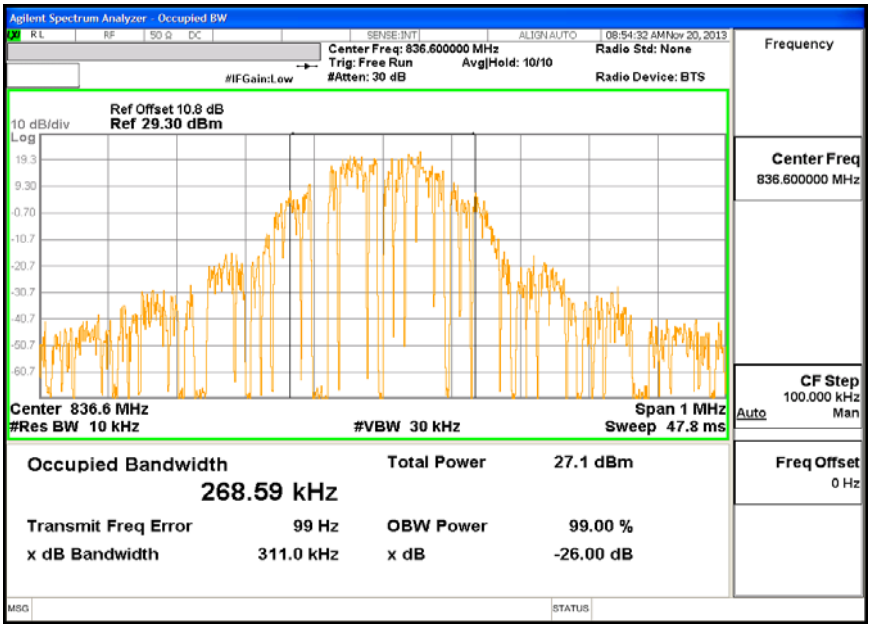
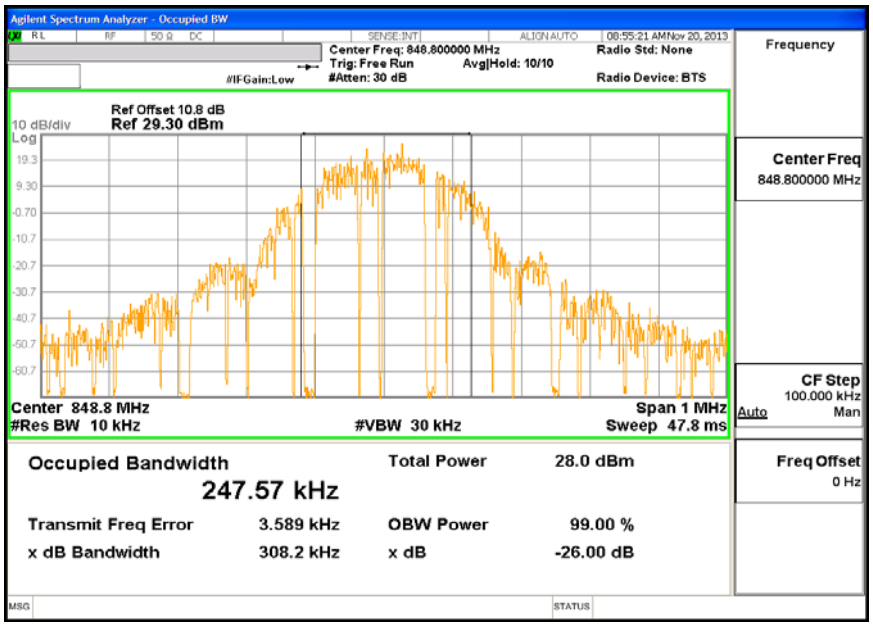
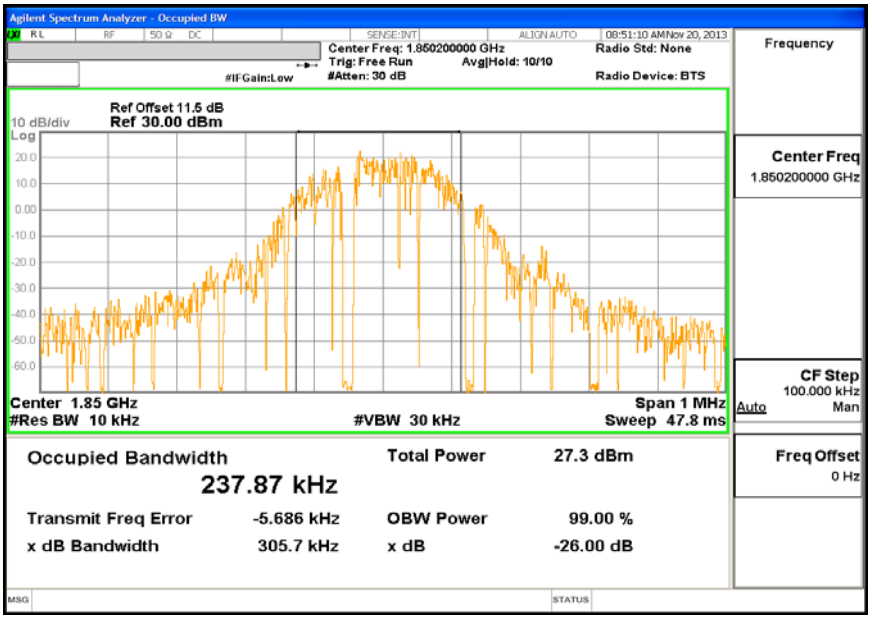


HIGH CH

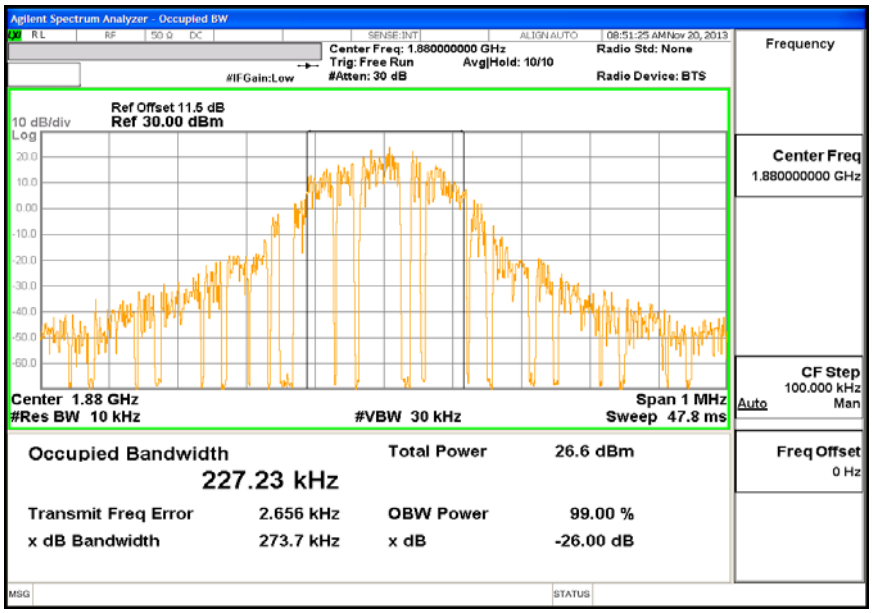


GSM-EGPRS 1900MHz BAND

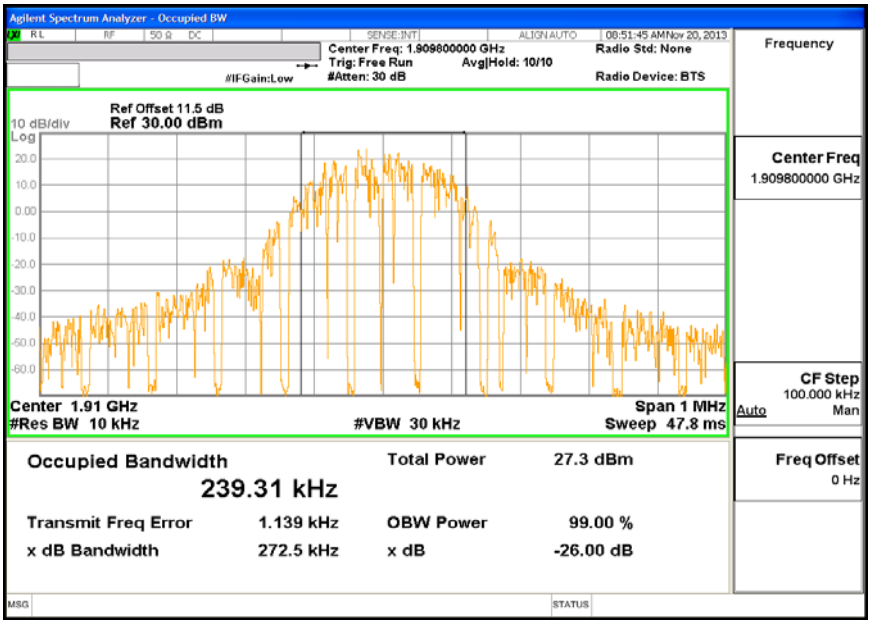
LOW CH



MID CH

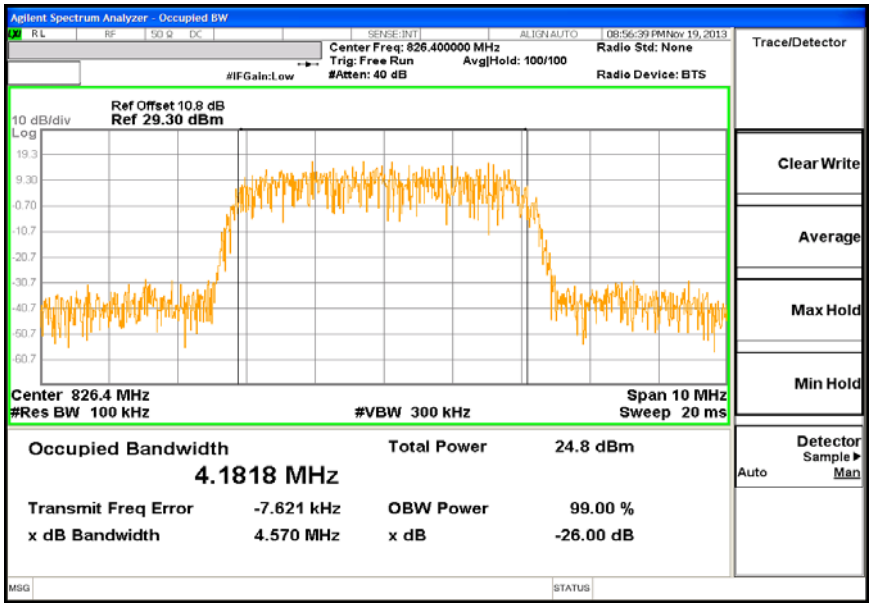


HIGH CH

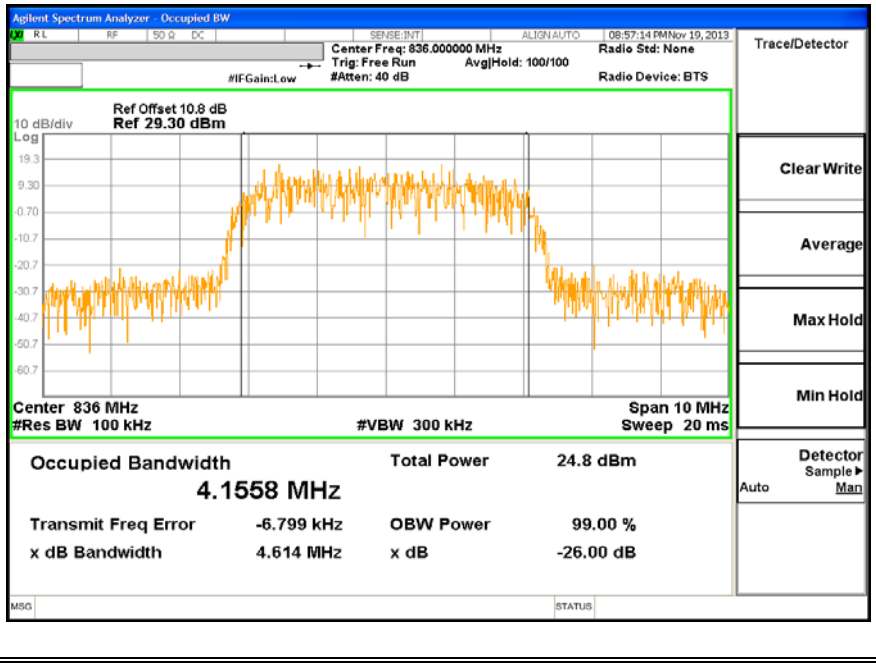


UMTS Rel99 850MHz BAND

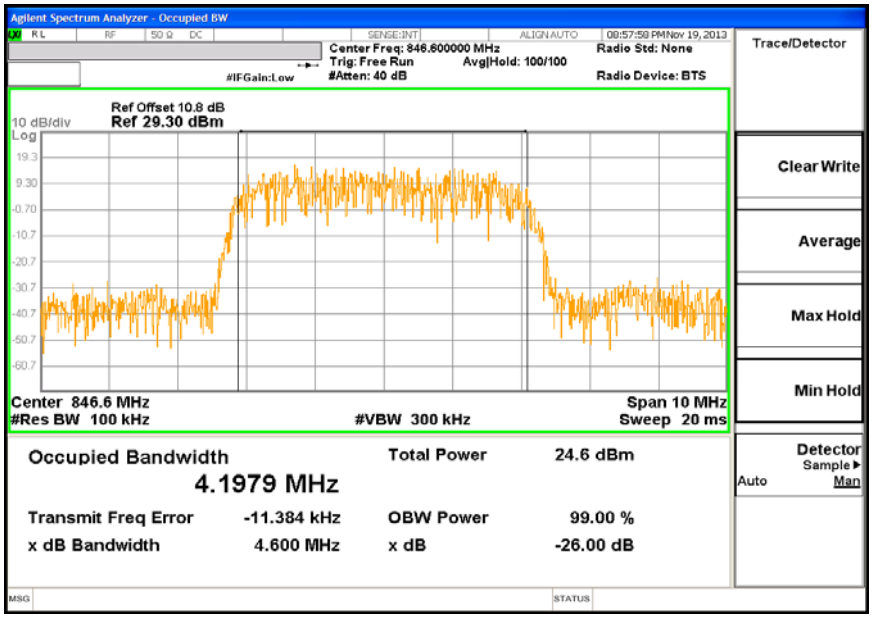
LOW CH



MID CH

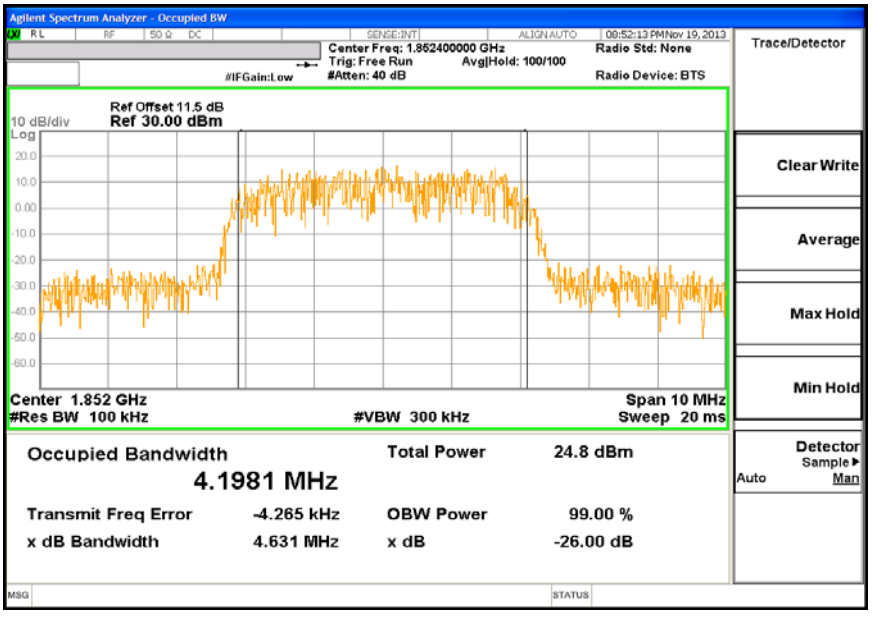


HIGH CH

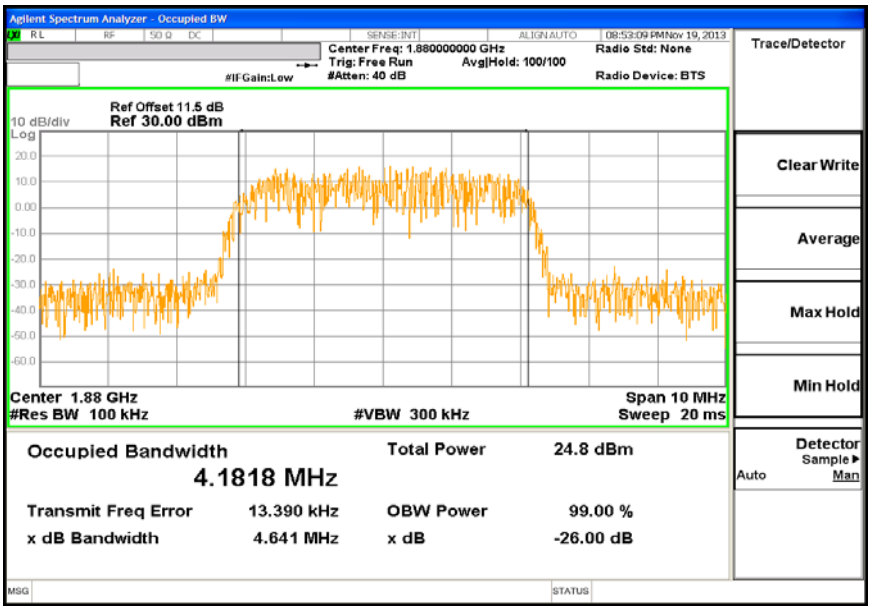


UMTS Rel99 1900MHz BAND

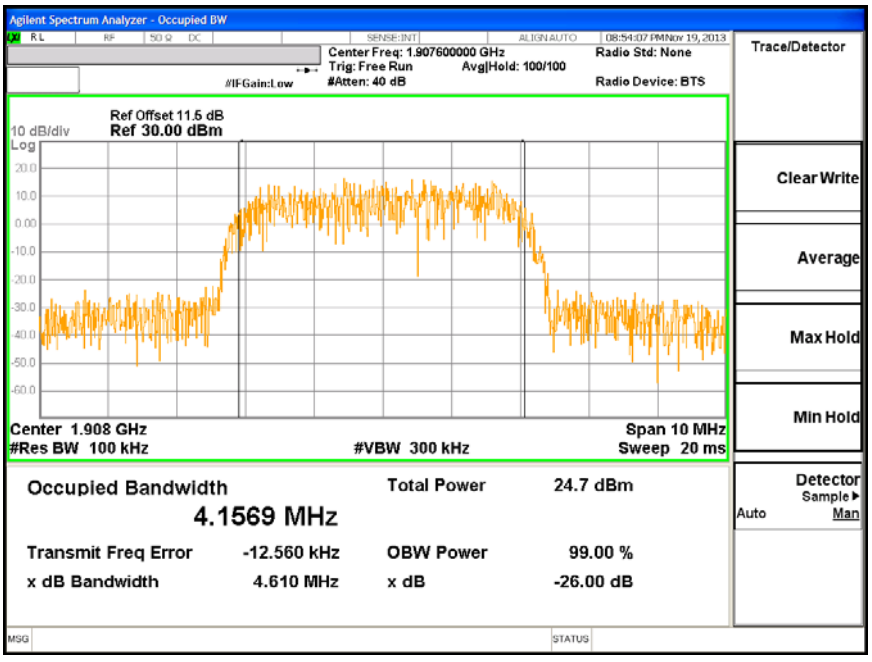
LOW CH



MID CH

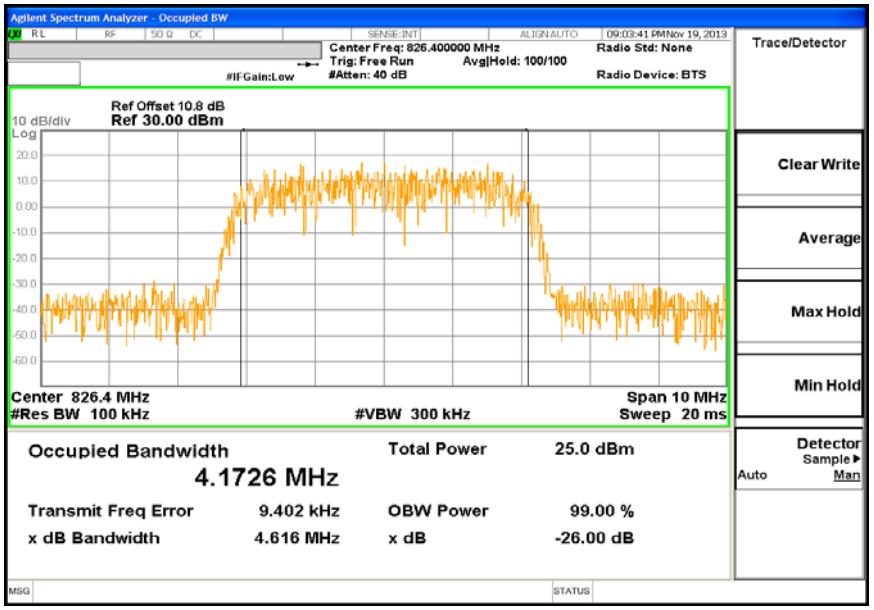


HIGH CH



UMTS HSDPA 850MHz BAND

LOW CH



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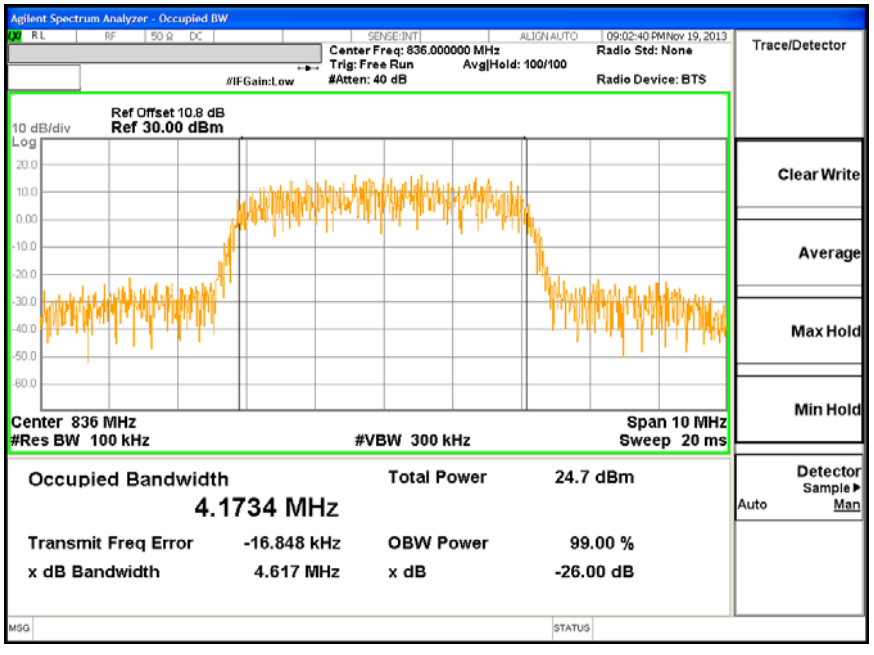
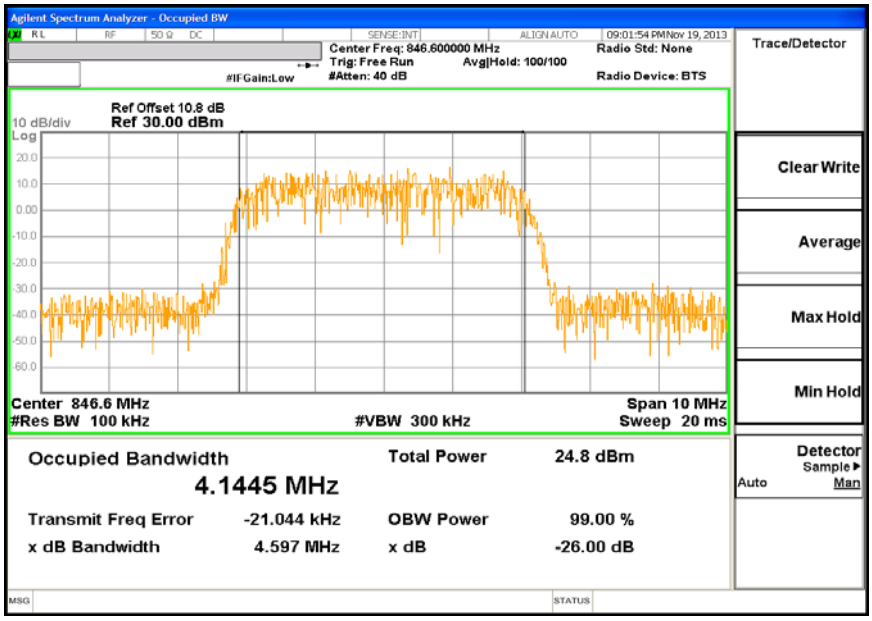
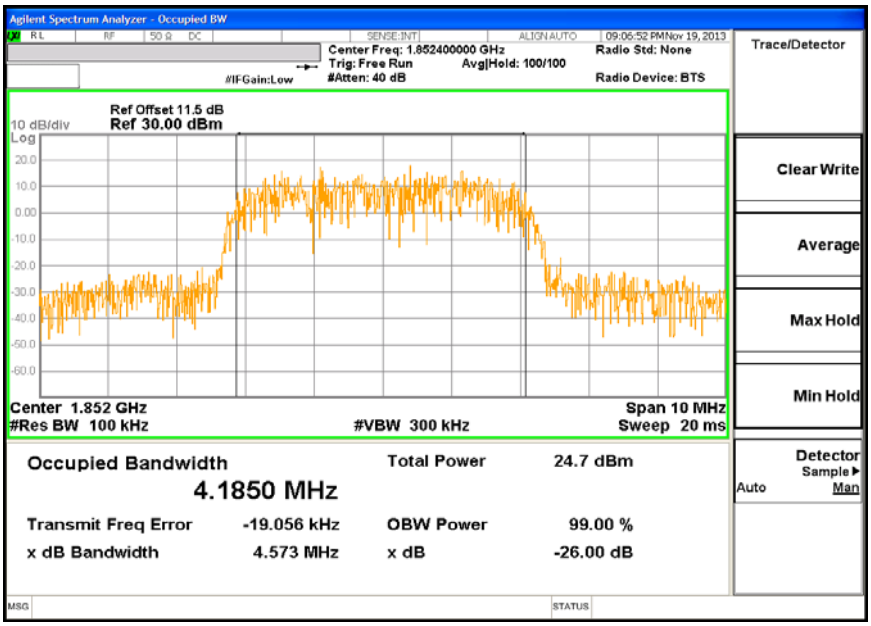


HIGH CH

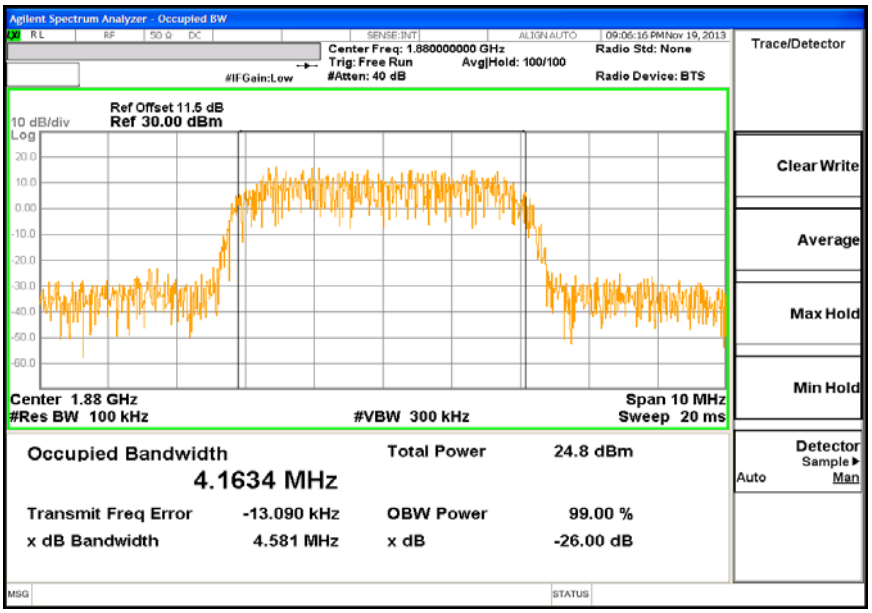


UMTS HSDPA 1900MHz BAND

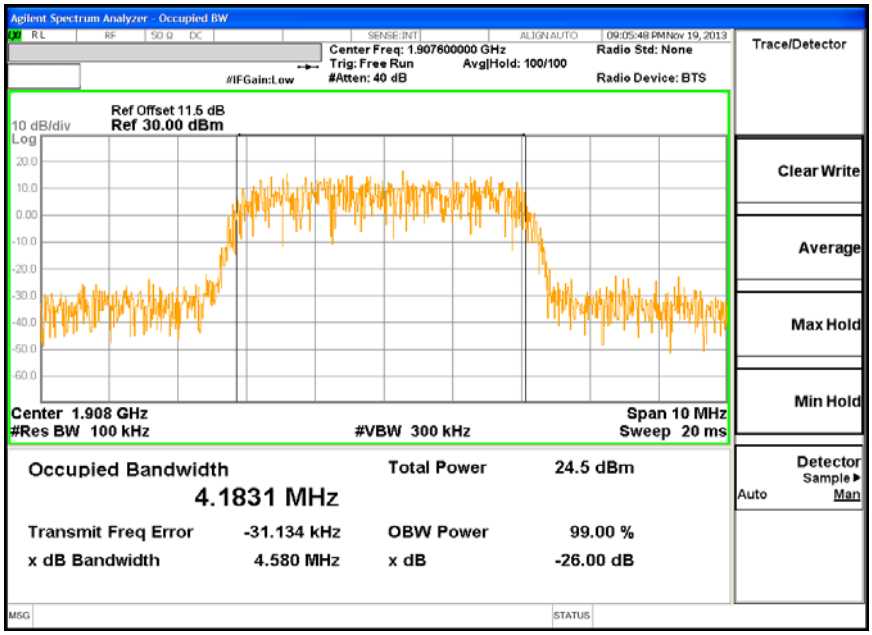
LOW CH



MID CH



HIGH CH



8.2. BAND EDGE

RULE PART(S)

FCC: §22.359 and §24.238

LIMITS

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

TEST PROCEDURE

The transmitter output was connected to a Agilent 8960 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.
For each band edge measurement:

- Set the spectrum analyzer span to include the block edge frequency (824, 849, 1850 and 1910MHz)
- Set a marker to point the corresponding band edge frequency in each test case.
- Set display line at -13 dBm
- Set resolution bandwidth to at least 1% of emission bandwidth.

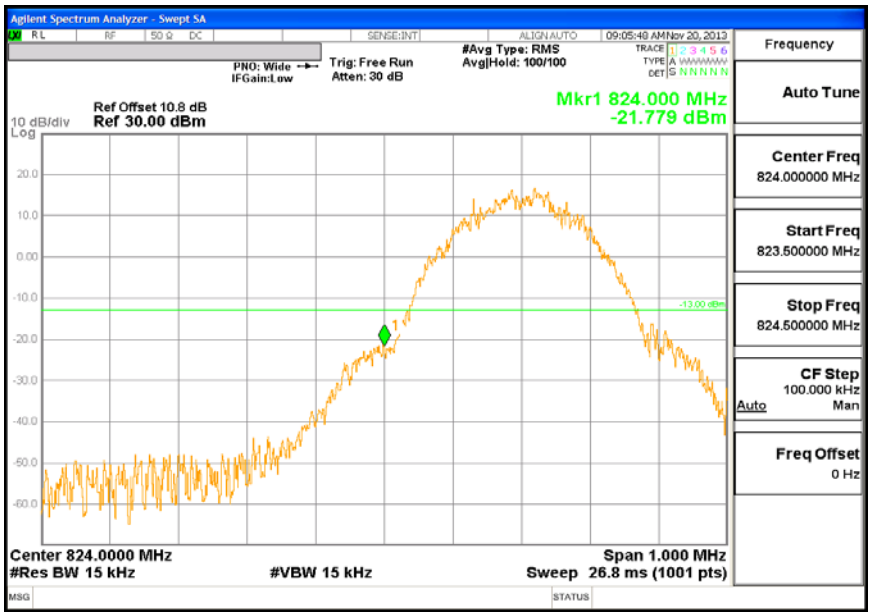
MODES TESTED

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

RESULTS

GSM GPRS 850MHz BAND

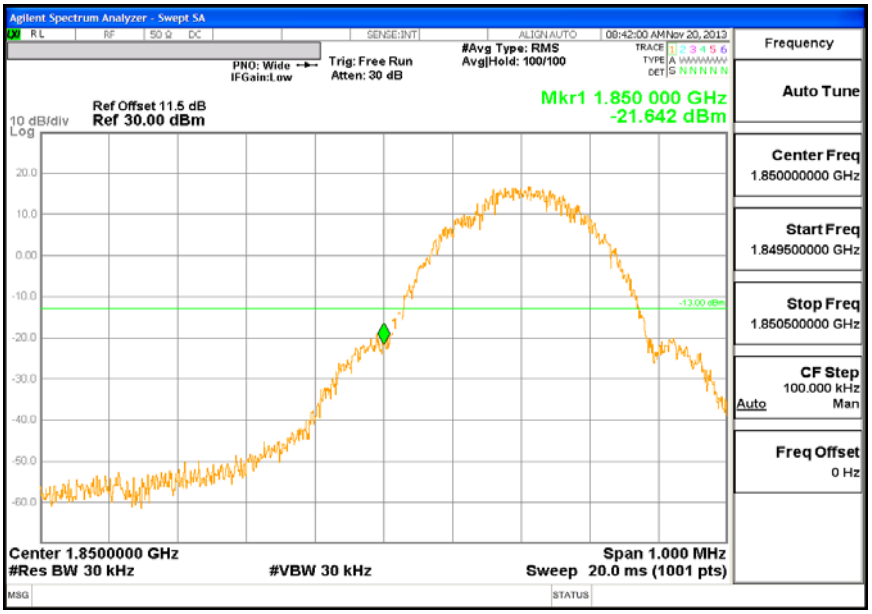
LOW CH



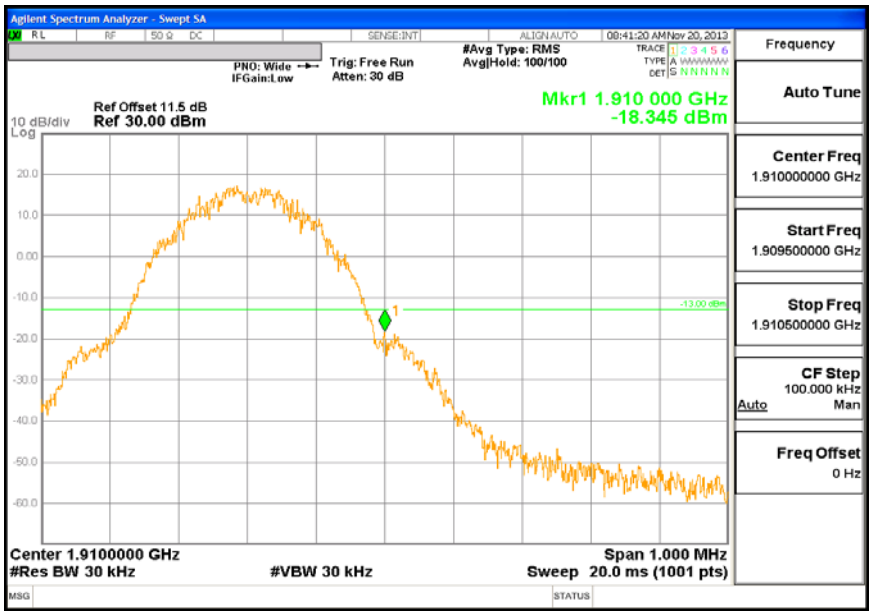
HIGH CH

GSM GPRS 1900MHz BAND

LOW CH

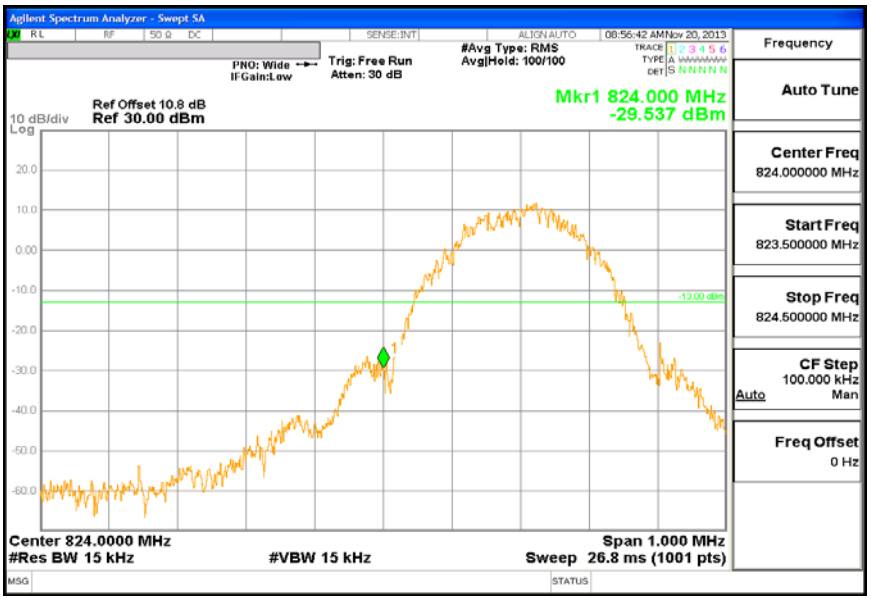


HIGH CH

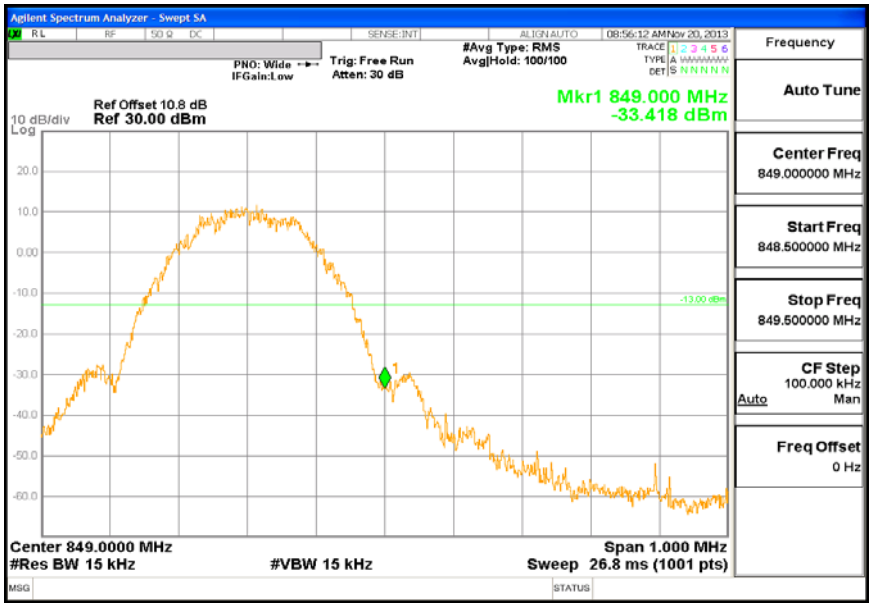


GSM EGPRS 850MHz BAND

LOW CH

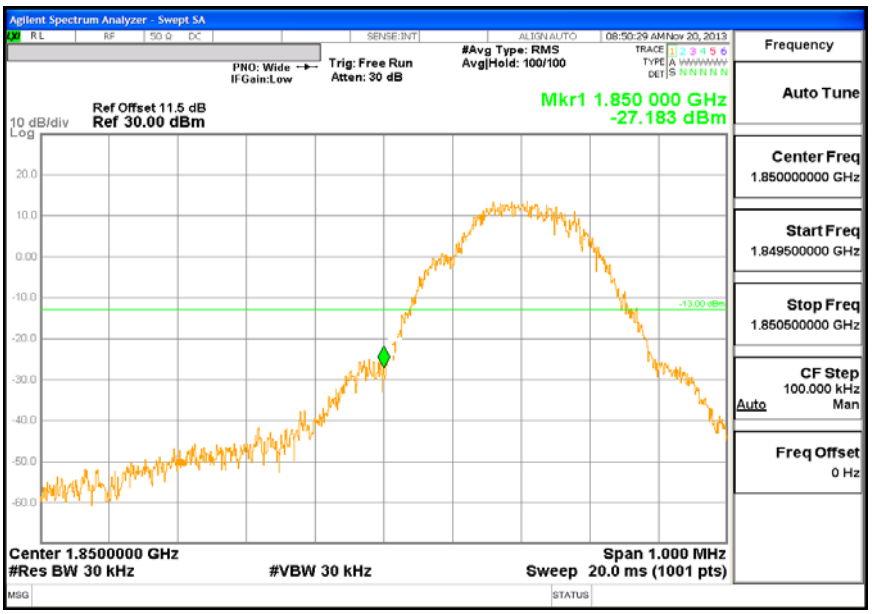


HIGH CH

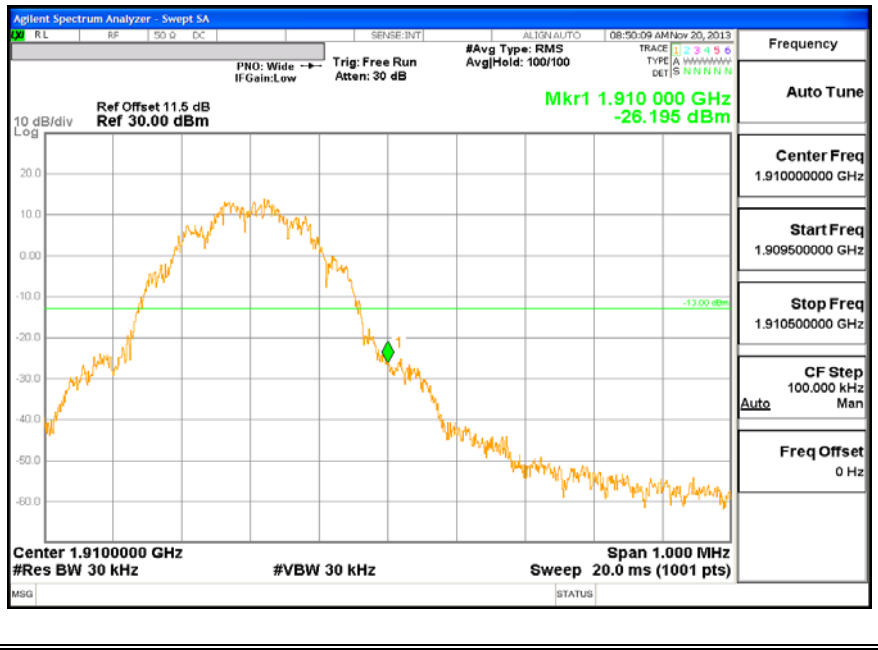


GSM EGPRS 1900MHz BAND

LOW CH

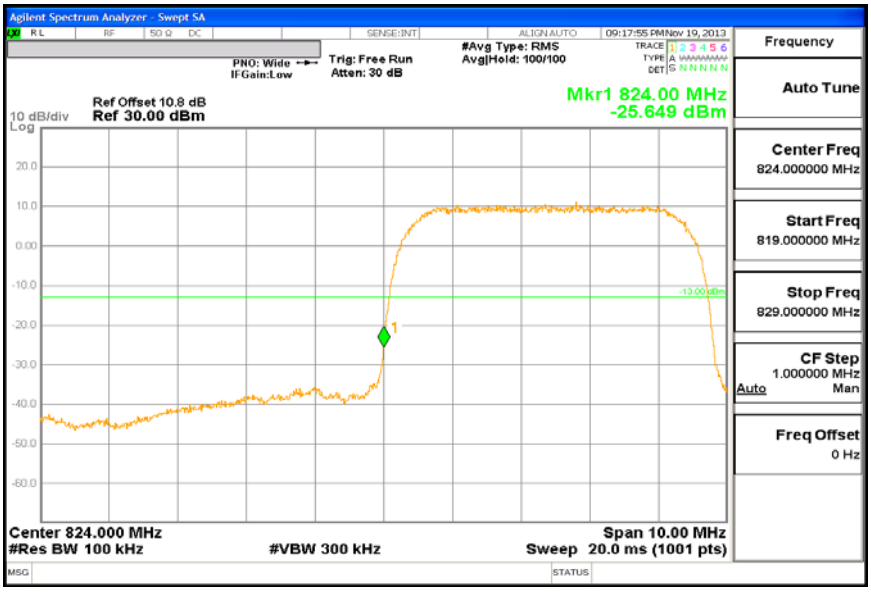


HIGH CH

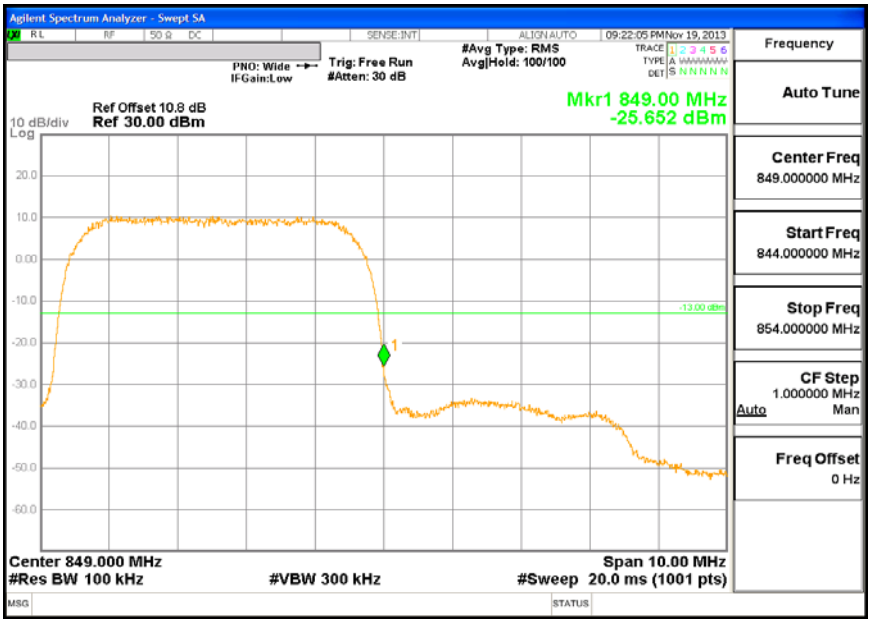


UMTS Rel 99 850MHz BAND

LOW CH

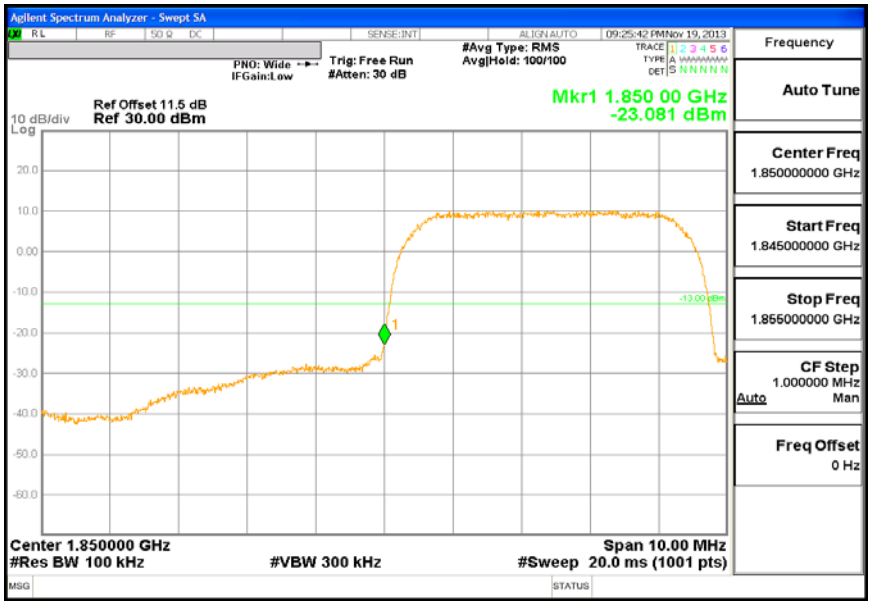


HIGH CH

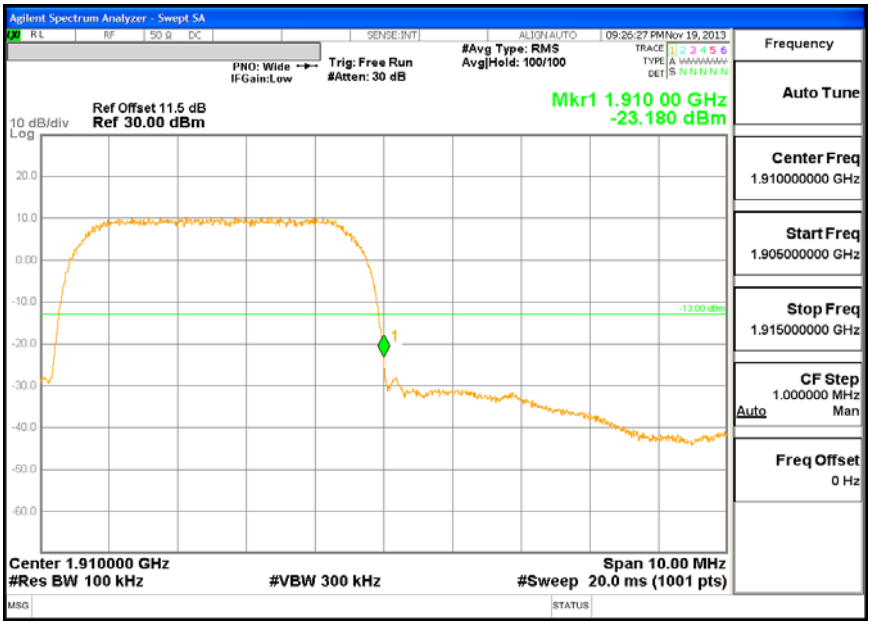


UMTS Rel 99 1900MHz BAND

LOW CH

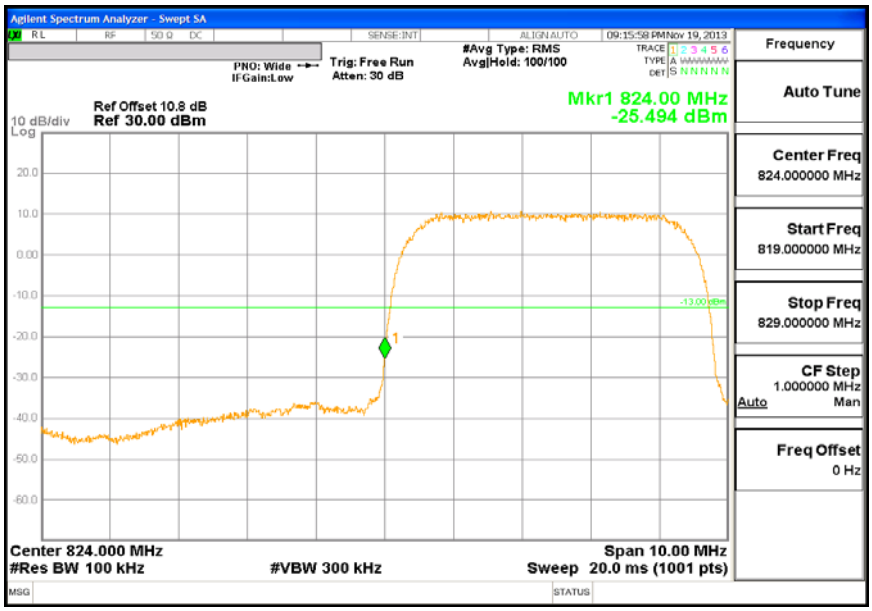


HIGH CH

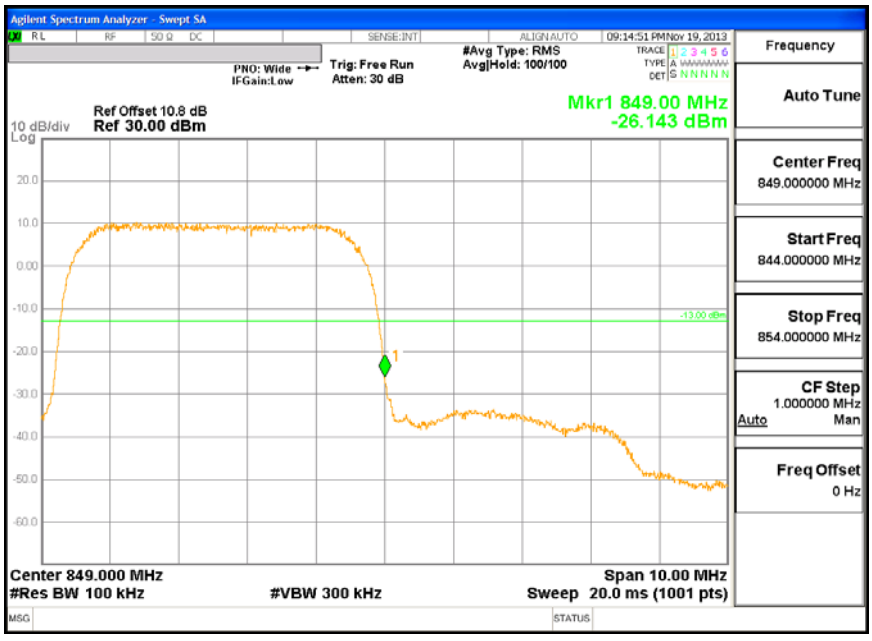


UMTS HSDPA 850MHz BAND

LOW CH

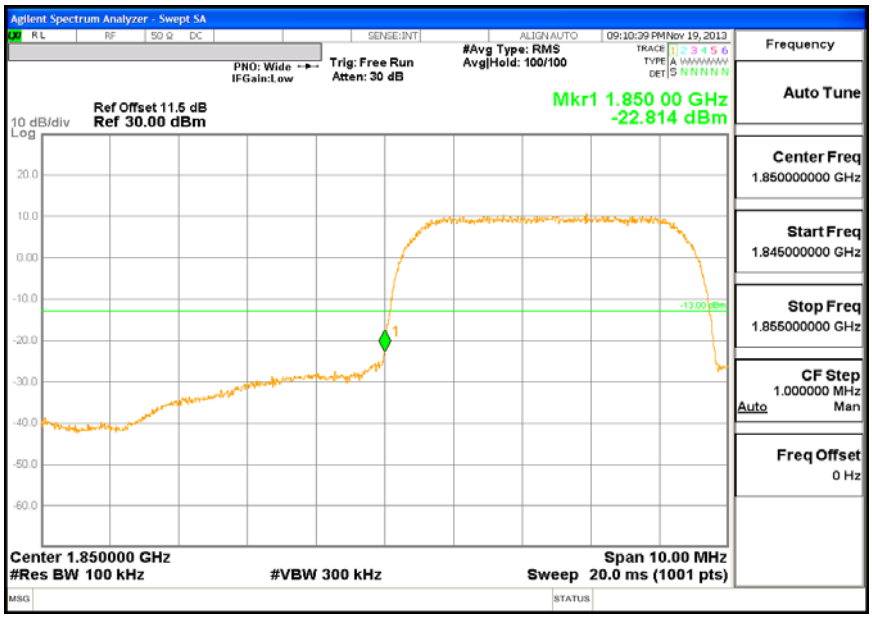


HIGH CH

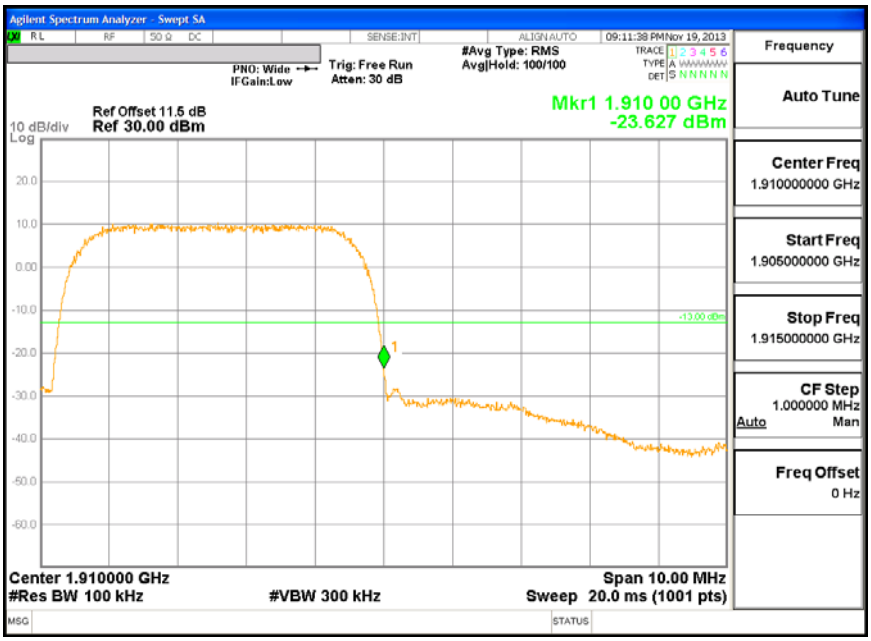


UMTS HSDPA 1900MHz BAND

LOW CH



HIGH CH



8.3. OUT OF BAND EMISSIONS

RULE PART(S)

FCC: §2.1051, §22.901, §22.917 and §24.238

LIMITS

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

TEST PROCEDURE

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

For each out of band emissions measurement:

- Set display line at -13 dBm
- Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz.

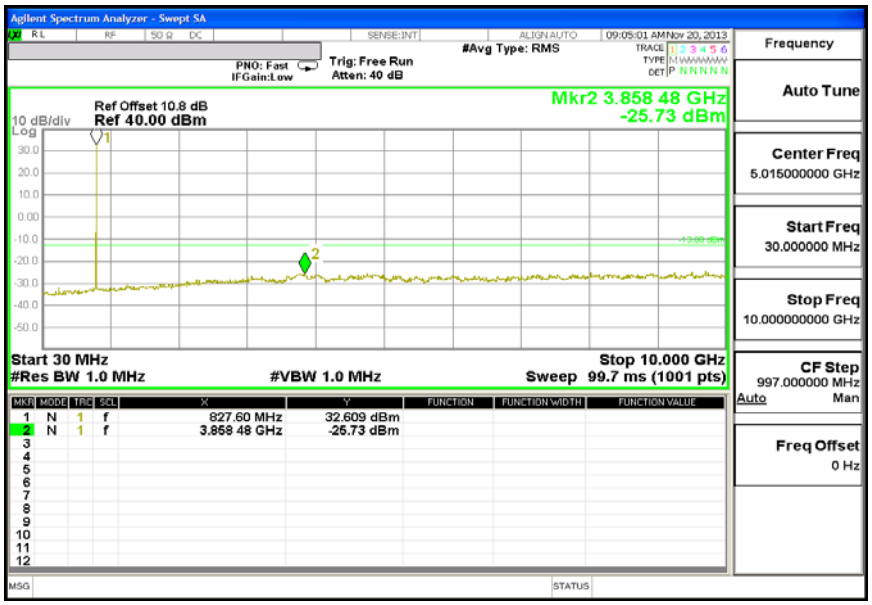
MODES TESTED

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

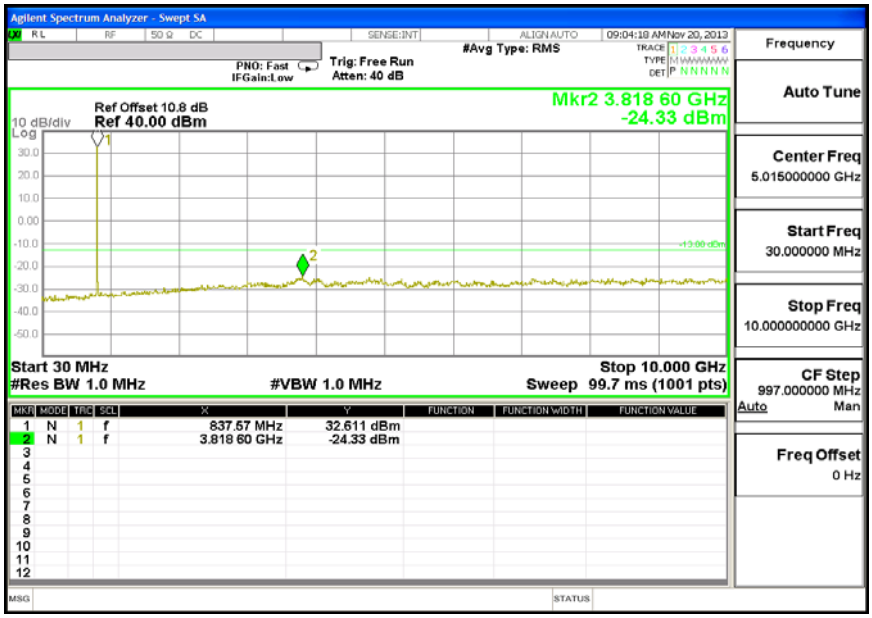
RESULTS

GSM GPRS 850MHz BAND

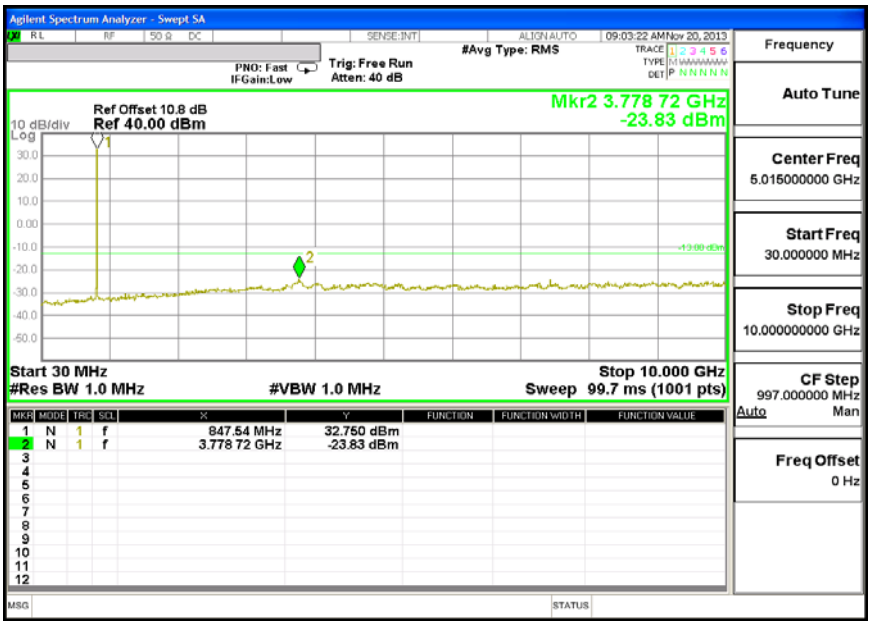
LOW CH



MID CH



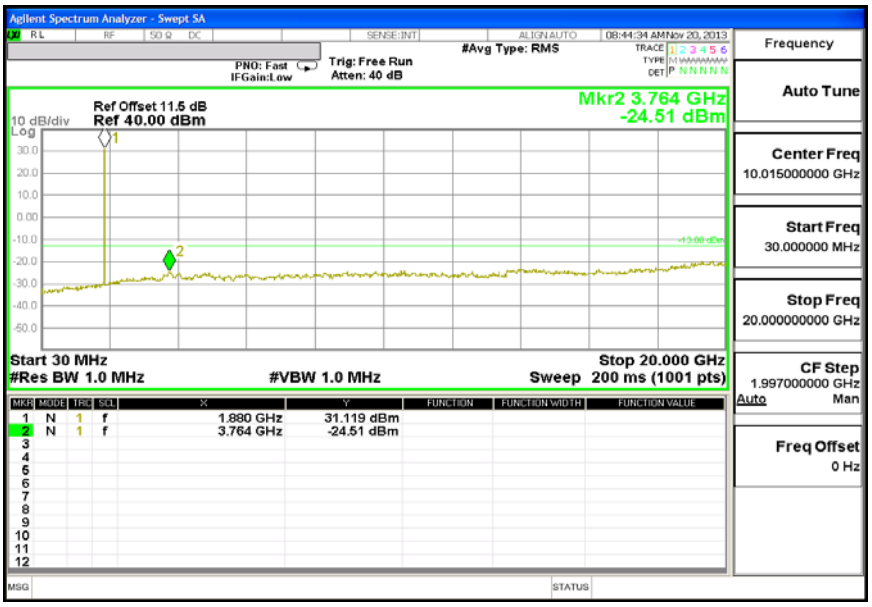
HIGH CH



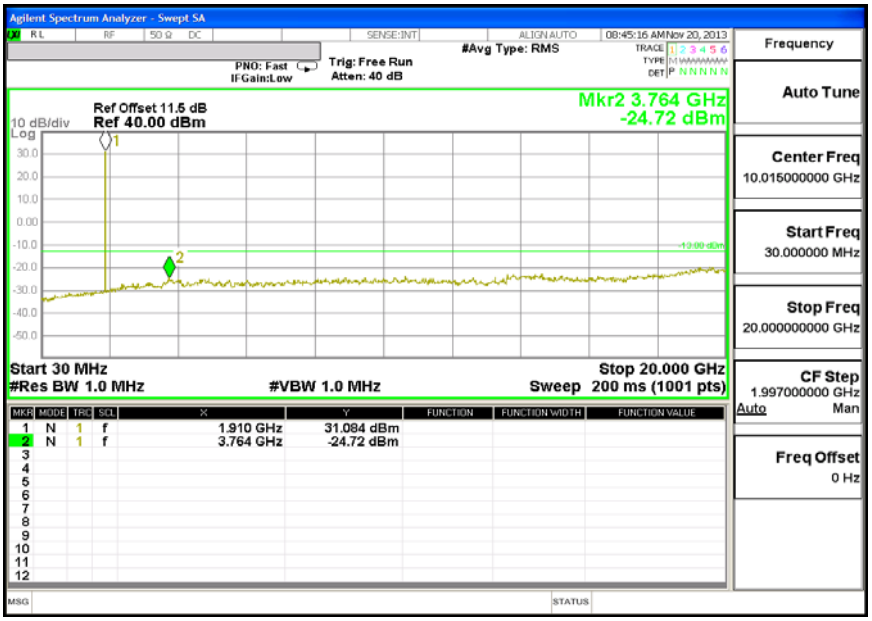
GSM GPRS 1900MHz BAND

LOW CH

MID CH

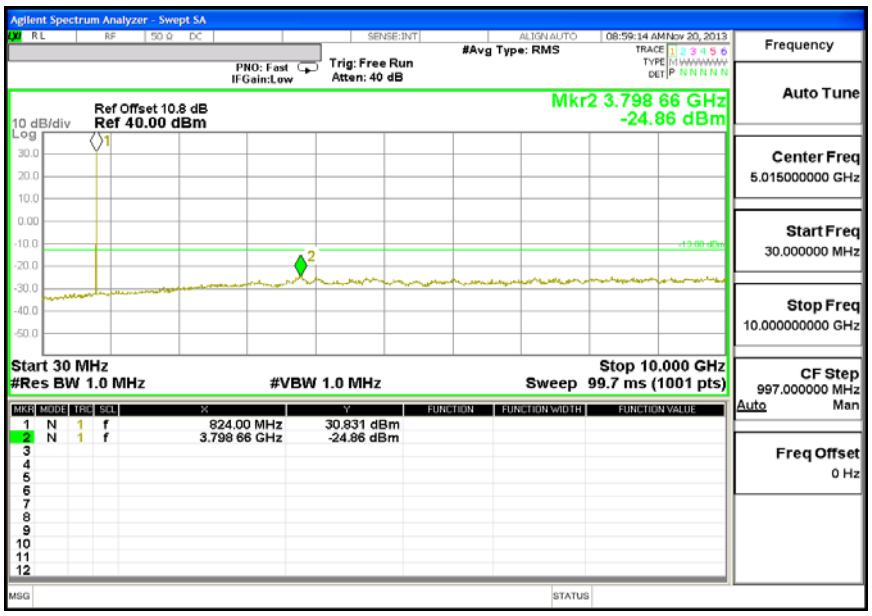


HIGH CH

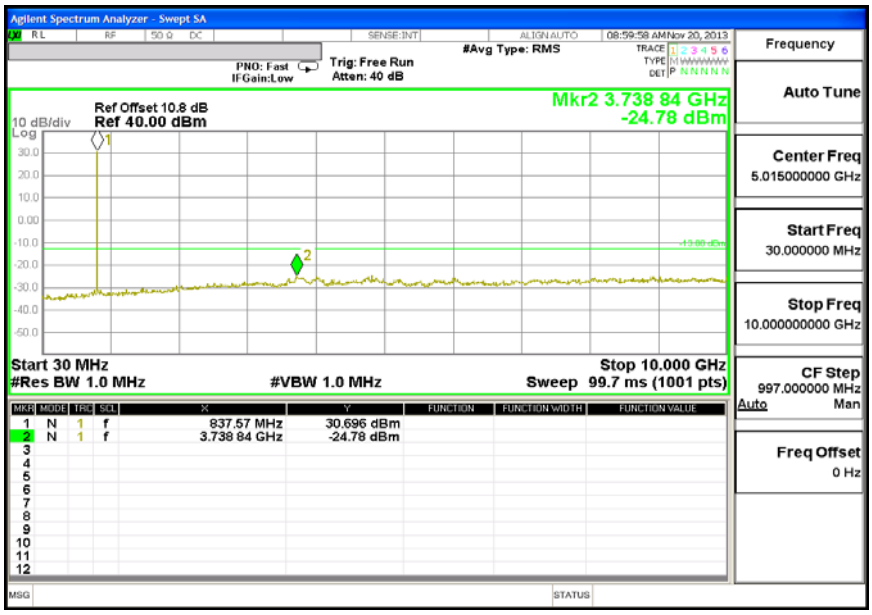


GSM EGPRS 850MHz BAND

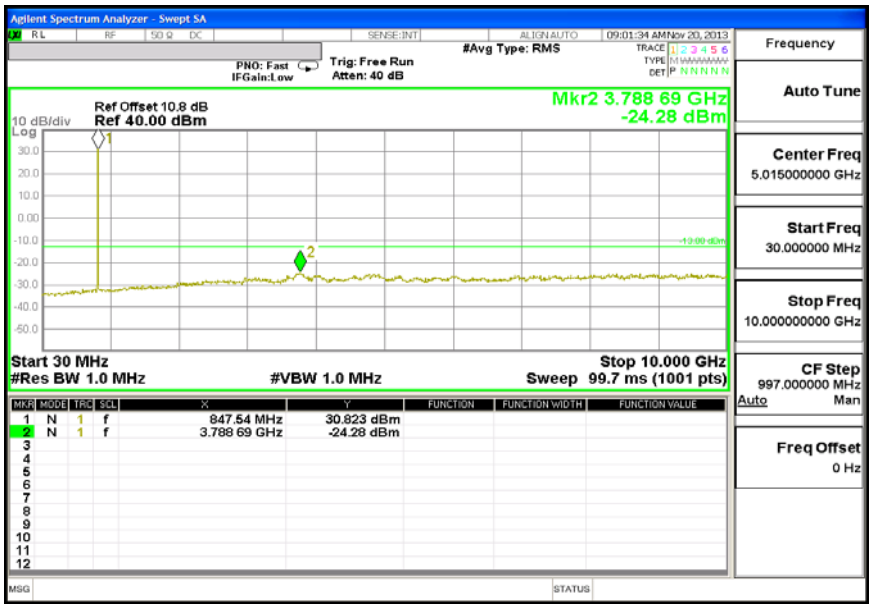
LOW CH



MID CH

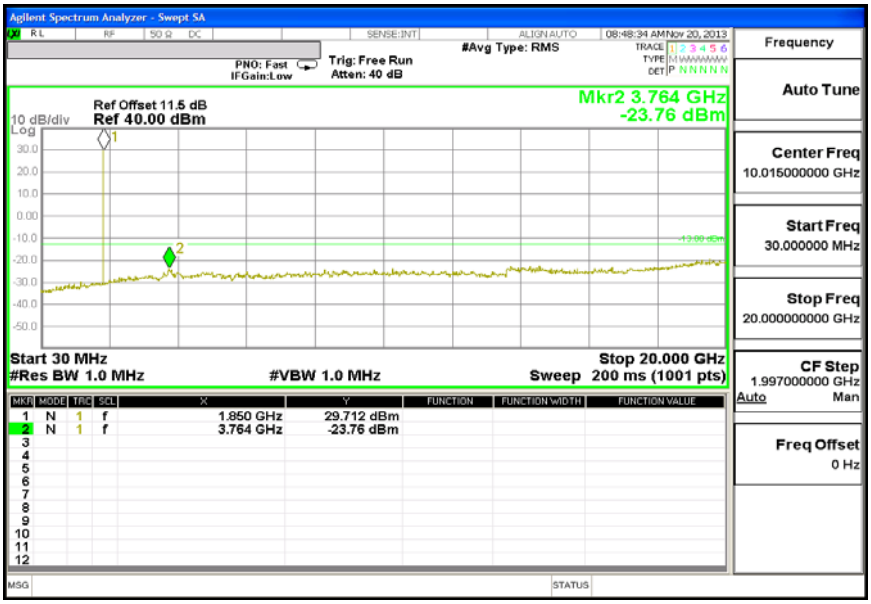


HIGH CH

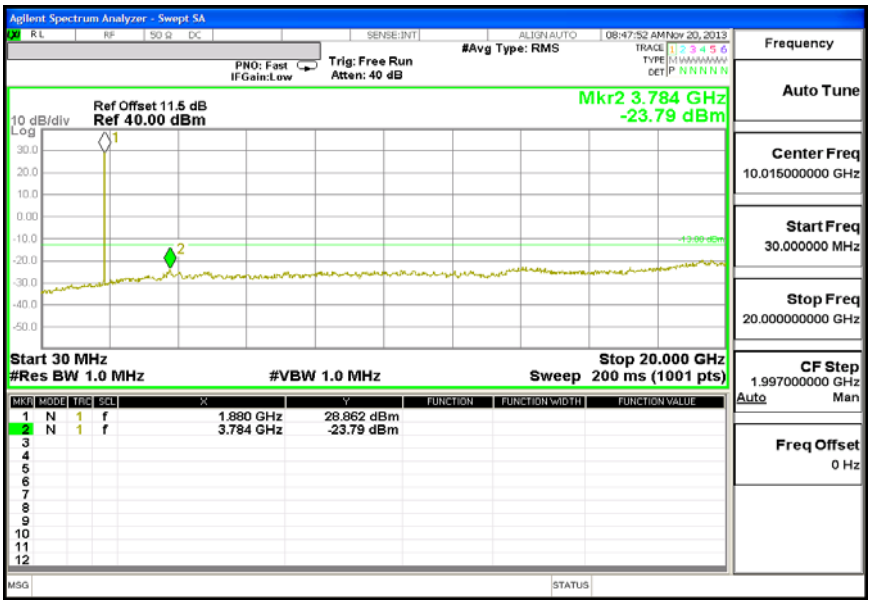


GSM EGPRS 1900MHz BAND

LOW CH



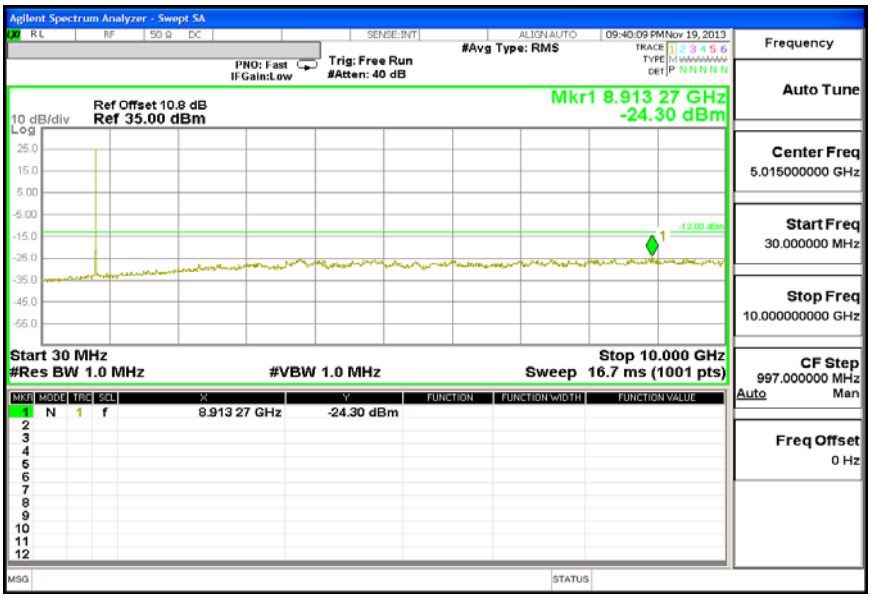
MID CH



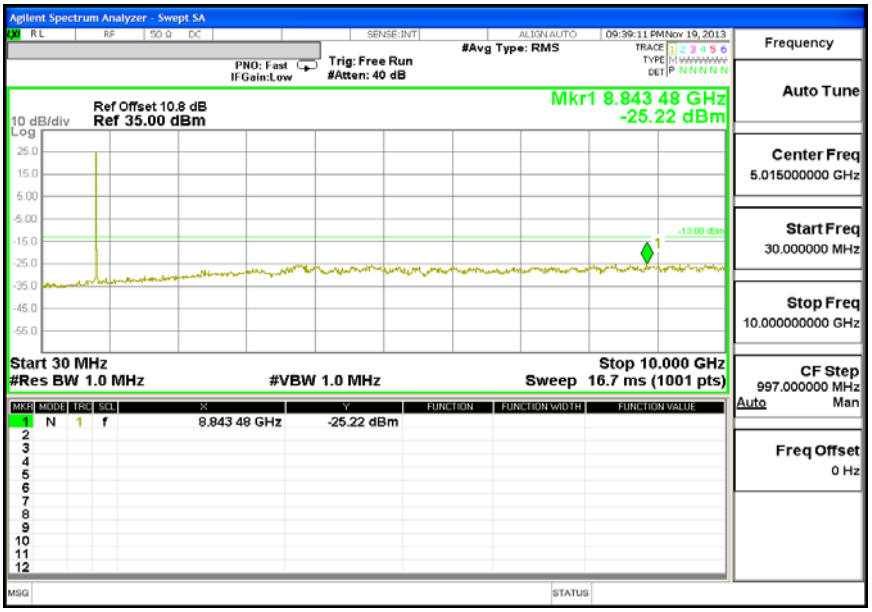
HIGH CH

UMTS Rel 99 850MHz BAND

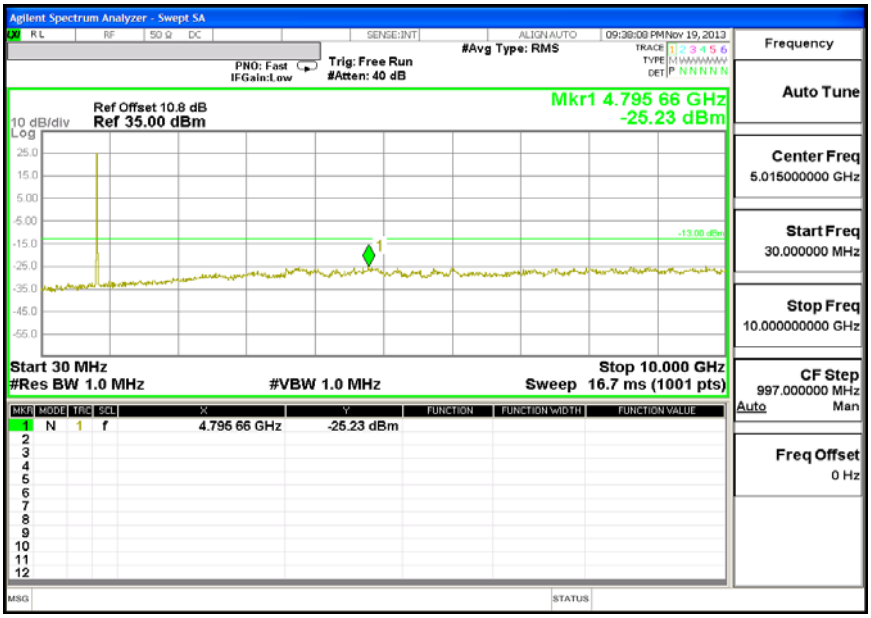
LOW CH



MID CH



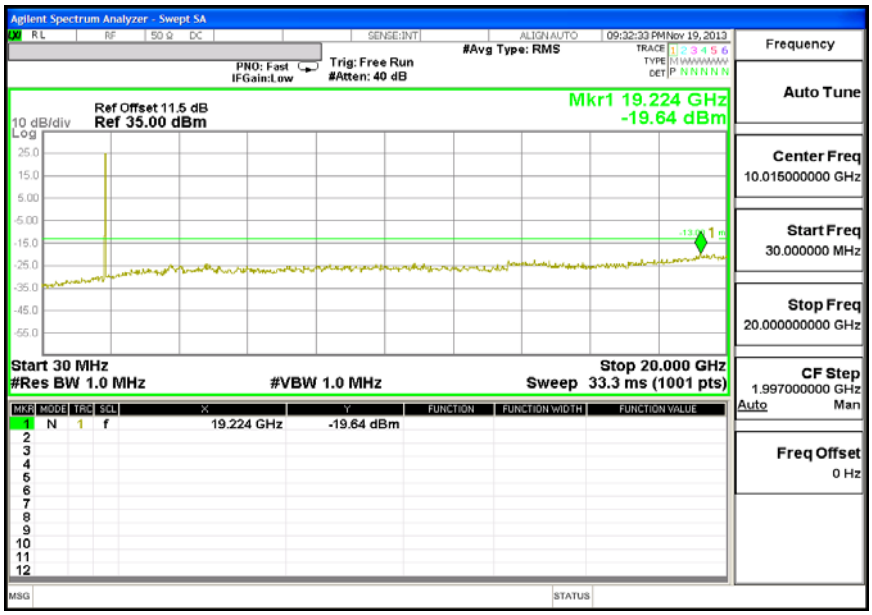
HIGH CH



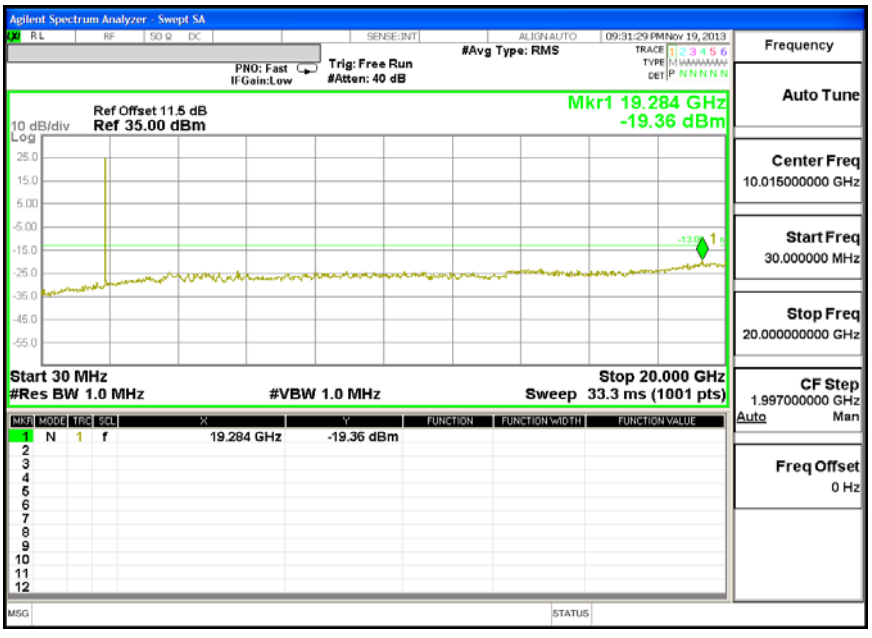
UMTS Rel 99 1900MHz BAND

LOW CH

MID CH

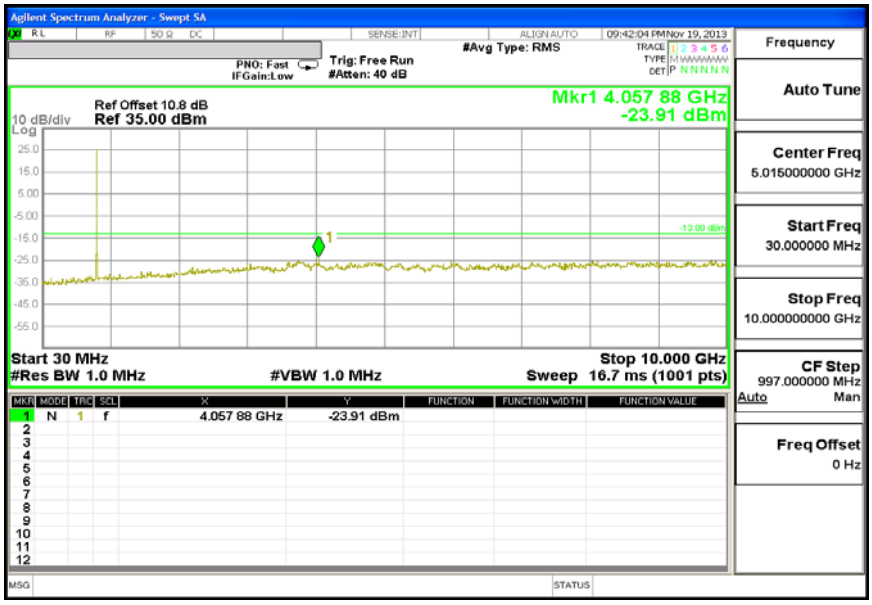


HIGH CH



UMTS HSDPA 850MHz BAND

LOW CH



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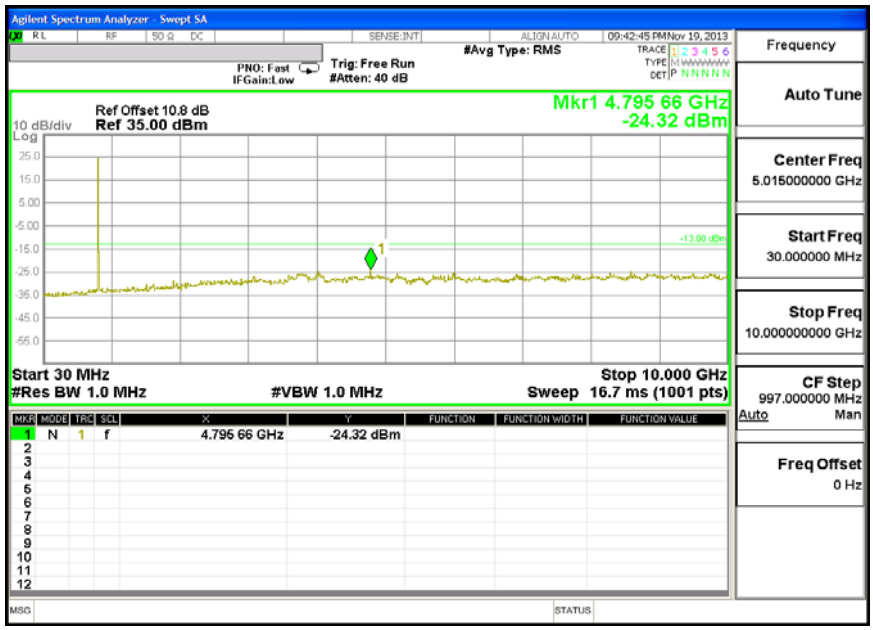
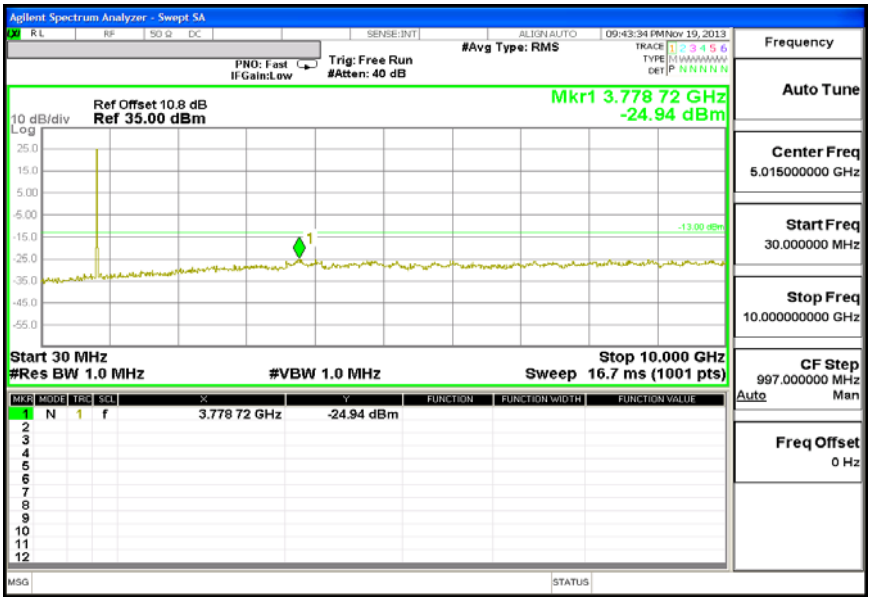
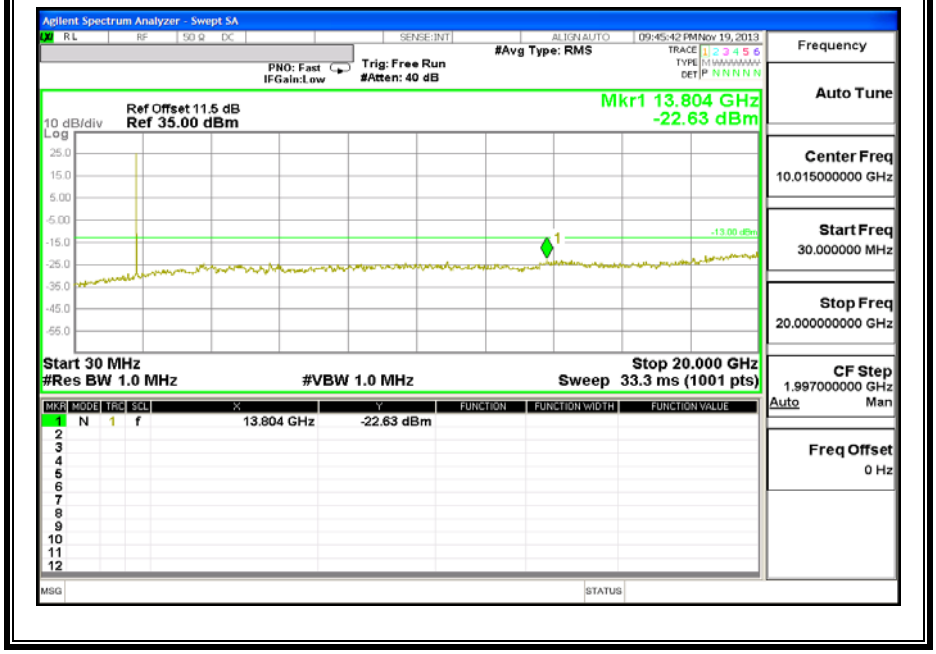


HIGH CH

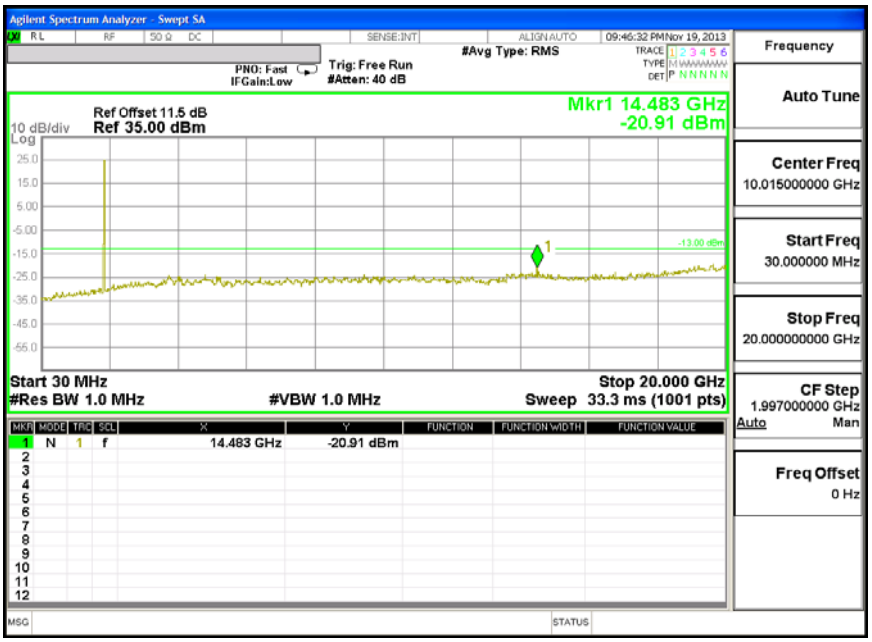


UMTS HSDPA 1900MHz BAND

LOW CH



MID CH



HIGH CH

9. FREQUENCY STABILITY

RULE PART(S)

FCC: §2.1055, §22.355 and §24.235

LIMITS

- §22.355 - The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for mobile stations.

- §24.235 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

TEST PROCEDURE

Use Agilent 8960 and CMW 500 with Frequency Error measurement capability.

- Temp. = −30° to +50°C
- Voltage = (85% - 115%)

Frequency Stability vs Temperature:
The EUT is place inside a temperature chamber. The temperature is set to 20ºC and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until +50ºC is reached.

Frequency Stability vs Voltage:
The peak frequency error is recorded (worst-case).

MODES TESTED

- GPRS;EGPRS 850MHz, 1900MHz
- UMTS, REL 99 and HSDPA

RESULTS

See the following pages.

GSM GPRS 850MHz BAND – MID CHANNEL (836.60 MHz)

Reference Frequency: CDMA2000 CELL_Mid Channel 836.6000142 MHz @ 20°C Limit: to stay +- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.6000157	-0.002	2.5
3.80	40	836.6000151	-0.001	2.5
3.80	30	836.6000150	-0.001	2.5
3.80	***20***	***836.6000142***	***0***	***2.5***
3.80	10	836.6000120	0.003	2.5
3.80	0	836.6000122	0.002	2.5
3.80	-10	836.6000080	0.007	2.5
3.80	-20	836.6000072	0.008	2.5
3.80	-30	836.5999804	0.040	2.5

Reference Frequency: CDMA2000 CELL_Mid channel 836.6000142 MHz @ 20°C Limit: to stay +- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	***20***	***836.6000142***	***0***	***2.5***
3.23	20	836.6000125	0.002	2.5
4.37	20	836.6000101	0.005	2.5
End Volt(3.20)	20	836.6000125	*0.002*	2.5

GSM GPRS 1900MHz BAND – MID CHANNEL (1880.0 MHz)

Reference Frequency: CDMA2000 PCS_Mid Channel 1879.9999785 MHz @ 20°C Limit: to stay +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vac)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.9999520	0.014	2.5
3.80	40	1879.9999671	0.006	2.5
3.80	30	1879.9999702	0.004	2.5
3.80	***20***	***1879.9999785***	***0***	***2.5***
3.80	10	1879.9999791	0.000	2.5
3.80	0	1879.9999840	-0.003	2.5
3.80	-10	1879.9999831	-0.002	2.5
3.80	-20	1879.9999812	-0.001	2.5
3.80	-30	1879.9999898	-0.006	2.5

Reference Frequency: CDMA2000 PCS_Mid Channel 1879.9999785 MHz @ 20°C Limit: to stay +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vac)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	***20***	***1879.9999785***	***0***	***2.5***
3.23	20	1879.9999783	*0.000*	2.5
4.37	20	1879.9999775	*0.001*	2.5
End Volt(3.20)	20	1879.9999783	*0.000*	2.5

GSM EGPRS 850MHz BAND – MID CHANNEL (836.60 MHz)

Reference Frequency: CDMA2000 CELL_Mid Channe 836.600011MHz @ 20°C Limit: to stay +- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.600016	-0.005	2.5
3.80	40	836.600015	-0.004	2.5
3.80	30	836.600012	-0.001	2.5
3.80	***20***	***836.600011***	***0***	***2.5***
3.80	10	836.600011	0.000	2.5
3.80	0	836.600009	0.002	2.5
3.80	-10	836.600006	0.007	2.5
3.80	-20	836.600006	0.007	2.5
3.80	-30	836.600005	0.007	2.5

Reference Frequency: CDMA2000 CELL_Mid channel 836.600011 MHz @ 20°C Limit: to stay +- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	***20***	***836.600011***	***0***	***2.5***
3.23	20	836.600011	0.000	2.5
4.37	20	836.600009	0.002	2.5
End Volt(3.20)	20	836.600011	*0.000*	2.5

GSM EGPRS 1900MHz BAND – MID CHANNEL (1880.0 MHz)

Reference Frequency: CDMA2000 PCS_Mid Channel 1879.999984 MHz @ 20°C Limit: to stay +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vac)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999955	0.016	2.5
3.80	40	1879.999956	0.015	2.5
3.80	30	1879.999960	0.013	2.5
3.80	***20***	***1879.999984***	***0***	***2.5***
3.80	10	1879.999980	0.002	2.5
3.80	0	1879.999982	0.001	2.5
3.80	-10	1879.999981	0.002	2.5
3.80	-20	1879.999977	0.004	2.5
3.80	-30	1879.999976	0.004	2.5

Reference Frequency: CDMA2000 PCS_Mid Channel 1879.999984 MHz @ 20°C Limit: to stay +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vac)	Environment Temperature (°C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	***20***	***1879.999984***	***0***	***2.5***
3.23	20	1879.999984	*0.000*	2.5
4.37	20	1879.999979	*0.003*	2.5
End Volt(3.2)	20	1879.999984	*0.000*	2.5

UMTS 850MHz BAND – MID CHANNEL (836.00 MHz)

Reference Frequency: CELL Mid Channel 835.999994 MHz @ 20ºC Limit: within the authorized block or +- 2.5 ppm = 2090.000 Hz				
Power Supply (Vdc)	Environment Temperature (*C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.000006	-0.014	2.5
3.80	40	836.000003	-0.011	2.5
3.80	30	835.999998	-0.005	2.5
3.80	***20***	**835.999994**	***0.000***	***2.5***
3.80	10	835.999997	-0.004	2.5
3.80	0	835.999989	0.006	2.5
3.80	-10	835.999999	-0.006	2.5
3.80	-20	836.000001	-0.008	2.5
3.80	-30	835.999993	0.001	2.5

Reference Frequency: CELL Mid Channel 835.999994 MHz @ 20ºC Limit: within the authorized block or +- 2.5 ppm = 2090.000 Hz				
Power Supply (Vdc)	Environment Temperature (*C)	Frequency Deviation Measureed with Time Elapse		
			Delta (ppm)	Limit (ppm)
3.80	***20***	***835.999994***	***0.0000***	***2.5***
4.20	20	835.999992	*0.0024*	2.5
3.40	20	835.999999	*-0.0060*	2.5
End Volt(3.2)	20	835.999977	*0.0203*	2.5

UMTS 1900MHz BAND – MID CHANNEL (1880.00 MHz)

Reference Frequency: PCS Mid Channel 1879.999992 MHz @ 20ºC Limit: within the authorized block or +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (*C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999974	0.010	2.5
3.80	40	1879.999977	0.008	2.5
3.80	30	1879.999979	0.007	2.5
3.80	***20***	**1879.999992**	***0***	***2.5***
3.80	10	1879.999988	0.002	2.5
3.80	0	1879.999992	0.000	2.5
3.80	-10	1879.999982	0.005	2.5
3.80	-20	1879.999979	0.007	2.5
3.80	-30	1879.999981	0.006	2.5

Reference Frequency: PCS Mid Channel 1879.999992 MHz @ 20ºC Limit: within the authorized block or +- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (*C)	Frequency Deviation Measureed with Time Elapse		
			Delta (ppm)	Limit (ppm)
3.80	***20***	***1879.999992***	***0.00000***	***2.5***
4.20	20	1879.999979	*0.00691*	2.5
3.40	20	1879.999977	*0.00798*	2.5
End Volt(3.2)	20	1879.999970	*0.01170*	2.5

10. RADIATED TEST RESULTS

10.1. RADIATED POWER (ERP & EIRP)

RULE PART(S)

FCC: §2.1046, §22.913 and §24.232

LIMITS

22.913(a) - The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

24.232(c) - Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

TEST PROCEDURE

ANSI / TIA / EIA 603C Clause 2.2.17

KDB 971168 v02r01 RF Power output using broadband peak and average power meter method

MODES TESTED

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

RESULTS:

Mode	Channel	f (MHz)	ERP	
			dBm	mW
GPRS	128	824.2	**29.42**	874.98
	190	836.6	29.13	818.46
	251	848.8	28.80	758.58
EGPRS	128	824.2	**28.32**	679.20
	190	836.6	27.84	608.14
	251	848.8	26.90	489.78

Mode	Channel	f (MHz)	EIRP	
			dBm	mW
GPRS	512	1850.2	32.36	1721.87
	661	1880.0	**32.43**	1749.85
	810	1909.8	30.57	1140.25
EGPRS	512	1850.2	32.11	1625.55
	661	1880.0	**32.15**	1640.59
	810	1909.8	30.43	1104.08

Mode	Channel	f (MHz)	ERP	
			dBm	mW
UMTS,REL 99	4357	826.4	21.23	132.74
	4405	836.0	21.08	128.23
	4455	846.0	**21.38**	137.40
UMTS, HSDPA	4357	826.4	20.28	106.66
	4405	836.0	20.13	103.04
	4455	846.0	**20.48**	111.69

Mode	Channel	f (MHz)	EIRP	
			dBm	mW
UMTS, REL 99	9662	1852.4	**28.07**	641.21
	9800	1880.0	27.92	619.44
	9938	1907.6	27.81	603.95
UMTS, HSDPA	9662	1852.4	**27.07**	509.33
	9800	1880.0	27.02	503.50
	9938	1907.6	26.91	490.91

GPRS (Cellular Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 12/18/13
Test Engineer: M. Hua
Configuration: EUT Only
Mode: GSM 850MHz

Test Equipment:
Receiving: Sunol T407, and Chamber D Cable
Substitution: Dipole S/N: 00022117, 8ft SMA Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch								
824.20	30.04	V	0.6	0.0	29.42	38.5	-9.0	
824.20	24.17	H	0.6	0.0	23.55	38.5	-14.9	
Mid Ch								
836.60	29.75	V	0.6	0.0	29.13	38.5	-9.3	
836.60	23.92	H	0.6	0.0	23.30	38.5	-15.1	
High Ch								
848.80	29.42	V	0.6	0.0	28.80	38.5	-9.6	
848.80	24.85	H	0.6	0.0	24.23	38.5	-14.2	

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EGPRS (Cellular Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 12/18/13
Test Engineer: M. Hua
Configuration: EUT Only
Mode: EDGE 850MHz

Test Equipment:
Receiving: Sunol T407, and Chamber D Cable
Substitution: Dipole S/N: 00022117, 8ft SMA Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch								
824.20	28.94	V	0.6	0.0	28.32	38.5	-10.1	
824.20	22.97	H	0.6	0.0	22.35	38.5	-16.1	
Mid Ch								
836.60	28.46	V	0.6	0.0	27.84	38.5	-10.6	
836.60	22.72	H	0.6	0.0	22.10	38.5	-16.3	
High Ch								
848.80	27.52	V	0.6	0.0	26.90	38.5	-11.5	
848.80	22.95	H	0.6	0.0	22.33	38.5	-16.1	

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GPRS (PCS Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 01/07/14
Test Engineer: M. Hua
Configuration: EUT Only
Mode: GPRS, 1900MHz

Test Equipment:
Receiving: Horn T344 and Chamber D SMA Cables
Substitution: Horn T59 Substitution, and 12ft SMA Cable

f GHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1.851	26.0	V	1.53	7.88	32.36	33.0	-0.6	
1.851	17.1	H	1.53	7.88	23.47	33.0	-9.5	
Mid Ch								
1.880	26.1	V	1.53	7.86	32.43	33.0	-0.6	
1.880	17.2	H	1.53	7.86	23.52	33.0	-9.5	
High Ch								
1.910	24.3	V	1.53	7.84	30.57	33.0	-2.4	
1.910	16.8	H	1.53	7.84	23.14	33.0	-9.9	

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EGPRS (PCS Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 01/08/14
Test Engineer: M. Hua
Configuration: EUT Only
Mode: EDGE 1900MHz

Test Equipment:
Receiving: Horn T344 and Chamber D SMA Cables
Substitution: Horn T59 Substitution, and 12ft SMA Cable

f GHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1.851	25.8	V	1.53	7.88	32.11	33.0	-0.9	
1.851	17.0	H	1.53	7.88	23.31	33.0	-9.7	
Mid Ch								
1.880	25.8	V	1.53	7.86	32.15	33.0	-0.9	
1.880	17.1	H	1.53	7.86	23.44	33.0	-9.6	
High Ch								
1.910	24.1	V	1.53	7.84	30.43	33.0	-2.6	
1.910	16.3	H	1.53	7.84	22.59	33.0	-10.4	

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UMTS REL 99 (Cellular Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 12/18/13
Test Engineer: M. Hua
Configuration: EUT Only
Mode: WCDMA Rel 99 850MHz

Test Equipment:
Receiving: Sunol T407, and Chamber D Cable
Substitution: Dipole S/N: 00022117, 8ft SMA Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch								
826.40	21.85	V	0.6	0.0	21.23	38.5	-17.2	
826.40	15.87	H	0.6	0.0	15.25	38.5	-23.2	
Mid Ch								
836.00	21.70	V	0.6	0.0	21.08	38.5	-17.4	
836.00	14.92	H	0.6	0.0	14.30	38.5	-24.1	
High Ch								
846.00	22.00	V	0.6	0.0	21.38	38.5	-17.1	
846.00	15.35	H	0.6	0.0	14.73	38.5	-23.7	

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UMTS HSDPA (Cellular Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 12/18/13
Test Engineer: M. Hua
Configuration: EUT Only
Mode: WCDMA HSPA 850MHz

Test Equipment:
Receiving: Sunol T407, and Chamber D Cable
Substitution: Dipole S/N: 00022117, 8ft SMA Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch								
826.40	20.90	V	0.6	0.0	20.28	38.5	-18.2	
826.40	14.27	H	0.6	0.0	13.65	38.5	-24.8	
Mid Ch								
836.00	20.75	V	0.6	0.0	20.13	38.5	-18.3	
836.00	13.12	H	0.6	0.0	12.50	38.5	-25.9	
High Ch								
846.00	21.10	V	0.6	0.0	20.48	38.5	-18.0	
846.00	14.05	H	0.6	0.0	13.43	38.5	-25.0	

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UMTS REL 99 (PCS Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 01/07/14
Test Engineer: M. Hua
Configuration: EUT Only
Mode: WCDMA Rel 99 1900MHz

Test Equipment:
Receiving: Horn T344 and Chamber D SMA Cables
Substitution: Horn T59 Substitution, and 12ft SMA Cable

f GHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1.852	21.7	V	1.53	7.88	28.07	33.0	-4.9	
1.852	14.8	H	1.53	7.88	21.14	33.0	-11.9	
Mid Ch								
1.880	21.6	V	1.53	7.86	27.92	33.0	-5.1	
1.880	15.2	H	1.53	7.86	21.52	33.0	-11.5	
High Ch								
1.908	21.5	V	1.53	7.84	27.81	33.0	-5.2	
1.908	13.4	H	1.53	7.84	19.74	33.0	-13.3	

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UMTS HSDPA (PCS Band)

High Frequency Substitution Measurement
UL Fremont Radiated Chamber D

Company: Apple
Project #: 13U16583
Date: 01/08/14
Test Engineer: M. Hua
Configuration: EUT Only
Mode: WCDMA HSPA 1900MHz

Test Equipment:
Receiving: Horn T344 and Chamber D SMA Cables
Substitution: Horn T59 Substitution, and 12ft SMA Cable

f GHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1.852	20.7	V	1.53	7.88	27.07	33.0	-5.9	
1.852	13.2	H	1.53	7.88	19.56	33.0	-13.4	
Mid Ch								
1.880	20.7	V	1.53	7.86	27.02	33.0	-6.0	
1.880	13.0	H	1.53	7.86	19.29	33.0	-13.7	
High Ch								
1.908	20.6	V	1.53	7.84	26.91	33.0	-6.1	
1.908	11.7	H	1.53	7.84	18.02	33.0	-15.0	

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10.2. FIELD STRENGTH OF SPURIOUS RADIATION

RULE PART(S)

FCC: §2.1053, §22.917 and §24.238

LIMIT

§22.917 (e) and §24.238 (a): Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

TEST PROCEDURE

For Cellular equipment - Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

For PCS equipment - Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

MODES TESTED:

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

RESULTS

GPRS (Cellular Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: Cell GSM 850, GPRS

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 22

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (824.2MHz)										
1.65	-55.6	V	3.0	44.71	37.6	1.0	-47.5	-13.0	-34.5	
2.47	-60.1	V	3.0	48.34	38.0	1.0	-48.7	-13.0	-35.7	
1.65	-56.7	H	3.0	43.82	37.6	1.0	-49.4	-13.0	-36.4	
2.47	-59.3	H	3.0	48.50	38.0	1.0	-47.8	-13.0	-34.8	
Mid Ch, (836.6MHz)										
1.67	-55.4	V	3.0	44.9	37.6	1.0	-47.0	-13.0	-34.0	
2.51	-59.8	V	3.0	48.4	37.9	1.0	-48.3	-13.0	-35.3	
1.67	-55.0	H	3.0	44.1	37.6	1.0	-47.5	-13.0	-34.5	
2.51	-60.0	H	3.0	48.6	37.9	1.0	-48.3	-13.0	-35.3	
High Ch, (848.8MHz)										
1.70	-57.6	V	3.0	45.2	37.6	1.0	-49.0	-13.0	-36.0	
2.55	-59.6	V	3.0	48.5	38.0	1.0	-48.1	-13.0	-35.1	
1.70	-58.0	H	3.0	44.4	37.6	1.0	-50.2	-13.0	-37.2	
2.55	-59.4	H	3.0	48.7	38.0	1.0	-47.7	-13.0	-34.7	

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EGPRS (Cellular Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: Cell GSM 850, EGPRS

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 22

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (824.2MHz)										
1.65	-56.6	V	3.0	44.71	37.6	1.0	-48.5	-13.0	-35.5	
2.47	-60.9	V	3.0	48.34	38.0	1.0	-49.5	-13.0	-36.5	
1.65	-57.7	H	3.0	43.82	37.6	1.0	-50.4	-13.0	-37.4	
2.47	-60.3	H	3.0	48.50	38.0	1.0	-48.8	-13.0	-35.8	
Mid Ch, (836.6MHz)										
1.67	-56.4	V	3.0	44.9	37.6	1.0	-48.0	-13.0	-35.0	
2.51	-60.7	V	3.0	48.4	37.9	1.0	-49.2	-13.0	-36.2	
1.67	-55.8	H	3.0	44.1	37.6	1.0	-48.3	-13.0	-35.3	
2.51	-60.0	H	3.0	48.6	37.9	1.0	-48.3	-13.0	-35.3	
High Ch, (848.8MHz)										
1.70	-58.6	V	3.0	45.2	37.6	1.0	-50.0	-13.0	-37.0	
2.55	-60.6	V	3.0	48.5	38.0	1.0	-49.1	-13.0	-36.1	
1.70	-58.9	H	3.0	44.4	37.6	1.0	-51.1	-13.0	-38.1	
2.55	-60.4	H	3.0	48.7	38.0	1.0	-48.7	-13.0	-35.7	

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UMTS REL 99 (Cellular Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: UMTS B5 REL 99

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 22

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (826.4MHz)										
1.65	-53.4	V	3.0	44.75	37.6	1.0	-45.2	-13.0	-32.2	
2.48	-59.3	V	3.0	48.36	38.0	1.0	-47.9	-13.0	-34.9	
1.65	-52.5	H	3.0	43.87	37.6	1.0	-45.2	-13.0	-32.2	
2.48	-59.5	H	3.0	48.52	38.0	1.0	-47.9	-13.0	-34.9	
Mid Ch, (836MHz)										
1.67	-53.2	V	3.0	44.9	37.6	1.0	-44.8	-13.0	-31.8	
2.51	-59.7	V	3.0	48.4	37.9	1.0	-48.2	-13.0	-35.2	
1.67	-53.3	H	3.0	44.1	37.6	1.0	-45.8	-13.0	-32.8	
2.51	-60.3	H	3.0	48.6	37.9	1.0	-48.6	-13.0	-35.6	
High Ch, (846MHz)										
1.69	-57.6	V	3.0	45.1	37.6	1.0	-49.1	-13.0	-36.1	
2.54	-59.7	V	3.0	48.5	38.0	1.0	-48.2	-13.0	-35.2	
1.69	-52.0	H	3.0	44.3	37.6	1.0	-44.3	-13.0	-31.3	
2.54	-59.9	H	3.0	48.6	38.0	1.0	-48.2	-13.0	-35.2	

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UMTS HSDPA (Cellular Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: UMTS B5 HSDPA

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 22

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (826.4MHz)										
1.65	-53.9	V	3.0	44.75	37.6	1.0	-45.7	-13.0	-32.7	
2.48	-59.9	V	3.0	48.36	38.0	1.0	-48.5	-13.0	-35.5	
1.65	-53.5	H	3.0	43.87	37.6	1.0	-46.2	-13.0	-33.2	
2.48	-60.2	H	3.0	48.52	38.0	1.0	-48.6	-13.0	-35.6	
Mid Ch, (836MHz)										
1.67	-54.2	V	3.0	44.9	37.6	1.0	-45.8	-13.0	-32.8	
2.51	-60.5	V	3.0	48.4	37.9	1.0	-49.0	-13.0	-36.0	
1.67	-54.2	H	3.0	44.1	37.6	1.0	-46.7	-13.0	-33.7	
2.51	-61.2	H	3.0	48.6	37.9	1.0	-49.5	-13.0	-36.5	
High Ch, (846MHz)										
1.69	-58.6	V	3.0	45.1	37.6	1.0	-50.1	-13.0	-37.1	
2.54	-60.7	V	3.0	48.5	38.0	1.0	-49.2	-13.0	-36.2	
1.69	-53.0	H	3.0	44.3	37.6	1.0	-45.3	-13.0	-32.3	
2.54	-60.6	H	3.0	48.6	38.0	1.0	-48.9	-13.0	-35.9	

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GPRS (PCS Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U15683
Date: 12/05/13
Test Engineer: M. Hua
Configuration: EUT only
Mode: GPRS PCS

Chamber	Pre-amplifer	Filter	Limit
3m Chamber D	3m Chamber D	Filter 1	Part 24

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (1850.2MHz)										
3.70	-63.8	V	3.0	50.69	38.0	1.0	-50.2	-13.0	-37.2	
5.56	-62.8	V	3.0	52.76	37.4	1.0	-46.4	-13.0	-33.4	
3.70	-63.4	H	3.0	50.48	38.0	1.0	-50.0	-13.0	-37.0	
5.56	-60.2	H	3.0	52.99	37.4	1.0	-43.6	-13.0	-30.6	
Mid Ch, (1880MHz)										
3.76	-63.9	V	3.0	50.8	38.0	1.0	-50.1	-13.0	-37.1	
5.64	-61.8	V	3.0	52.9	37.3	1.0	-45.3	-13.0	-32.3	
3.76	-64.0	H	3.0	50.6	38.0	1.0	-50.4	-13.0	-37.4	
5.64	-60.8	H	3.0	53.1	37.3	1.0	-44.0	-13.0	-31.0	
High Ch, (1909.8MHz)										
3.82	-63.5	V	3.0	50.9	37.9	1.0	-49.5	-13.0	-36.5	
5.72	-62.6	V	3.0	53.0	37.3	1.0	-45.9	-13.0	-32.9	
3.82	-63.0	H	3.0	50.7	37.9	1.0	-49.3	-13.0	-36.3	
5.72	-61.1	H	3.0	53.2	37.3	1.0	-44.2	-13.0	-31.2	

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EGPRS (PCS Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U15683
Date: 12/05/13
Test Engineer: M. Hua
Configuration: EUT only
Mode: EGPRS PCS

Chamber	Pre-amplifer	Filter	Limit
3m Chamber D	3m Chamber D	Filter 1	Part 24

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (1850.2MHz)										
3.70	-64.4	V	3.0	50.69	38.0	1.0	-50.8	-13.0	-37.8	
5.56	-63.8	V	3.0	52.76	37.4	1.0	-47.4	-13.0	-34.4	
3.70	-63.7	H	3.0	50.48	38.0	1.0	-50.3	-13.0	-37.3	
5.56	-63.1	H	3.0	52.99	37.4	1.0	-46.5	-13.0	-33.5	
Mid Ch, (1880MHz)										
3.76	-63.6	V	3.0	50.8	38.0	1.0	-49.8	-13.0	-36.8	
5.64	-64.0	V	3.0	52.9	37.3	1.0	-47.5	-13.0	-34.5	
3.76	-63.9	H	3.0	50.6	38.0	1.0	-50.3	-13.0	-37.3	
5.64	-63.2	H	3.0	53.1	37.3	1.0	-46.4	-13.0	-33.4	
High Ch, (1909.8MHz)										
3.82	-63.8	V	3.0	50.9	37.9	1.0	-49.8	-13.0	-36.8	
5.72	-63.0	V	3.0	53.0	37.3	1.0	-46.3	-13.0	-33.3	
3.82	-63.1	H	3.0	50.7	37.9	1.0	-49.4	-13.0	-36.4	
5.72	-62.4	H	3.0	53.2	37.3	1.0	-45.5	-13.0	-32.5	

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UMTS REL 99 (PCS Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: PCS 1900, REL99

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 24

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (1852.4MHz)										
3.70	-57.0	V	3.0	50.92	38.6	1.0	-43.7	-13.0	-30.7	
5.56	-57.6	V	3.0	53.80	38.0	1.0	-40.8	-13.0	-27.8	
3.70	-56.8	H	3.0	51.02	38.6	1.0	-43.4	-13.0	-30.4	
5.56	-57.7	H	3.0	53.60	38.0	1.0	-41.1	-13.0	-28.1	
Mid Ch, (1880MHz)										
3.76	-56.0	V	3.0	51.1	38.6	1.0	-42.5	-13.0	-29.5	
5.64	-57.0	V	3.0	53.9	38.0	1.0	-40.0	-13.0	-27.0	
3.76	-55.0	H	3.0	51.2	38.6	1.0	-41.4	-13.0	-28.4	
5.64	-57.1	H	3.0	53.7	38.0	1.0	-40.4	-13.0	-27.4	
High Ch, (1907.6MHz)										
3.82	-55.8	V	3.0	51.2	38.6	1.0	-42.2	-13.0	-29.2	
5.72	-58.3	V	3.0	54.0	37.9	1.0	-41.2	-13.0	-28.2	
3.82	-55.7	H	3.0	51.3	38.6	1.0	-42.0	-13.0	-29.0	
5.72	-58.4	H	3.0	53.8	37.9	1.0	-41.5	-13.0	-28.5	

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UMTS HSDPA (PCS Band)

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:
Project #: 13U16583
Date: 12/9/13
Test Engineer: R.ZHENG
Configuration: EUT only
Mode: PCS 1900, HSDPA

Chamber	Pre-amplifer	Filter	Limit
3m Chamber E	3m Chamber E	Filter 1	Part 24

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, (1852.4MHz)										
3.70	-57.6	V	3.0	50.92	38.6	1.0	-44.3	-13.0	-31.3	
5.56	-58.3	V	3.0	53.80	38.0	1.0	-41.5	-13.0	-28.5	
3.70	-57.4	H	3.0	51.02	38.6	1.0	-44.0	-13.0	-31.0	
5.56	-58.3	H	3.0	53.60	38.0	1.0	-41.7	-13.0	-28.7	
Mid Ch, (1880MHz)										
3.76	-56.4	V	3.0	51.1	38.6	1.0	-42.9	-13.0	-29.9	
5.64	-57.5	V	3.0	53.9	38.0	1.0	-40.5	-13.0	-27.5	
3.76	-55.7	H	3.0	51.2	38.6	1.0	-42.1	-13.0	-29.1	
5.64	-57.7	H	3.0	53.7	38.0	1.0	-40.9	-13.0	-27.9	
High Ch, (1907.6MHz)										
3.82	-56.5	V	3.0	51.2	38.6	1.0	-42.9	-13.0	-29.9	
5.72	-58.8	V	3.0	54.0	37.9	1.0	-41.7	-13.0	-28.7	
3.82	-56.7	H	3.0	51.3	38.6	1.0	-43.0	-13.0	-30.0	
5.72	-58.9	H	3.0	53.8	37.9	1.0	-42.0	-13.0	-29.0	

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