



**FCC 47 CFR PART 22H & 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: A1476**

**FCC ID: BCGA1476**

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Revision History

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--	01/24/14	Initial Issue	T. Chan
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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:** A1476

**SERIAL NUMBER:** 12569 (CONDUCTED) AND 12558 (RADIATED)

**DATE TESTED:** NOVEMBER 20, 2013 - JANUARY 09, 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  
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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
<input type="checkbox"/> Chamber A	<input checked="" type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> 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.ul.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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 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 Apple iPad Model A1476 is a Tablet 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/CDMA mode of Cellular band, while peak detector is used for GSM mode of Cellular and all GSM/CDMA/UMTS PCS bands as follows:

#### GSM

Part 22 /24					
Frequency range (MHz)	Modulation	Conducted(Peak)		ERP/EIRP (Peak)	
		dBm	mW	dBm	mW
824.2 - 848.8	GPRS	33.80	2398.8	33.08	2032.4
	EGPRS	32.00	1584.9	31.13	1297.2
1850.2-1909.8	GPRS	31.20	1318.3	32.83	1918.7
	EGPRS	30.90	1230.3	32.63	1832.3

#### WCDMA

Part 22/24 /27		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			24.46	279.3			23.58	228.0
826.4-846.6	HSDPA			23.43	220.3			22.48	177.0
1852.4 - 1907.6	REL 99	26.41	437.5			28.13	650.1		
1852.4 - 1907.6	HSDPA	25.35	342.8			27.33	540.8		

### 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	-1.13
PCS, 1850 - 1910	1.78

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 4324B5\_ronl

The EUT is linked with Agilent 8960 Communication and 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 X-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	0.1m	NA
4	RF In/Out	1	Call Box	Un-Shielded	0.5m	NA

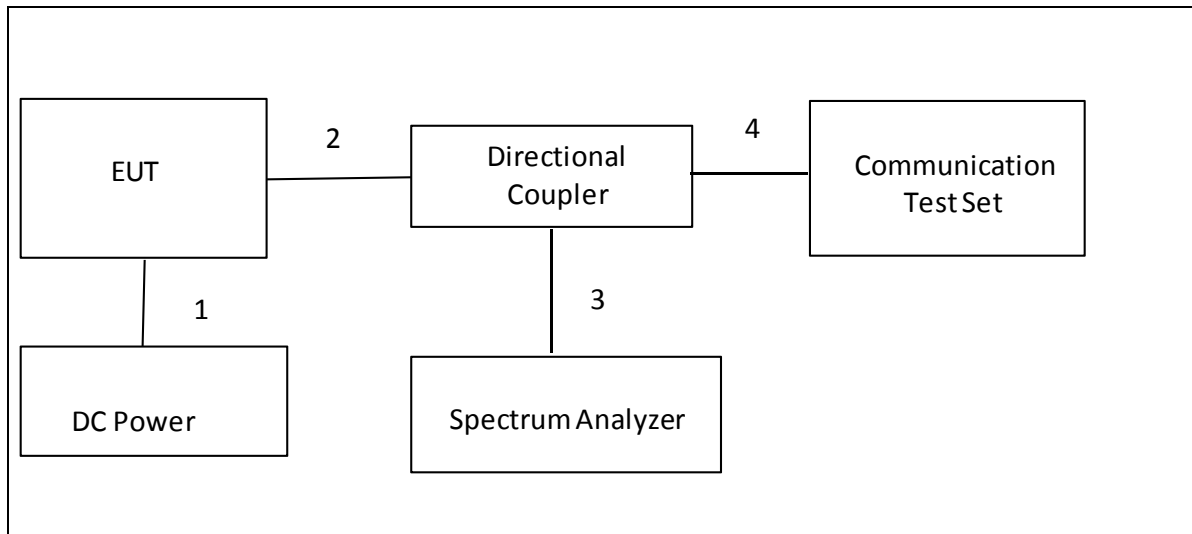
### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC adapter	Apple	A1401	60812	DoC
Earphone	Apple	NA	NA	NA

### TEST SETUP

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

**SETUP DIAGRAM FOR RF CONDUCTED TESTS**



## 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	R & S	CMW500	F00014	02/21/14
Spectrum Analyzer, 44GHz	Agilent	E4446A	C00996	05/22/14
Spectrum Analyzer, 44GHz	Agilent	N9030A	F00129	02/21/14
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	01/09/14
Peak Power Meter	Boonton	4541	C01189	06/20/14
Peak Power Sensor	Boonton	57006	C01202	05/29/14

## 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

**GPRS / EGPRS**

Mode	Ch.	f (MHz)	1 time slots		2 time slots	
			Peak	Average	Peak	Average
GPRS	128	824.2	33.74	33.45	32.70	32.48
	190	836.6	33.80	33.50	32.65	32.45
	251	848.8	33.70	33.40	32.70	32.50
EGPRS	128	824.2	31.90	28.90	31.80	28.90
	190	836.6	32.00	29.00	31.90	28.90
	251	848.8	31.90	28.95	31.80	28.90

Mode	Ch.	f (MHz)	1 time slots		2 time slots	
			Peak	Average	Peak	Average
GPRS	512	1850.2	31.00	30.96	29.20	29.00
	661	1880.0	31.03	30.90	29.15	28.95
	810	1909.8	31.20	31.00	29.20	29.00
EGPRS	512	1850.2	30.88	27.95	30.72	27.92
	661	1880.0	30.90	28.00	30.80	27.86
	810	1909.8	30.85	27.95	30.65	27.75

## 7.2. UMTS (REL99, HSDPA)

### TEST PROCEDURE

The following summary of these settings are illustrated below:

WCDMA General Settings	Mode	Rel99
	Subtest	-
	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	HSDPA FRC	Not Applicable
	HSUPA Test	Not Applicable
	Power Control Algorithm	Algorithm2
	$\beta_c$	Not Applicable
	$\beta_d$	Not Applicable
	$\beta_{ec}$	Not Applicable
	$\beta_c/\beta_d$	8/15
	$\beta_{hs}$	Not Applicable
	$\beta_{ed}$	Not Applicable

### REL99 BAND 5

Band	Mode	UL Ch	DL Ch	Frequency	Conducted output power (dBm)	
					Peak	Average
Band 5 UMTS 850	REL 99	4132	4357	826.4	28.53	24.44
		4180	4405	836.0	28.50	24.46
		4230	4455	846.6	28.46	24.32

### REL99 BAND 2

Band	Mode	UL Ch	DL Ch	Frequency	Conducted output power (dBm)	
					Peak	Average
Band 2 UMTS 1900	REL 99	9262	9662	1852.4	26.32	22.24
		9400	9800	1880.0	26.41	22.30
		9538	9938	1907.6	26.34	22.27

### 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			
	$\beta_c$	2/15	12/15	15/15	15/15
	$\beta_d$	15/15	15/15	8/15	4/15
	$\beta_{ec}$	-	-	-	-
	$\beta_c/\beta_d$	2/15	12/15	15/8	15/4
	$\beta_{hs}$	4/15	24/15	30/15	30/15
HSDPA Specific Settings	$\beta_{ed}$	Not Applicable			
	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			
	$A_{hs} = \beta_{hs}/\beta_c$	30/15			

**HSDPA, 850MHz**

Band	Mode	Subtest	UL Ch	DL Ch	Frequency	Conducted output power (dBm)	
						Peak	Average
UMTS850 (Band V)	HSDPA	1*	4132	4357	826.4	27.50	23.40
			4180	4405	836.0	27.45	23.42
			4230	4455	846.6	27.46	23.43
		2	4132	4357	826.4	27.11	23.00
			4180	4405	836.0	27.30	23.26
			4230	4455	846.6	27.00	23.10
		3	4132	4357	826.4	27.20	23.12
			4180	4405	836.0	27.21	23.10
			4230	4455	846.6	27.10	23.00
		4	4132	4357	826.4	27.16	23.04
			4180	4405	836.0	27.13	23.02
			4230	4455	846.6	27.22	23.14
UMTS1900 (Band II))	HSDPA	1*	9262	9662	1852.4	25.35	21.30
			9400	9800	1880.0	25.32	21.21
			9538	9938	1907.6	25.31	21.25
		2	9262	9662	1852.4	25.34	21.28
			9400	9800	1880.0	25.21	21.13
			9538	9938	1907.6	25.33	21.26
		3	9262	9662	1852.4	25.10	20.93
			9400	9800	1880.0	24.87	20.75
			9538	9938	1907.6	25.14	21.13
		4	9262	9662	1852.4	25.11	20.99
			9400	9800	1880.0	25.30	21.38
			9538	9938	1907.6	25.23	21.14



## 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				
	$\beta_c$	11/15	6/15	15/15	2/15	15/15
	$\beta_d$	15/15	15/15	9/15	15/15	0
	$\beta_{ec}$	209/225	12/15	30/15	2/15	5/15
	$\beta_c/\beta_d$	11/15	6/15	15/9	2/15	-
	$\beta_{hs}$	22/15	12/15	30/15	4/15	5/15
HSDPA Specific Settings	$\beta_{ed}$	1309/225	94/75	47/15	56/75	47/15
	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				
HSUPA Specific Settings	$A_{hs} = \beta_{hs}/\beta_c$	30/15				
	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)	Conducted output power (dBm)
					Peak	Average
UMTS850 (Band V)	1*	4132	4357	826.4	27.15	22.97
		4180	4405	836.0	26.87	22.74
		4230	4455	846.0	27.02	23.00
	2	4132	4357	826.4	26.94	22.81
		4180	4405	836.0	26.98	22.89
		4230	4455	846.0	26.95	22.86
	3	4132	4357	826.4	27.04	23.10
		4180	4405	836.0	27.10	23.00
		4230	4455	846.0	27.09	22.92
	4	4132	4357	826.4	27.12	23.00
		4180	4405	836.0	26.99	22.90
		4230	4455	846.0	27.00	22.99
	5	4132	4357	826.4	27.23	23.12
		4180	4405	836.0	27.20	23.10
		4230	4455	846.0	27.10	22.94
UMTS1900 (Band II)	1*	9262	9662	1852.4	25.32	21.28
		9400	9800	1880.0	25.30	21.24
		9538	9938	1907.6	25.24	21.21
	2	9262	9662	1852.4	25.21	21.25
		9400	9800	1880.0	25.25	21.10
		9538	9938	1907.6	25.27	21.22
	3	9262	9662	1852.4	25.21	21.14
		9400	9800	1880.0	24.98	20.82
		9538	9938	1907.6	25.00	21.08
	4	9262	9662	1852.4	25.30	21.40
		9400	9800	1880.0	25.29	21.21
		9538	9938	1907.6	25.28	21.14
	5	9262	9662	1852.4	25.30	21.10
		9400	9800	1880.0	25.00	20.90
		9538	9938	1907.6	25.28	21.10

## 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

**UMTS DUAL CARRIER HSDPA**

**RESULT**

Band	Subtest	UL Ch	DL Ch	Frequency	Conducted output power (dBm)	
					Peak	Average
UMTS850 (Band 5)	1*	4132	4357	826.4	27.22	23.18
		4180	4405	836.0	27.28	23.23
		4230	4455	846.0	27.26	23.17
	2	4132	4357	826.4	27.11	22.35
		4180	4405	836.0	27.17	22.31
		4230	4455	846.0	27.10	22.36
	3	4132	4357	826.4	27.15	23.09
		4180	4405	836.0	27.16	23.09
		4230	4455	846.0	27.15	23.07
	4	4132	4357	826.4	27.06	22.36
		4180	4405	836.0	27.08	22.31
		4230	4455	846.0	27.13	22.29
UMTS1900 (Band 2)	1	9262	9662	1852.4	25.23	21.20
		9400	9800	1880.0	25.25	21.17
		9538	9938	1907.6	25.28	21.22
	2*	9262	9662	1852.4	25.24	20.72
		9400	9800	1880.0	25.21	20.75
		9538	9938	1907.6	25.23	20.73
	3	9262	9662	1852.4	25.00	20.91
		9400	9800	1880.0	24.85	21.02
		9538	9938	1907.6	25.04	20.90
	4	9262	9662	1852.4	24.96	20.69
		9400	9800	1880.0	25.11	20.73
		9538	9938	1907.6	25.13	20.79

**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

Band	Mode	Channel	f (MHz)	99% BW (KHz)	-26dB BW (KHz)
Cellular	GPRS	128	824.20	240.0763	315.337
		190	836.60	246.3390	312.047
		251	848.80	244.0078	303.737
	EGPRS	128	824.20	243.8155	309.256
		190	836.60	246.6942	307.075
		251	848.80	249.0340	319.896

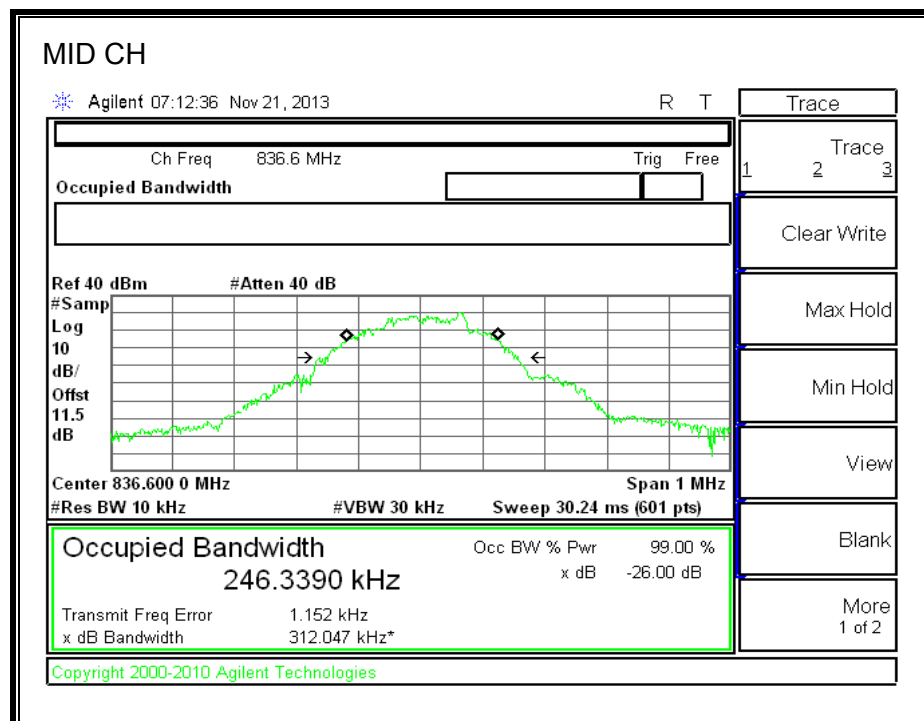
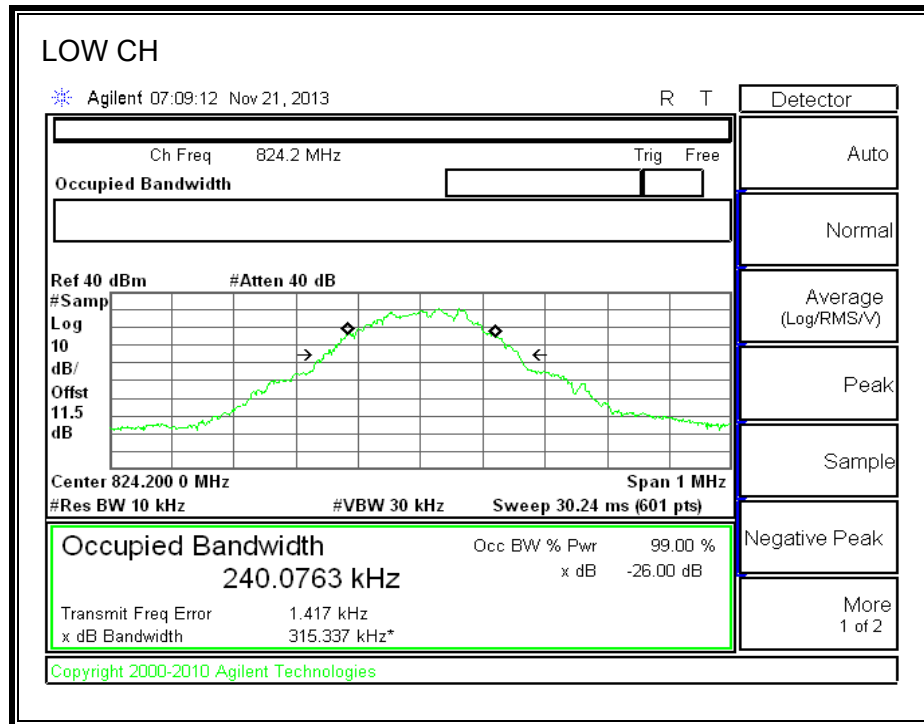
Band	Mode	Channel	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
Cellular	UMTS, REL 99	4357	826.4	4.1588	4.624
		4405	836.0	4.1734	4.607
		4455	846.0	4.1418	4.575
	UMTS, HSDPA	4357	826.4	4.1697	4.624
		4405	836.0	4.1692	4.551
		4455	846.0	4.1858	4.605

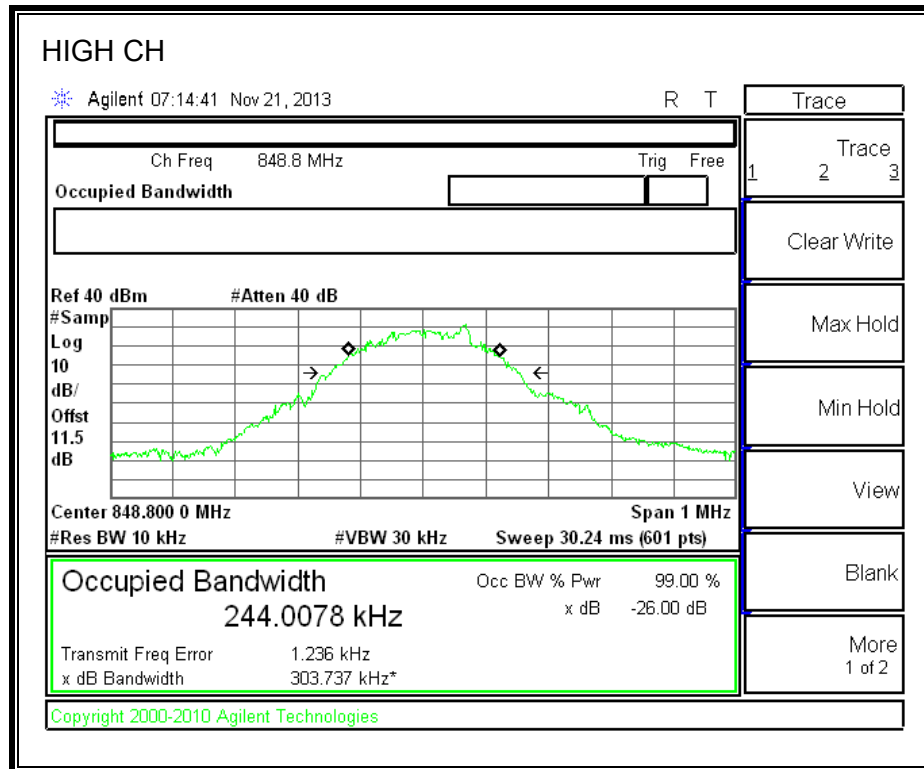
Band	Mode	Channel	f (MHz)	99% BW (KHz)	-26dB BW (KHz)
PCS	GPRS	512	1850.2	244.2060	311.296
		661	1880.0	247.7703	314.797
		810	1909.8	247.8327	305.508
	EGPRS	512	1850.2	247.8317	307.264
		661	1880.0	244.7209	315.402
		810	1909.8	247.7633	310.987

Band	Mode	Channel	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
PCS	UMTS, REL 99	9662	1852.4	4.1508	4.653
		9800	1880.0	4.1915	4.624
		9938	1907.6	4.1655	4.575
	UMTS, HSDPA	9662	1852.4	4.1683	4.638
		9800	1880.0	4.1706	4.596
		9938	1907.6	4.1599	4.670

**GPRS850**

**Cellular Band**

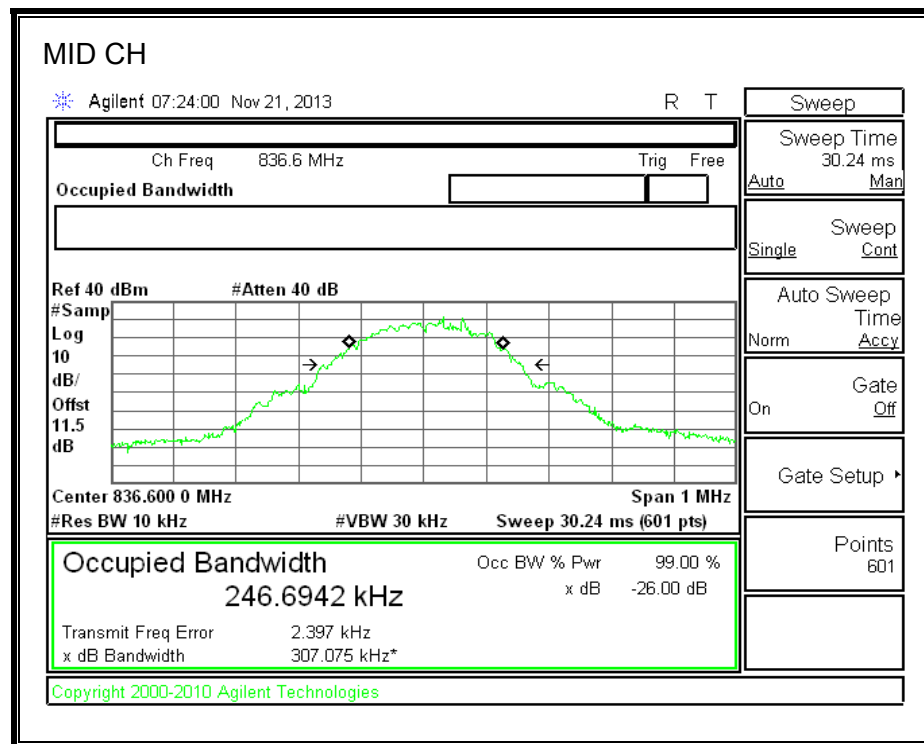
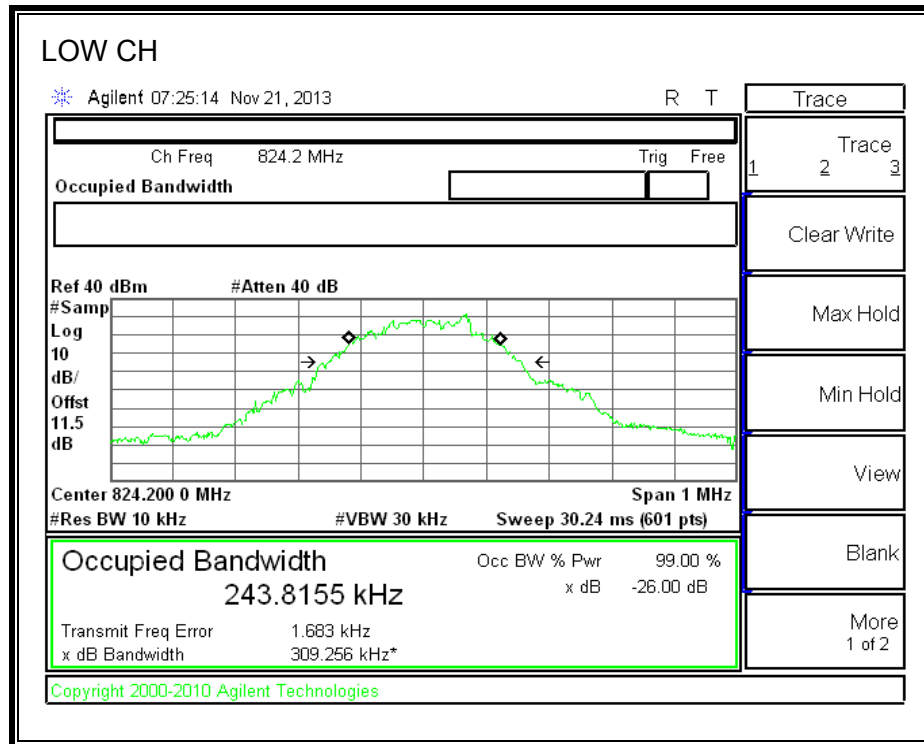


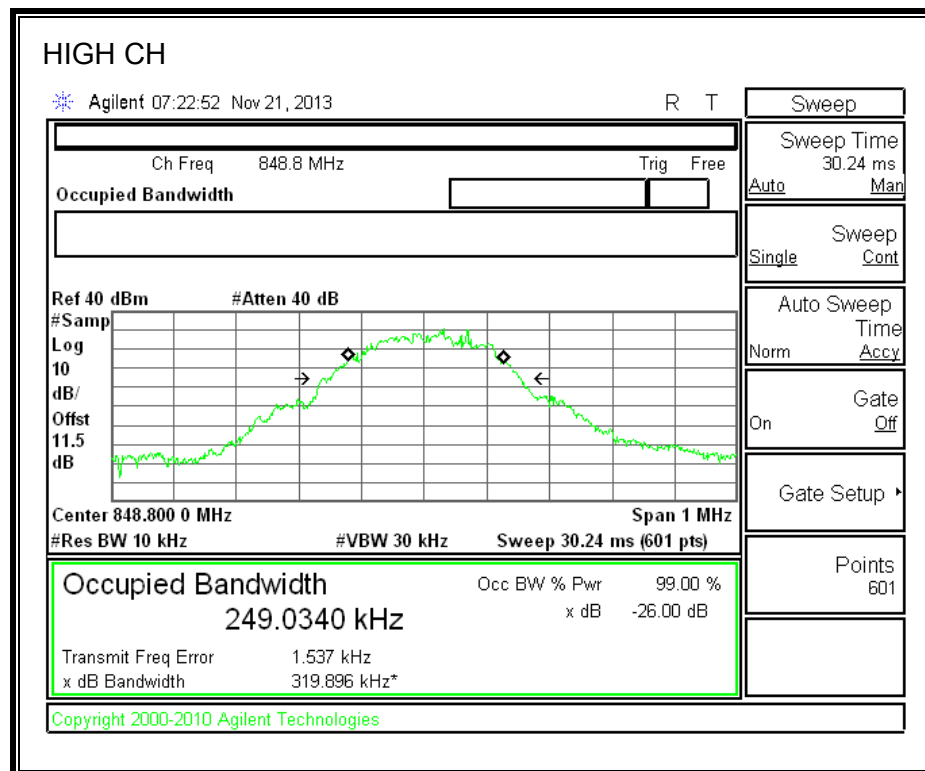




**EGPRS850**

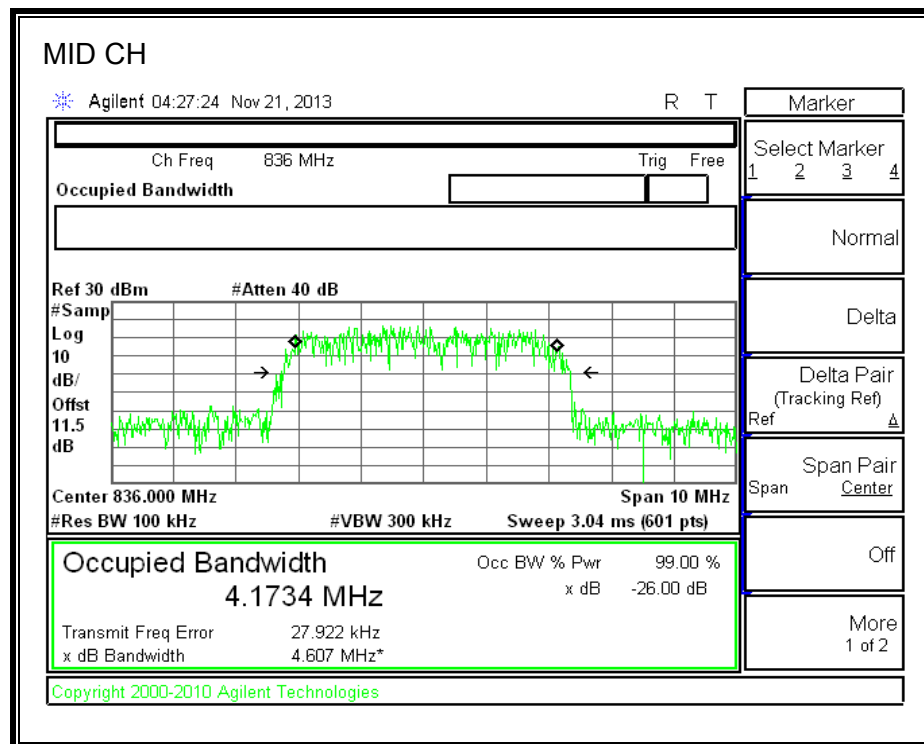
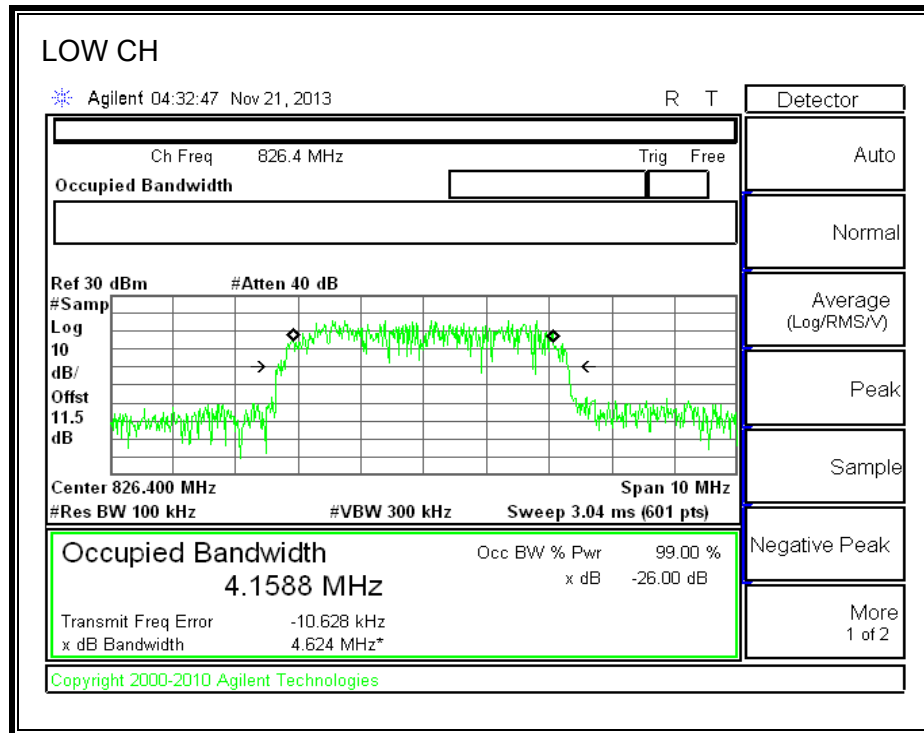
**Cellular Band**

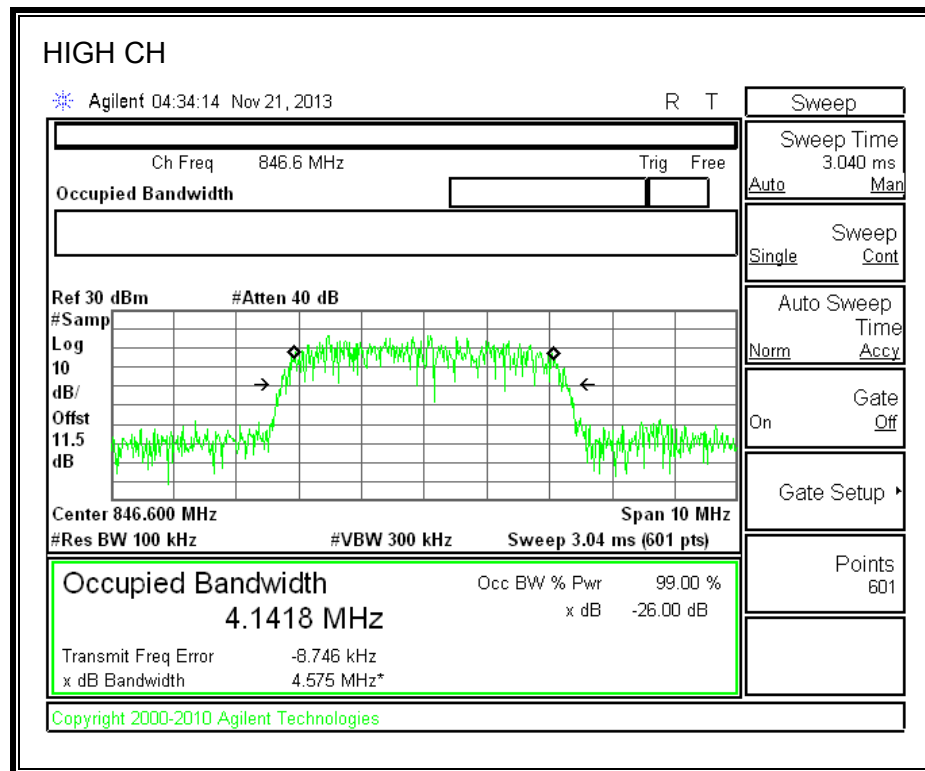




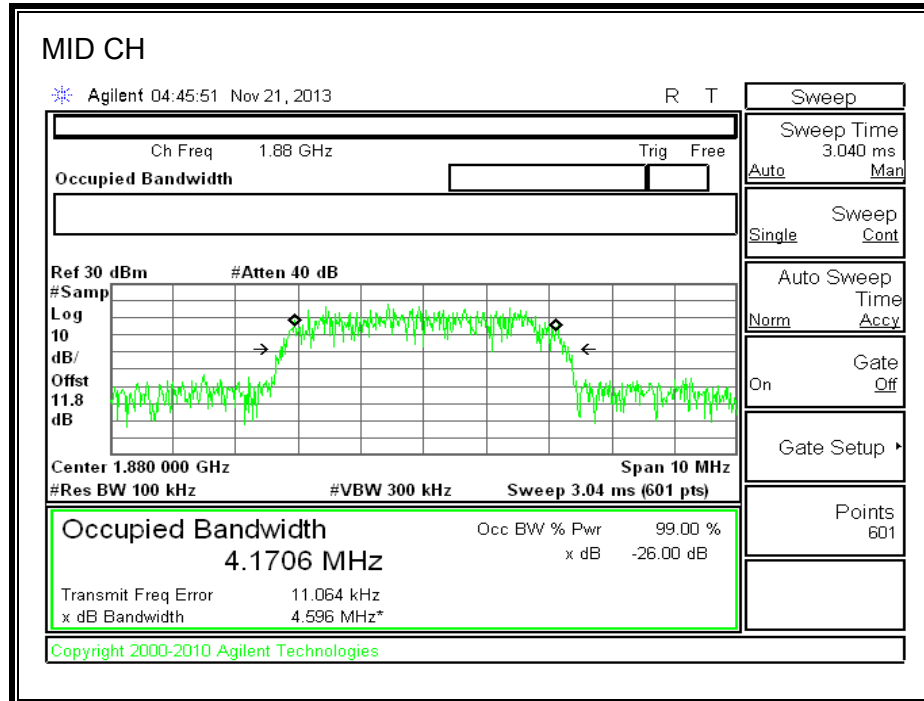
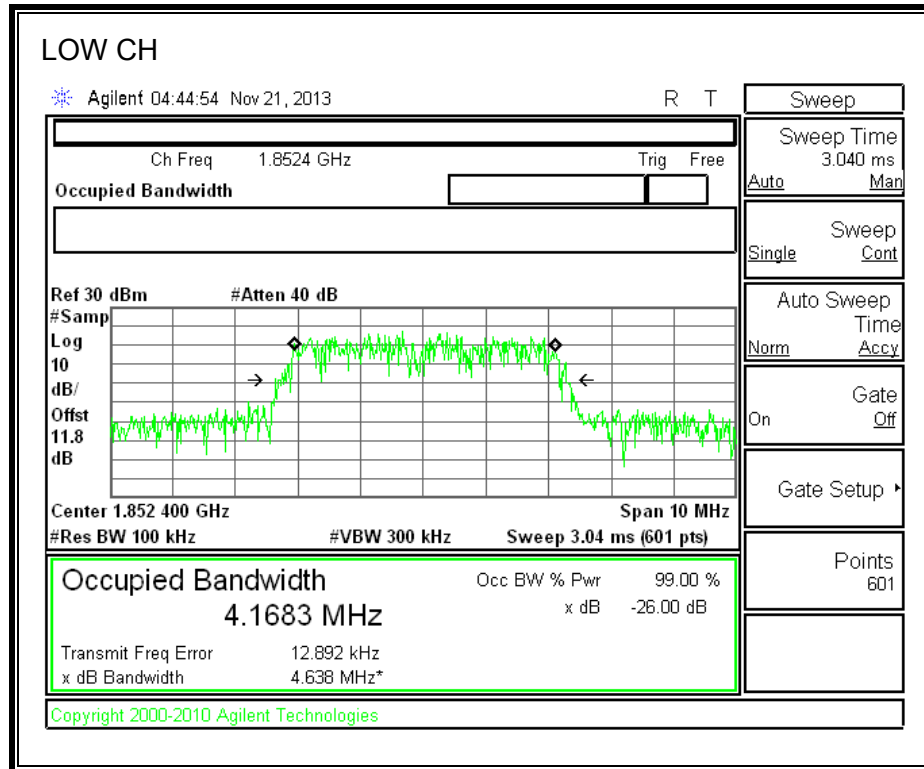
**WCDMA850**

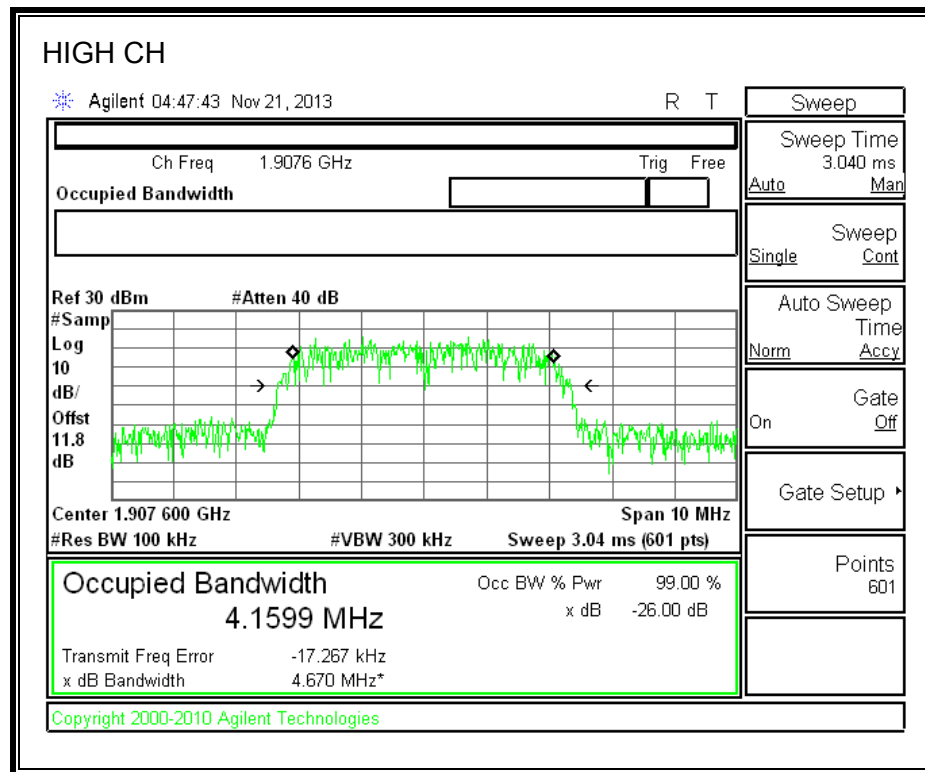
**Rel 99 (Cellular Band)**





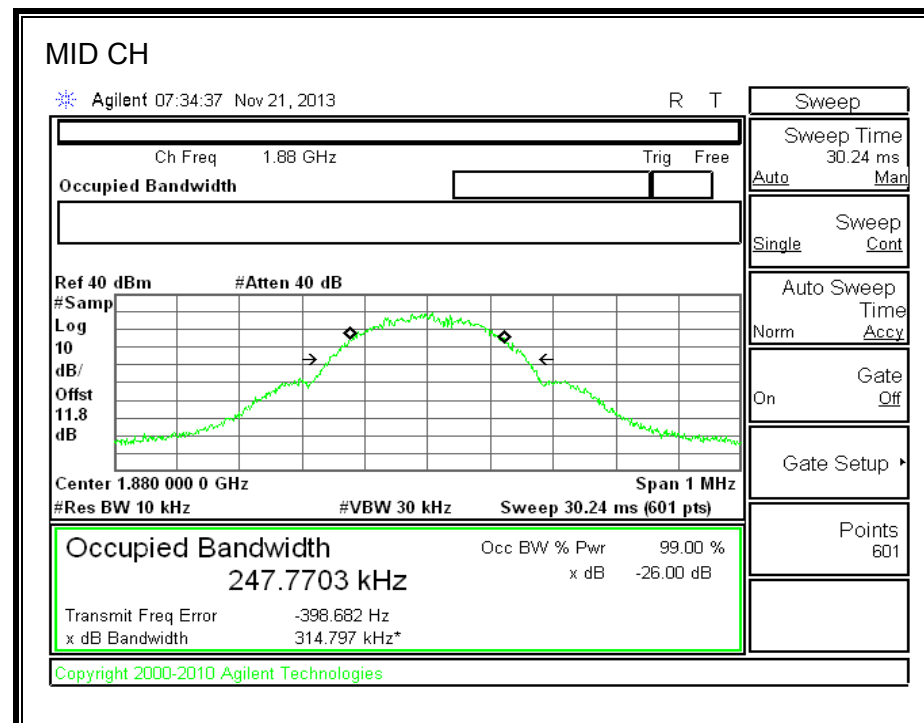
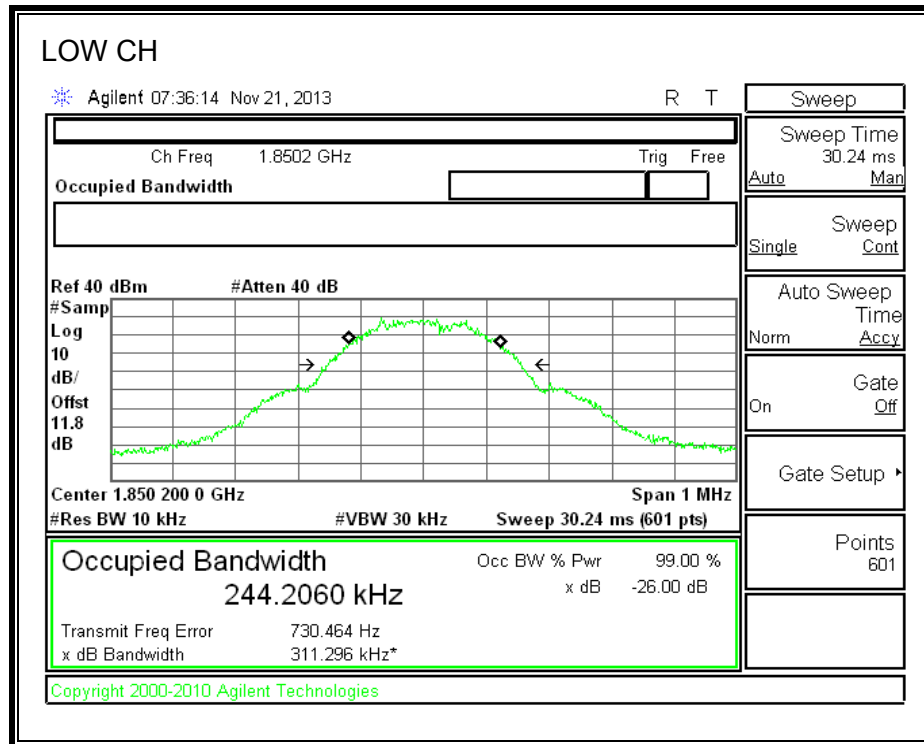
**HSDPA (Cellular Band)**

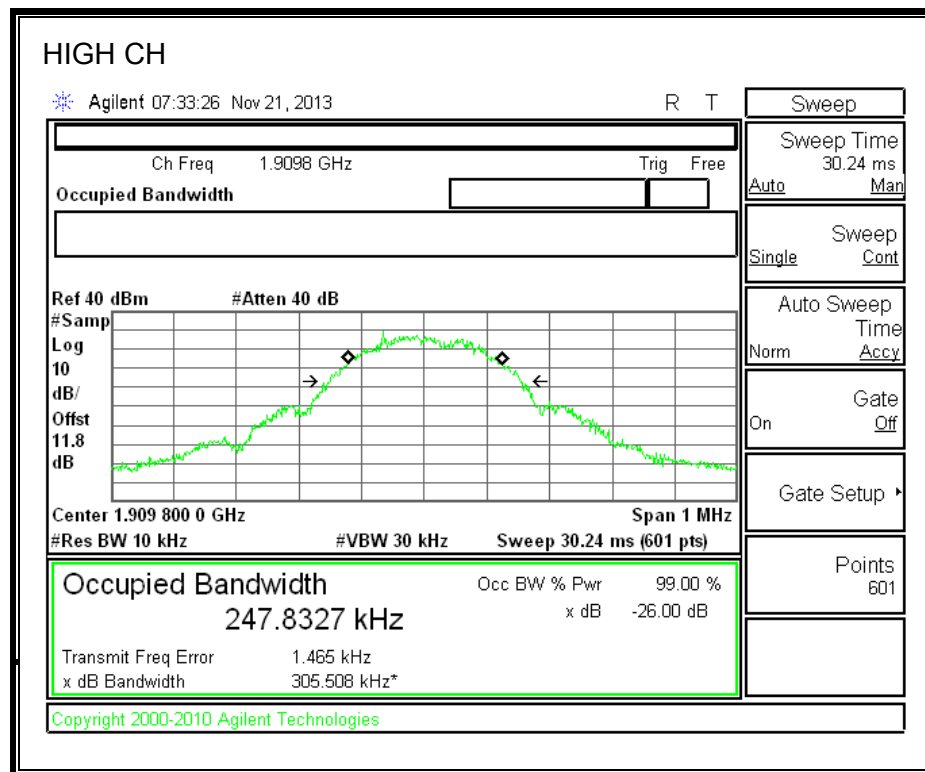




**GPRS 1900**

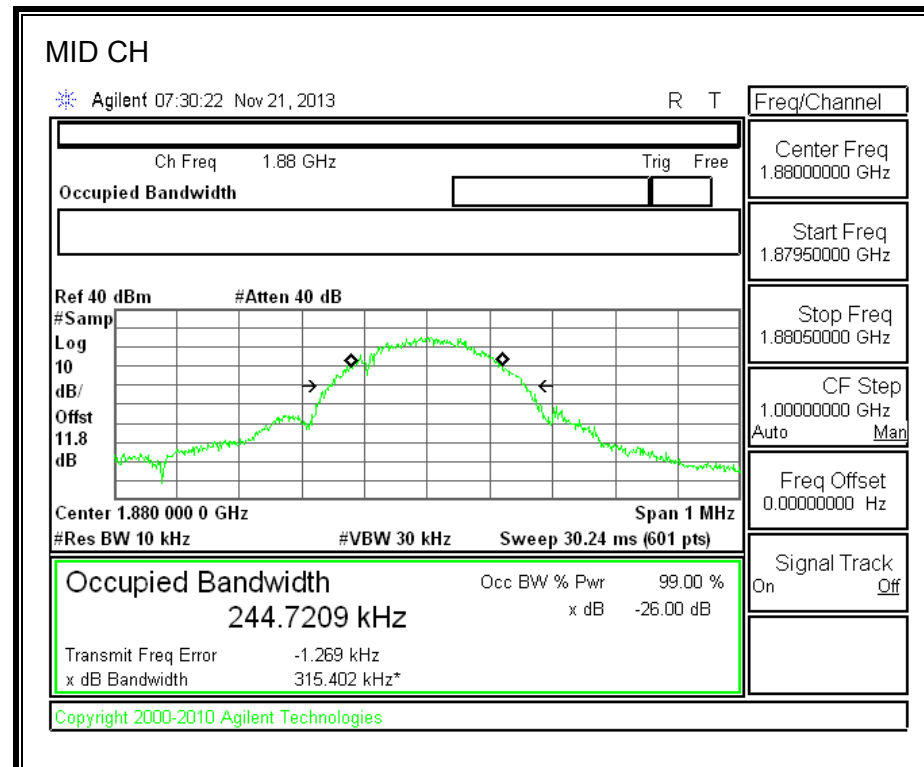
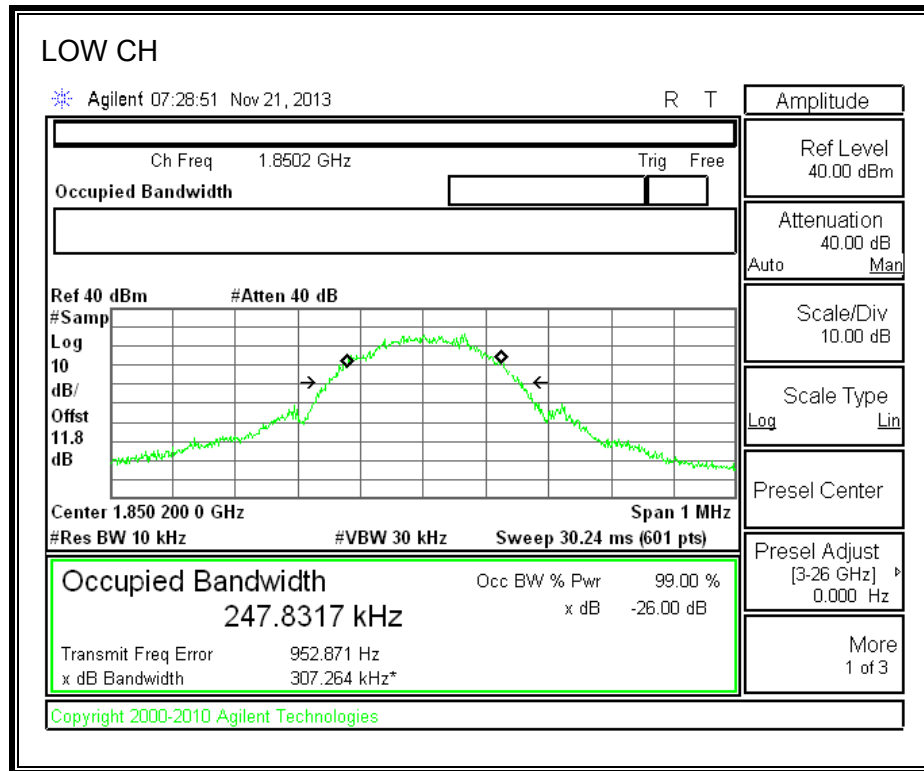
**PCS 1900 Band**

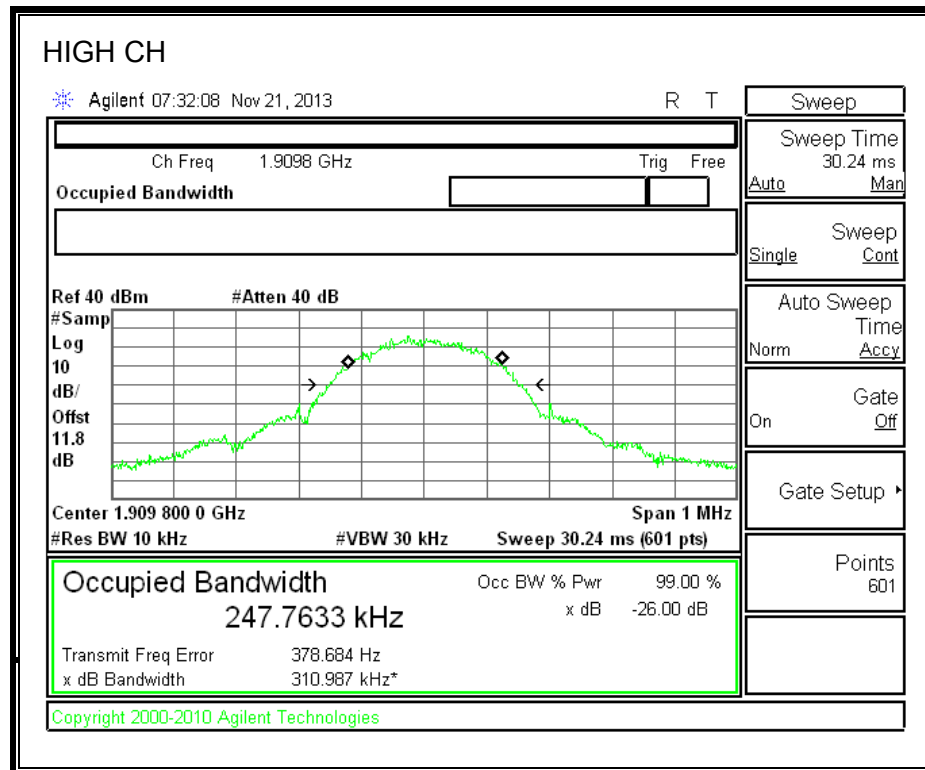






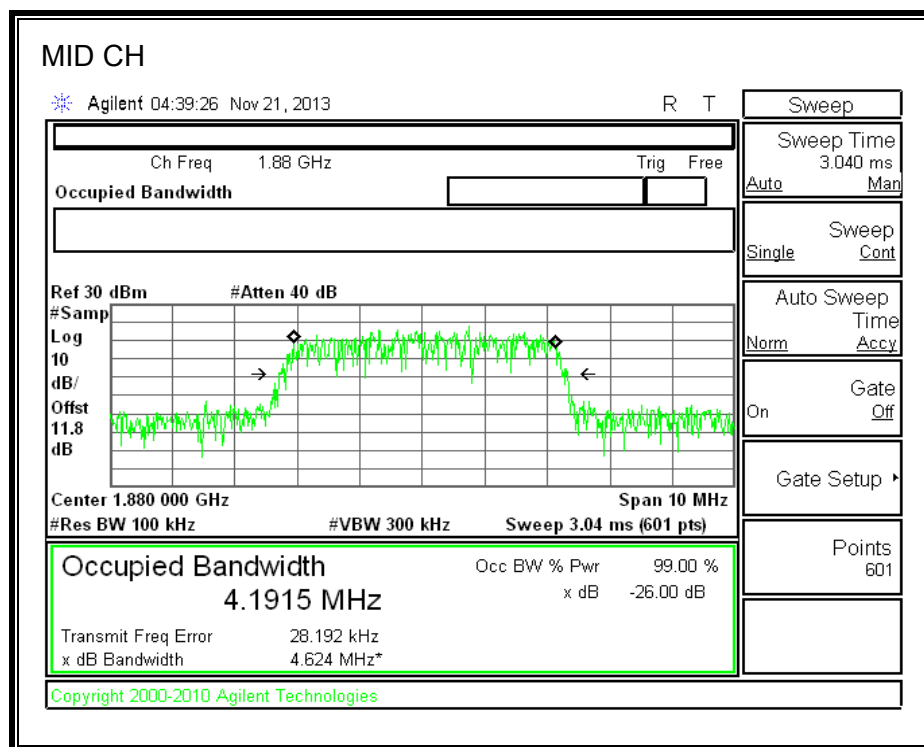
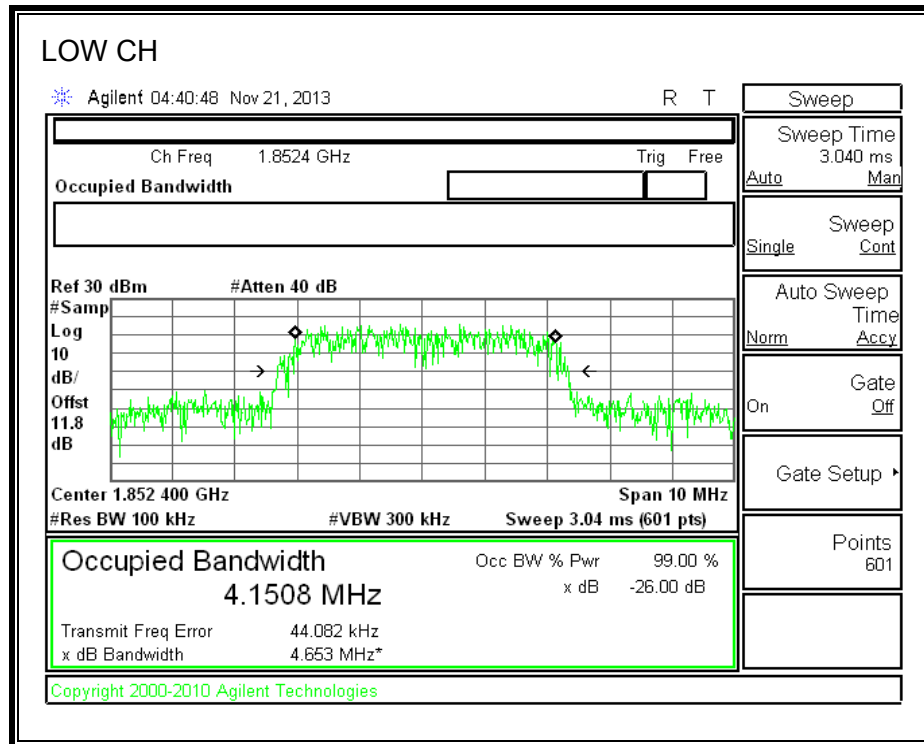
**EGPRS 1900**

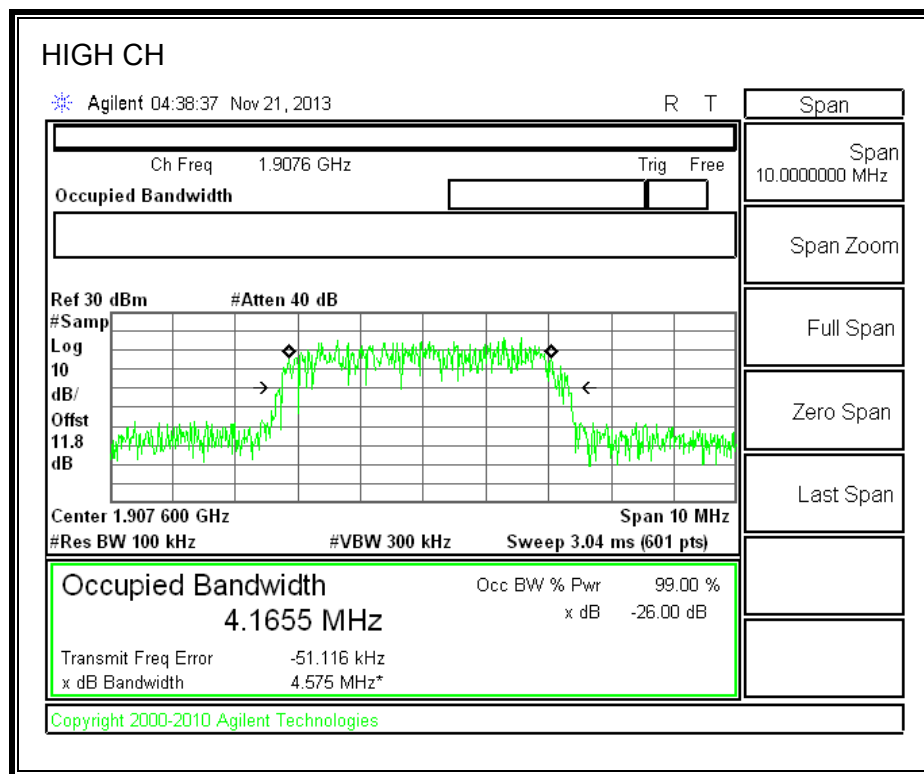




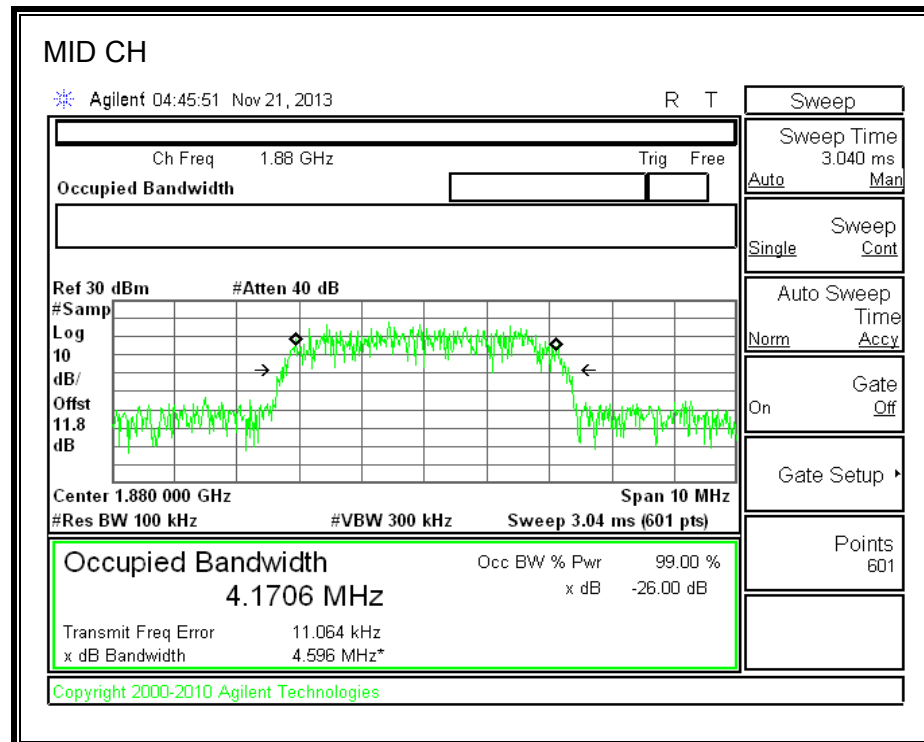
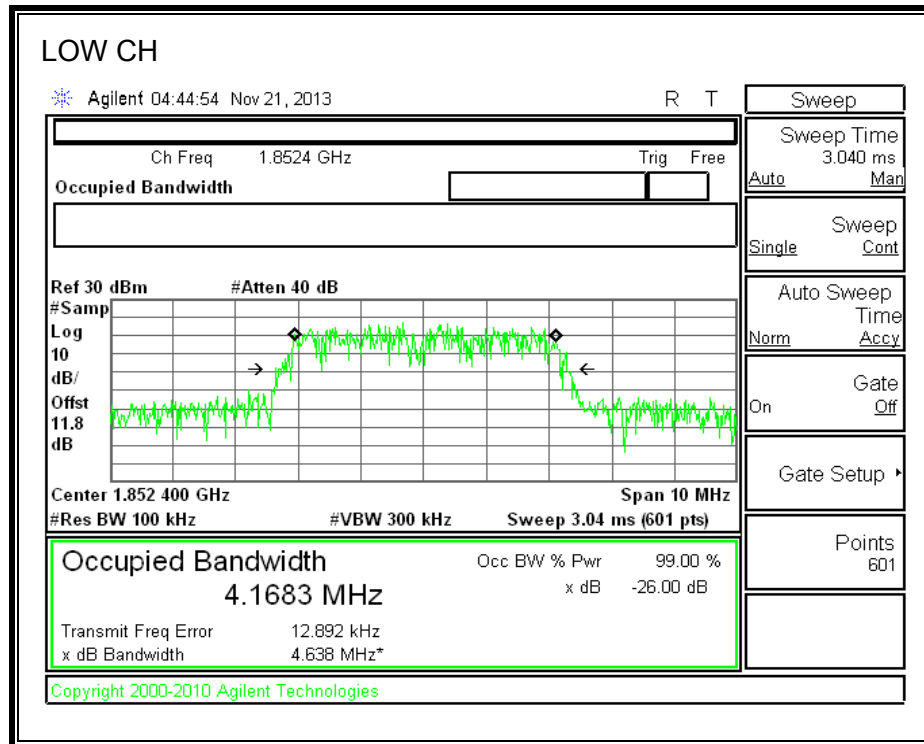
**WCDMA1900**

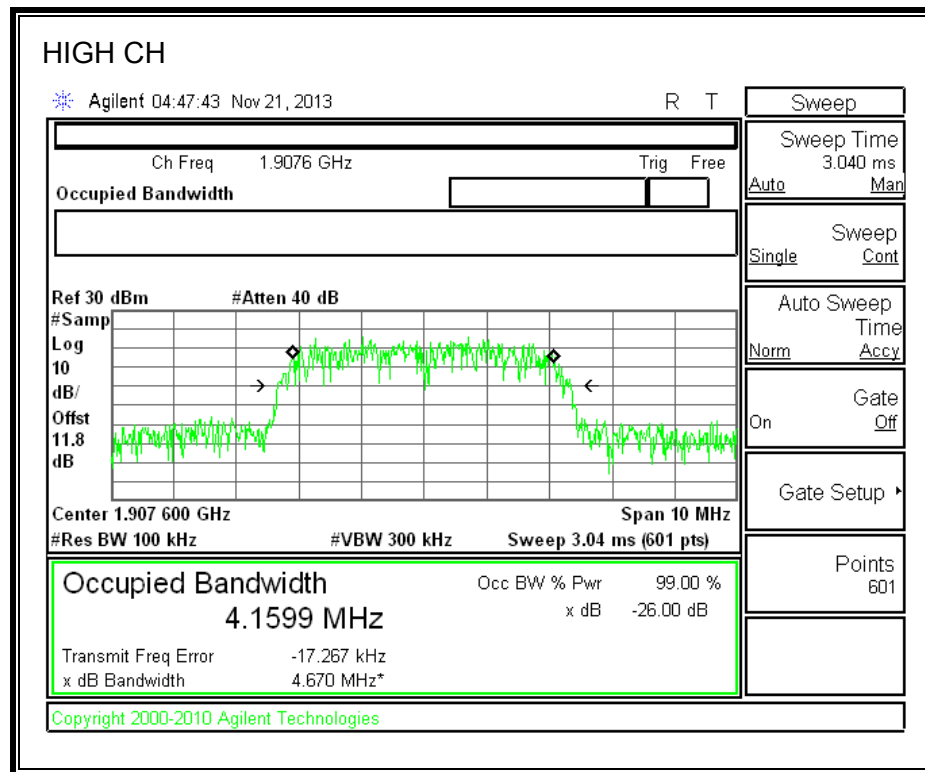
**REL 99 (PCS Band)**





**HSDPA Mode (PCS Band)**





## **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.
- .

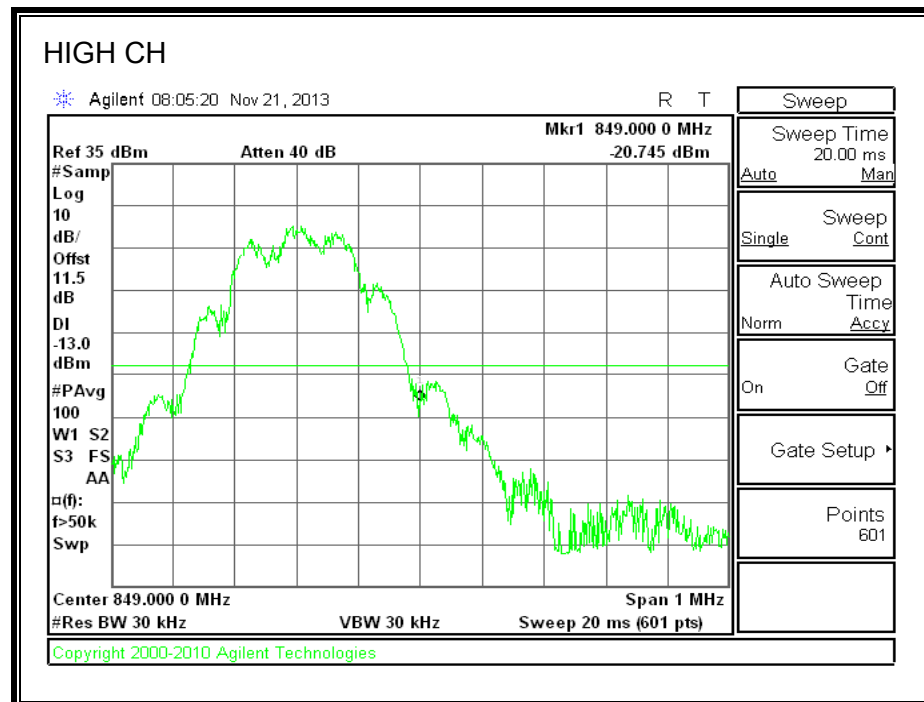
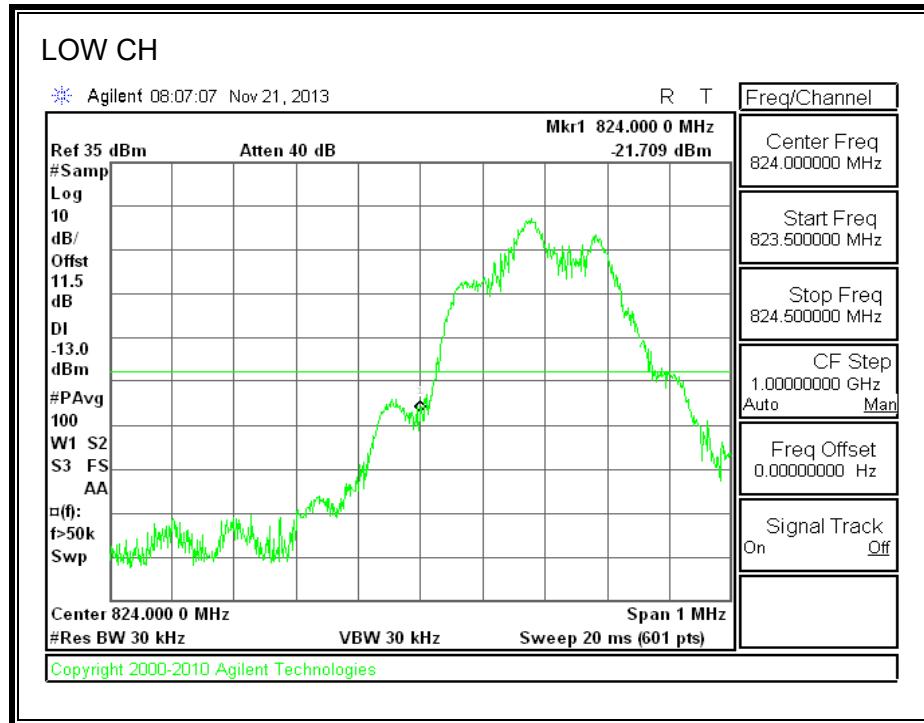
### **MODES TESTED**

- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

### **RESULTS**

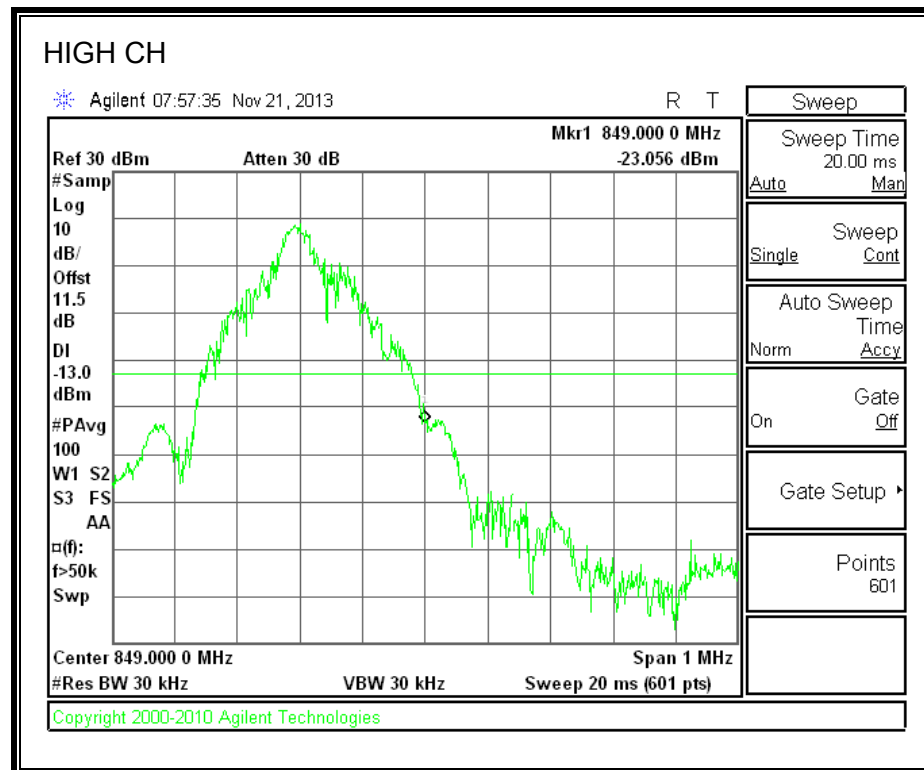
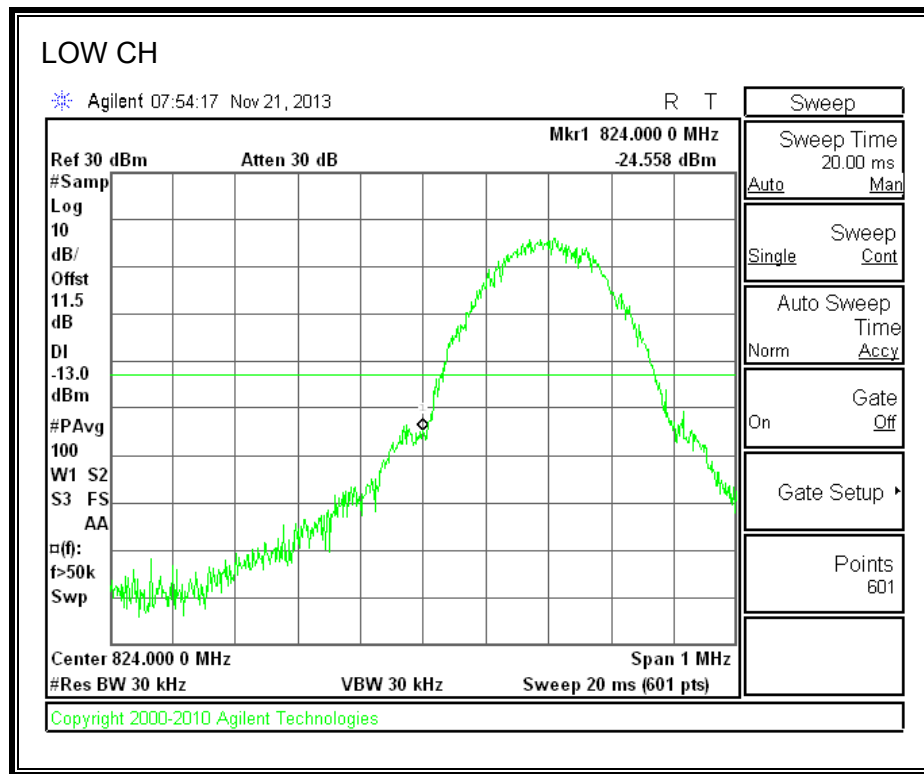
**GPRS850**

**CELL BAND**



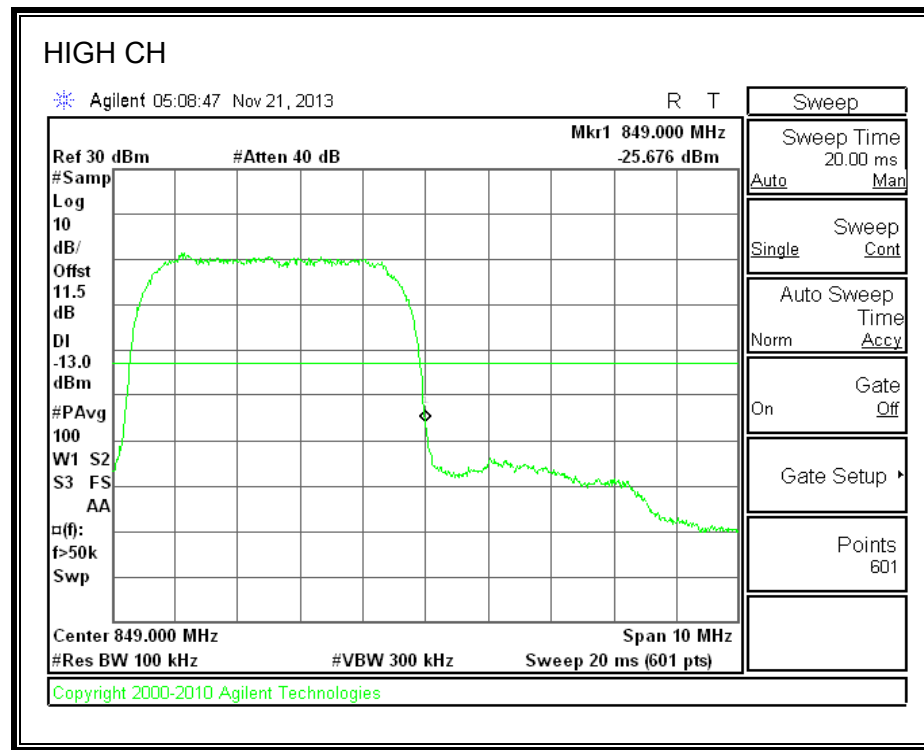
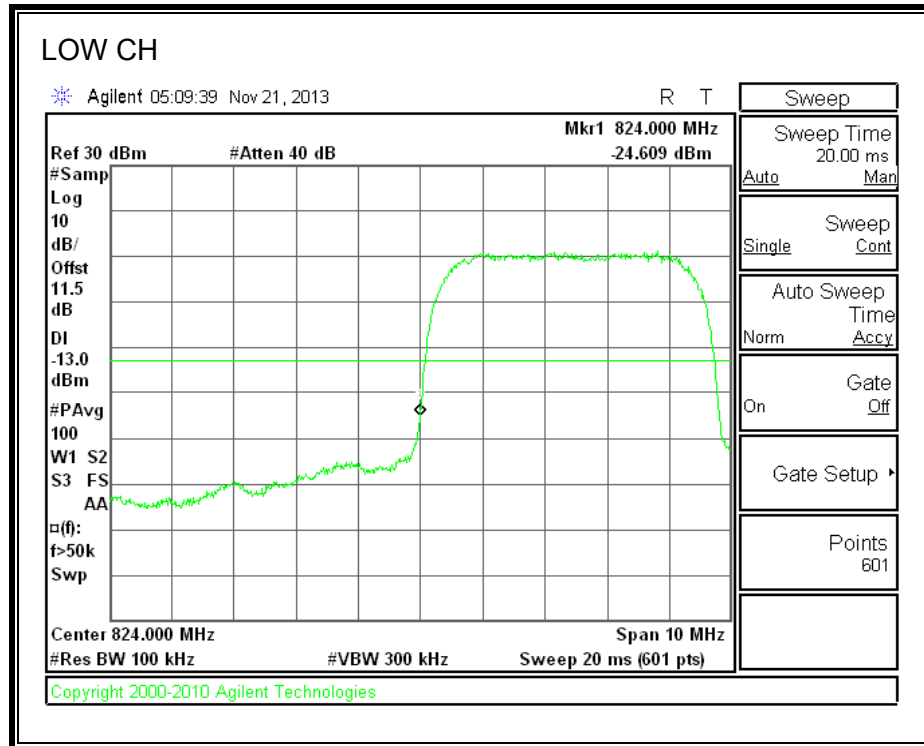


**EGPRS850**

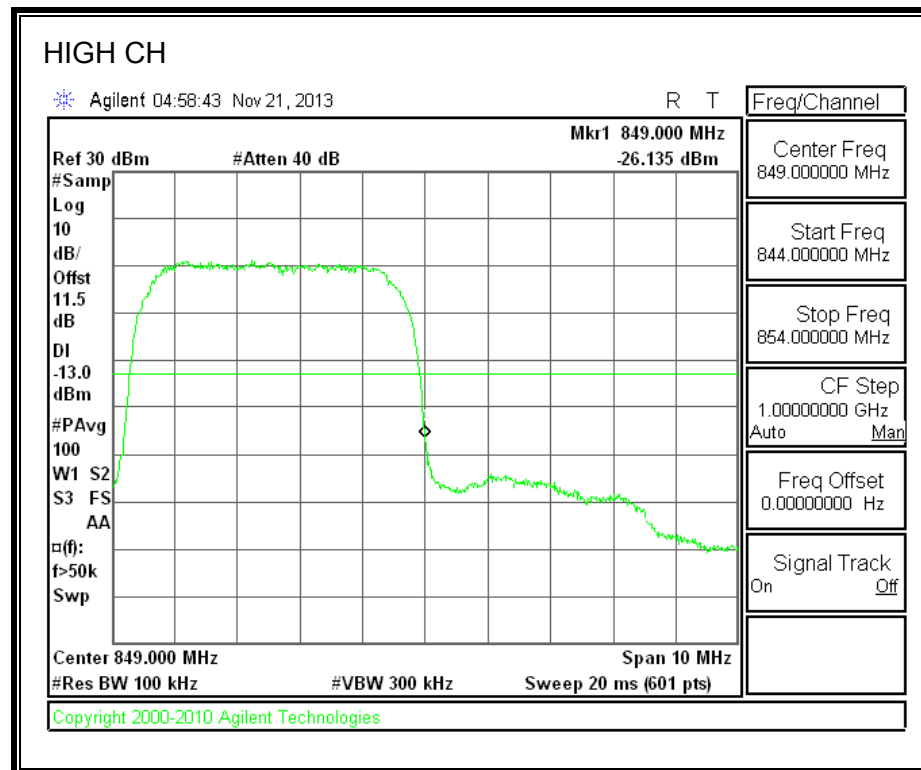
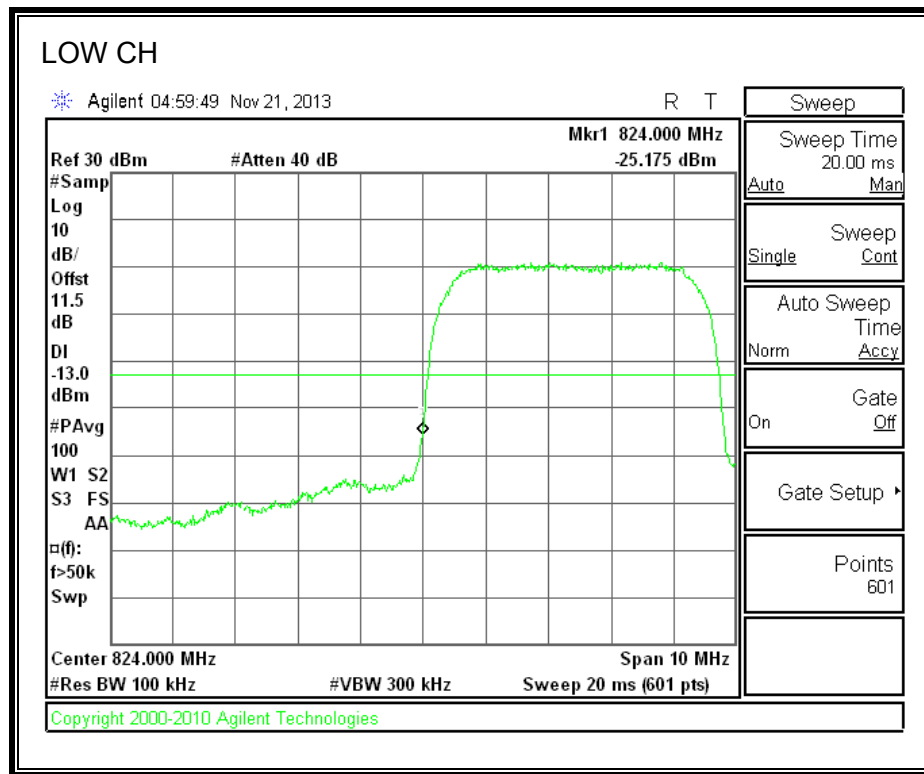


**UMTS850**

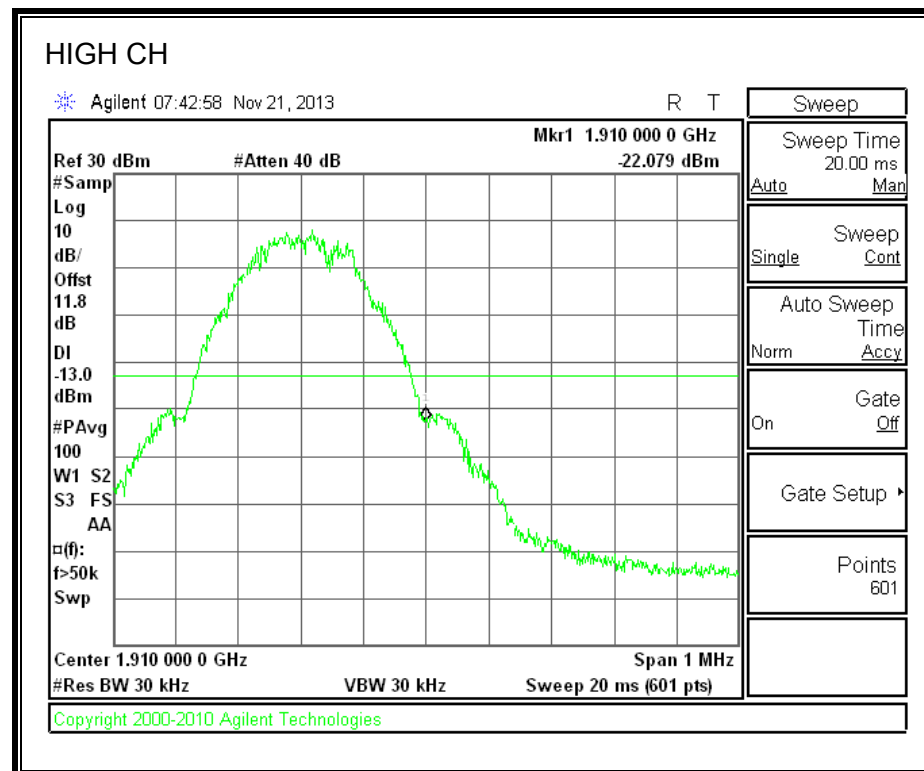
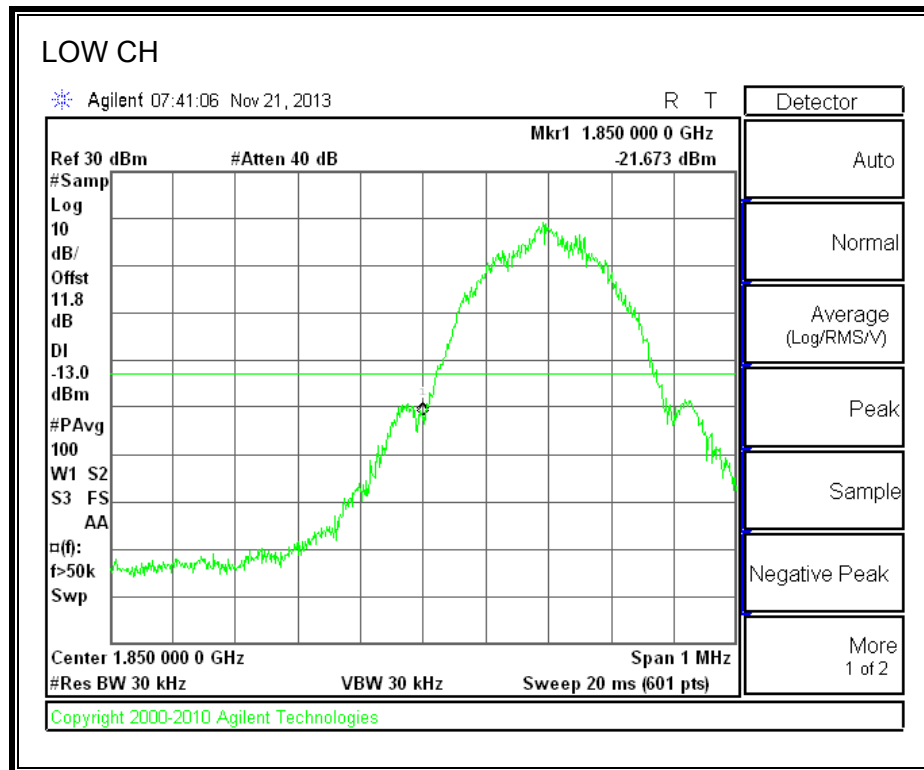
**REL99 (Cell Band)**



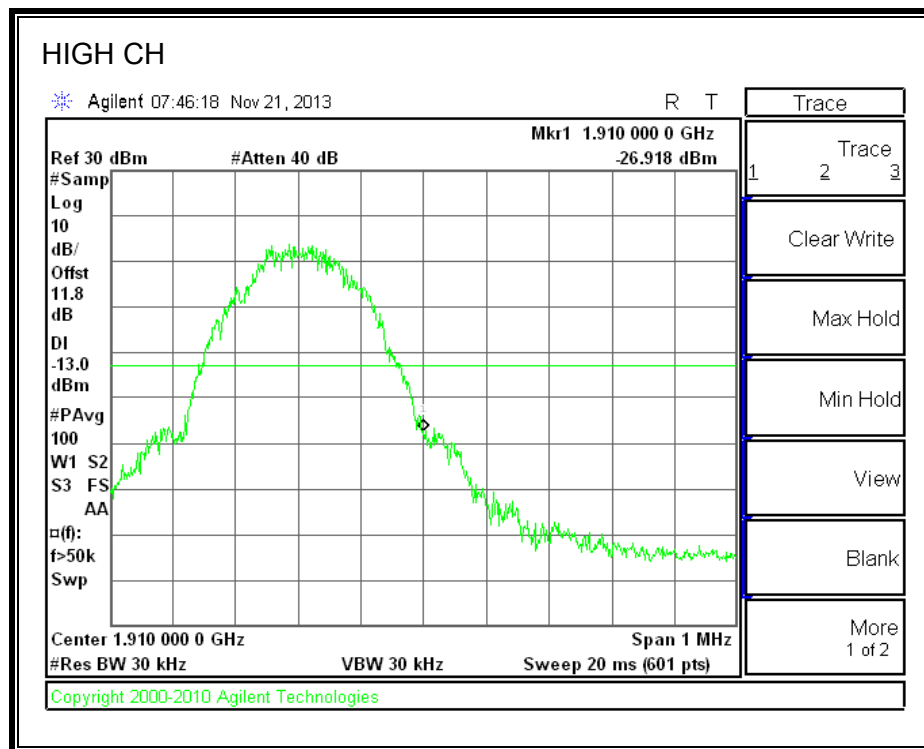
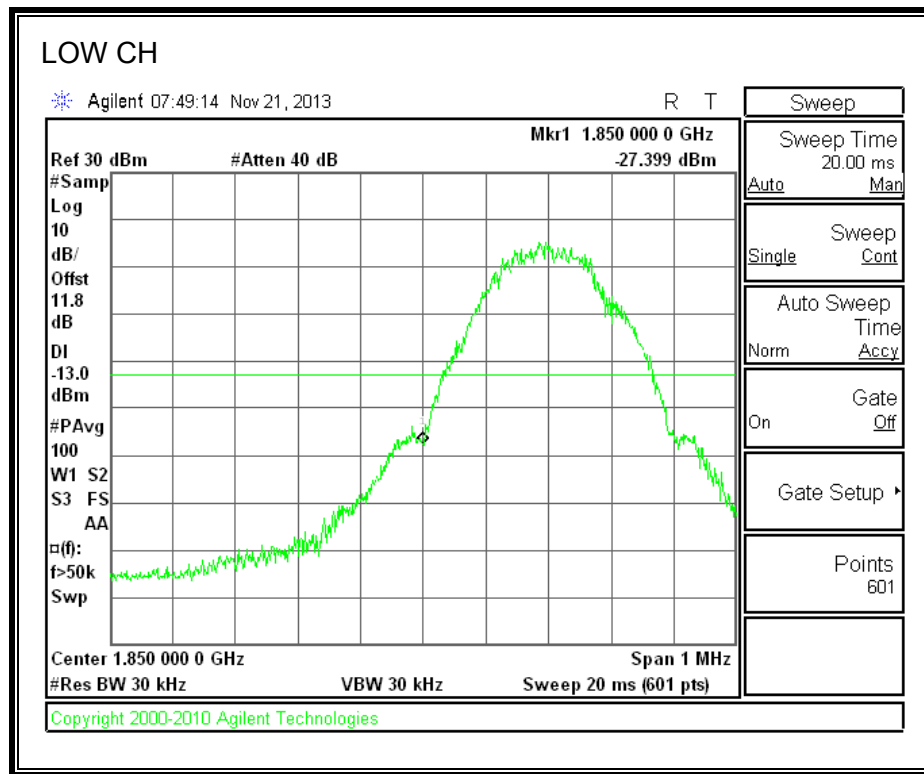
**HSDPA (Cell Band)**



**GPRS1900**

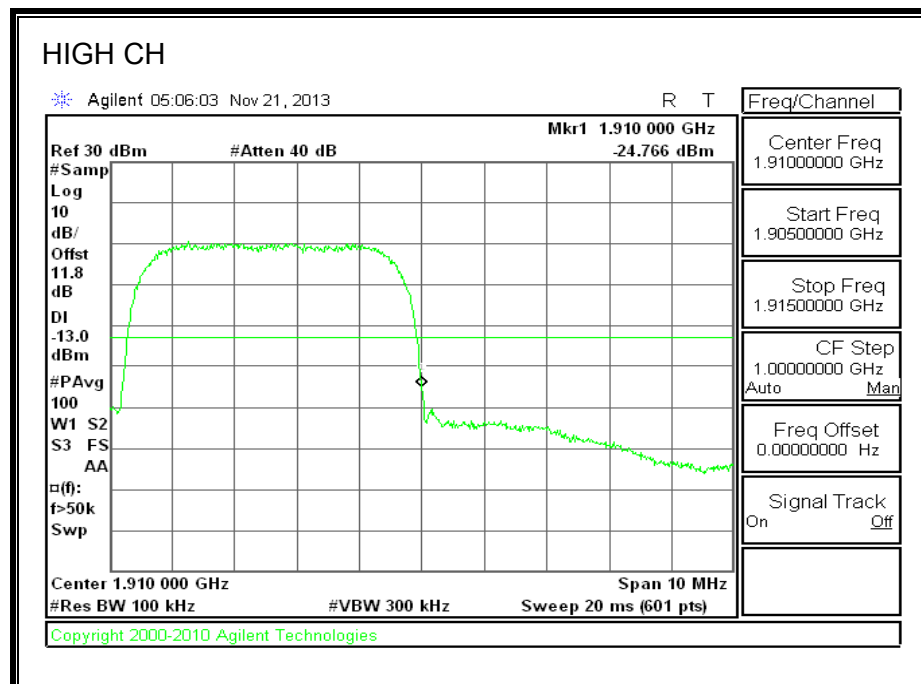
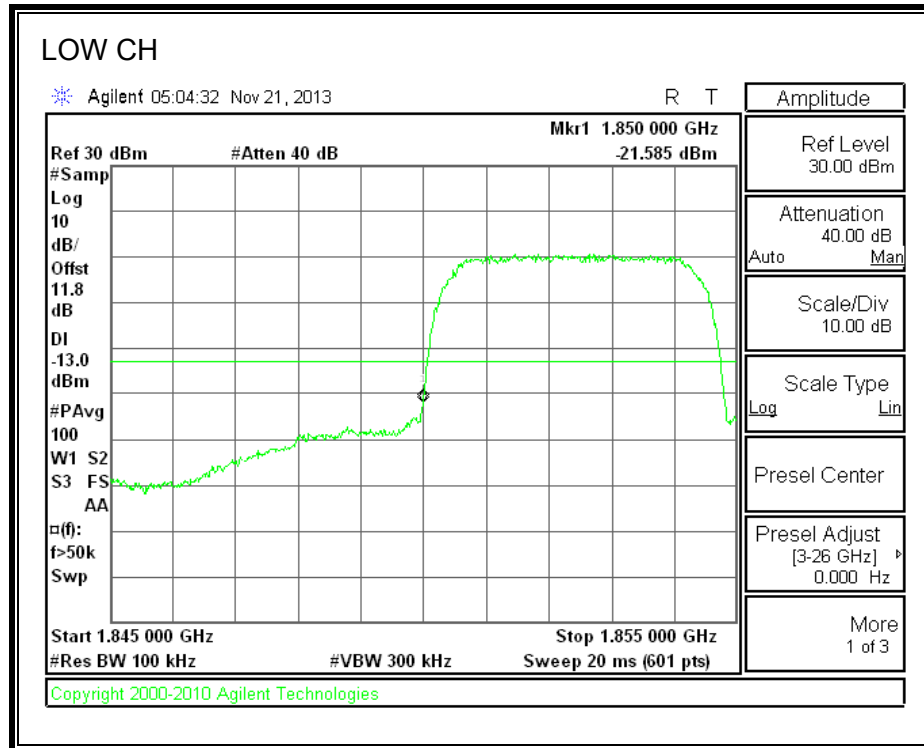


**EGPRS1900**

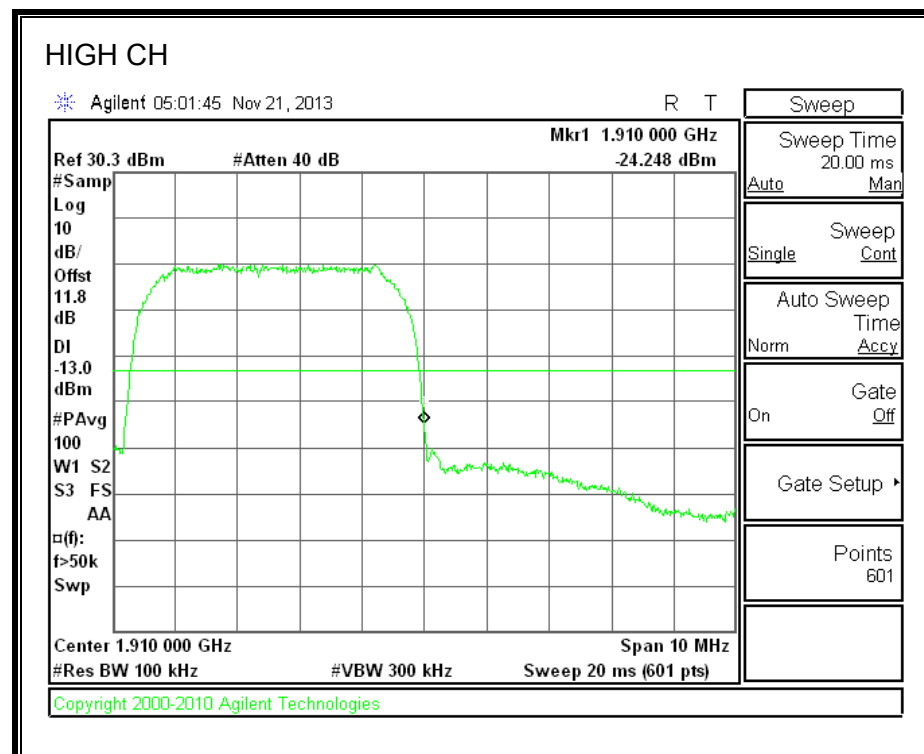
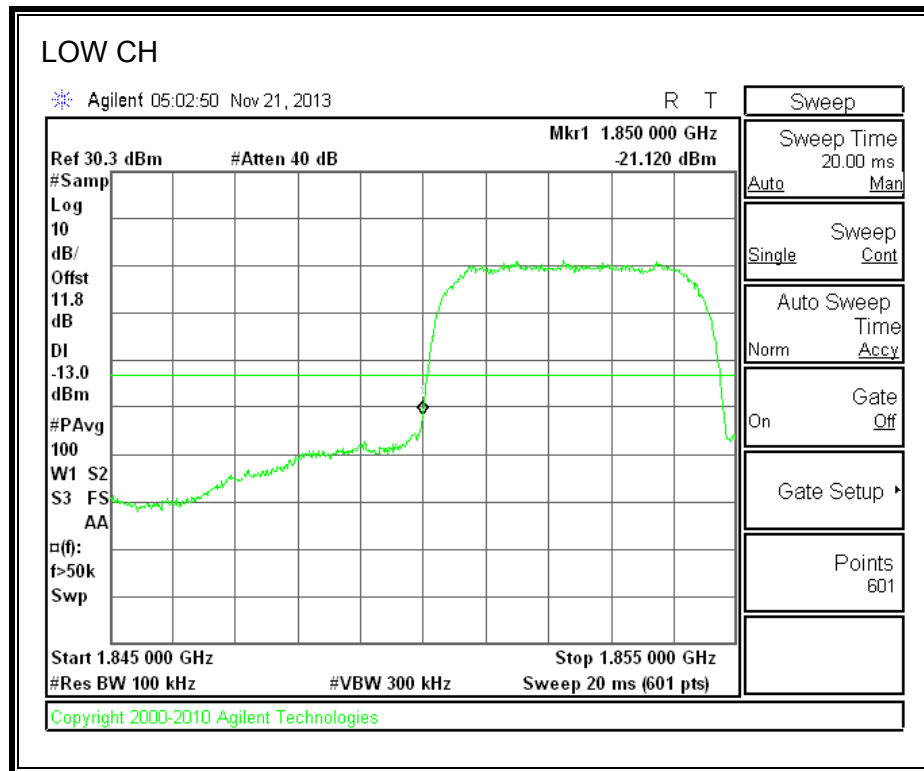


**UMTS1900**

**REL99 (PCS Band)**



**HSDPA (PCS Band)**



### **8.3. OUT OF BAND EMISSIONS**

#### **RULE PART(S)**

FCC: §2.1051, §22.901, §22.917, §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.

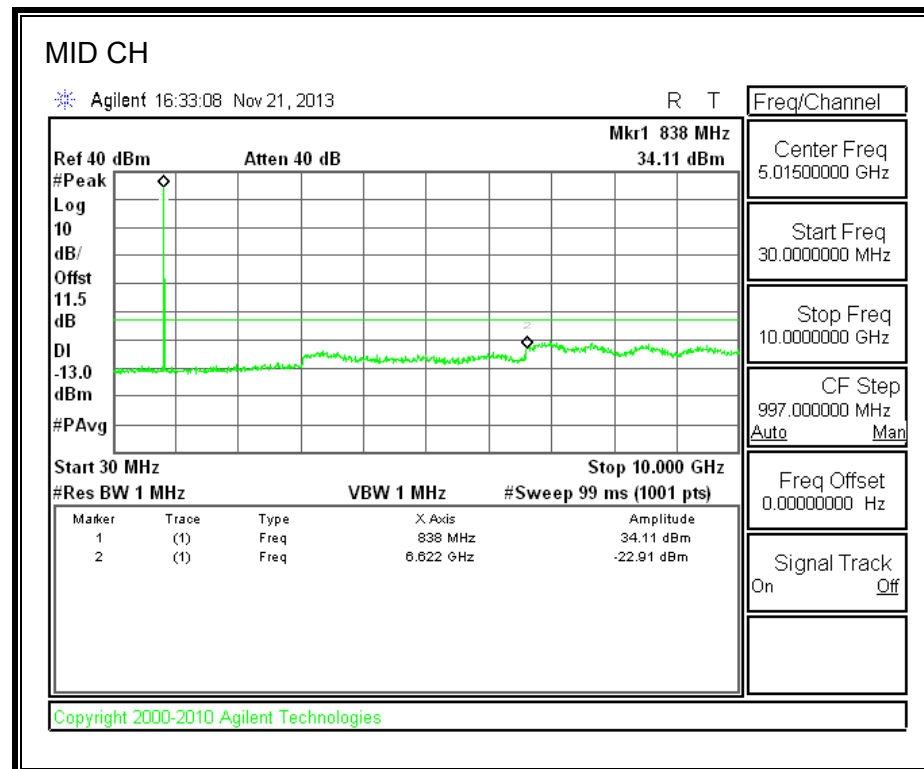
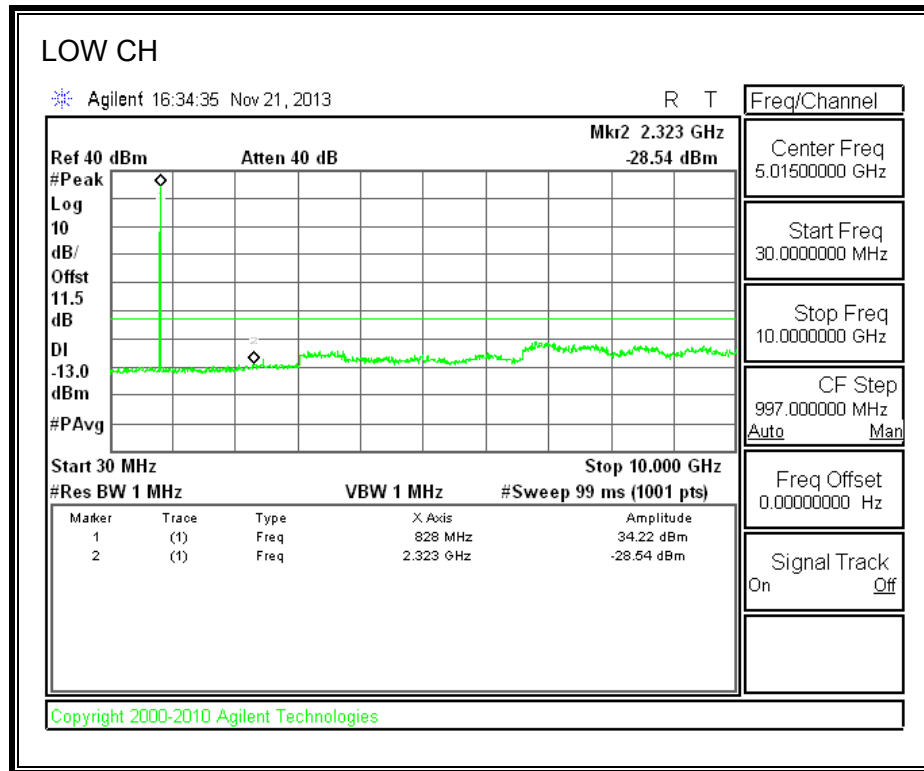
#### **MODES TESTED**

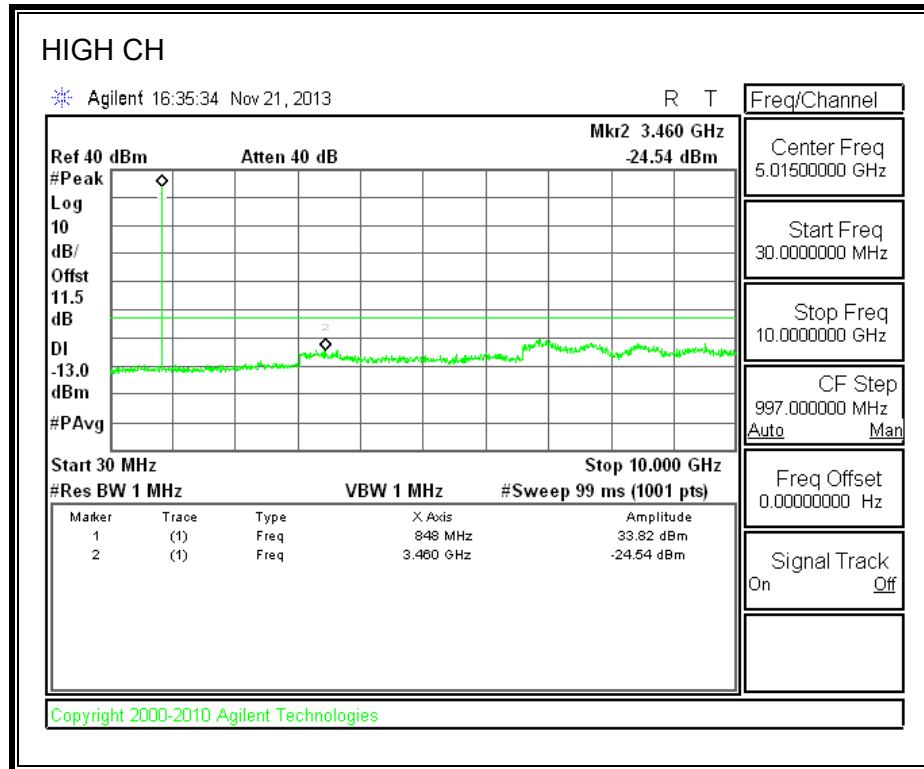
- GPRS and EGPRS
- UMTS, REL 99 and HSDPA

#### **RESULTS**

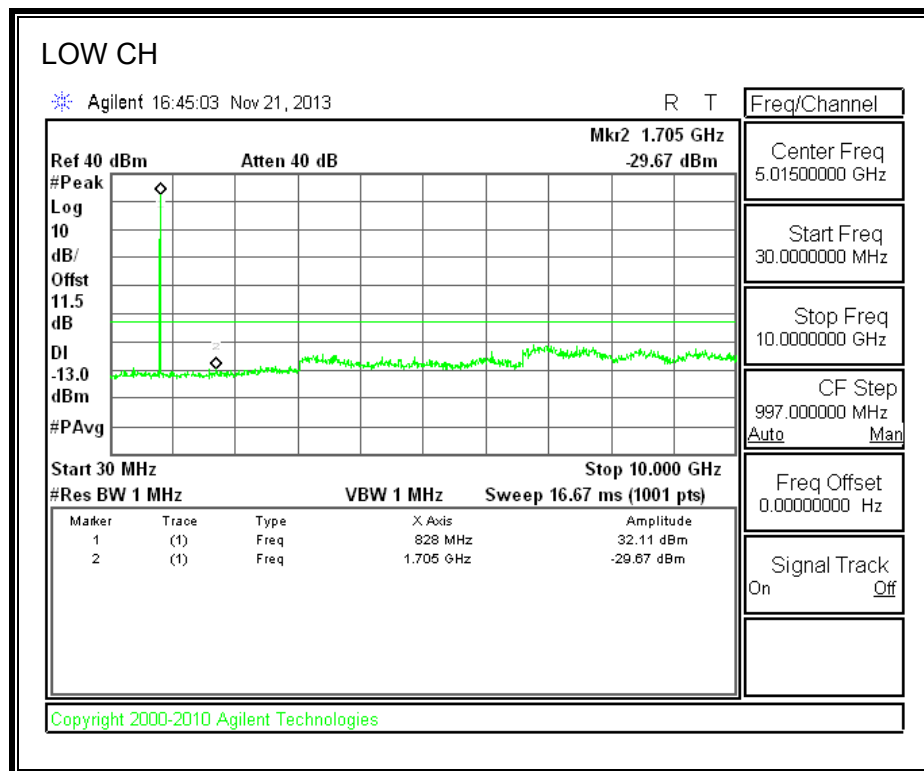


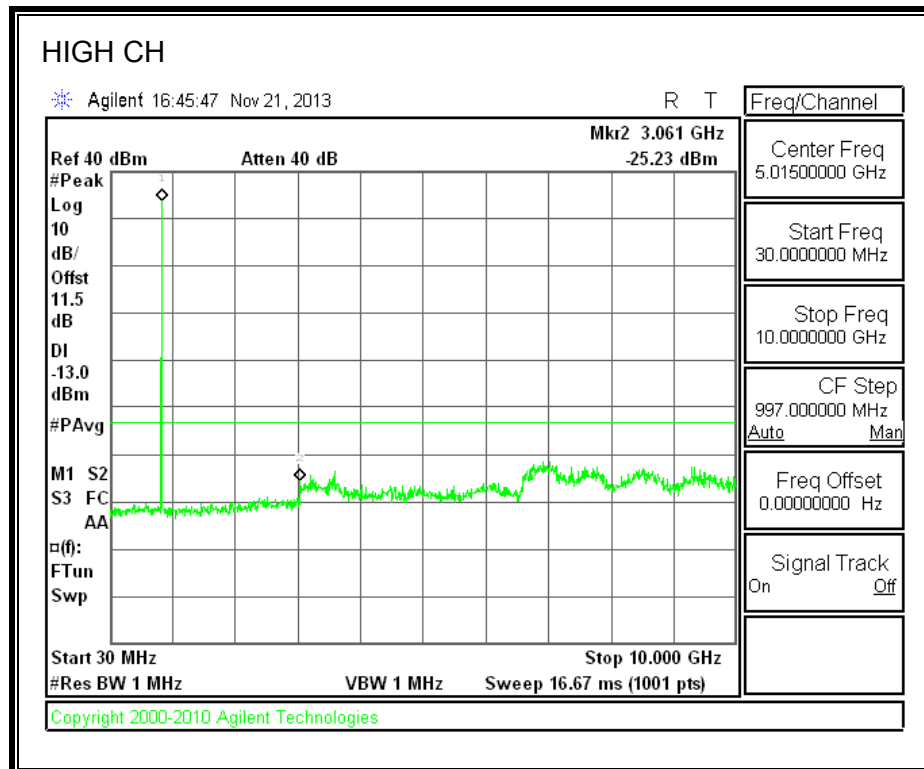
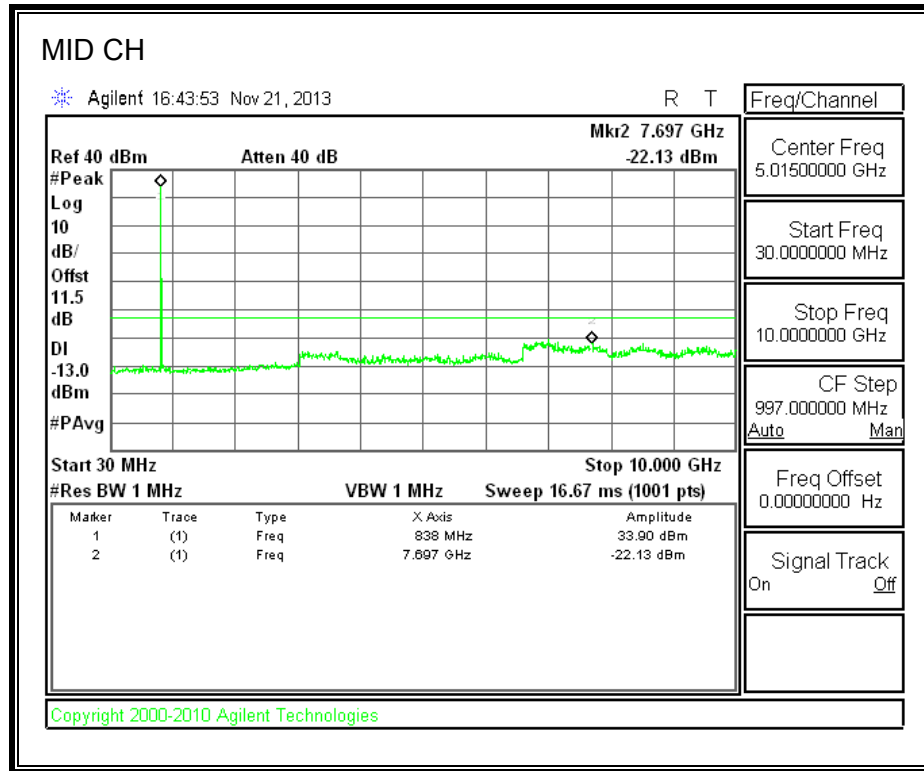
**GPRS850**





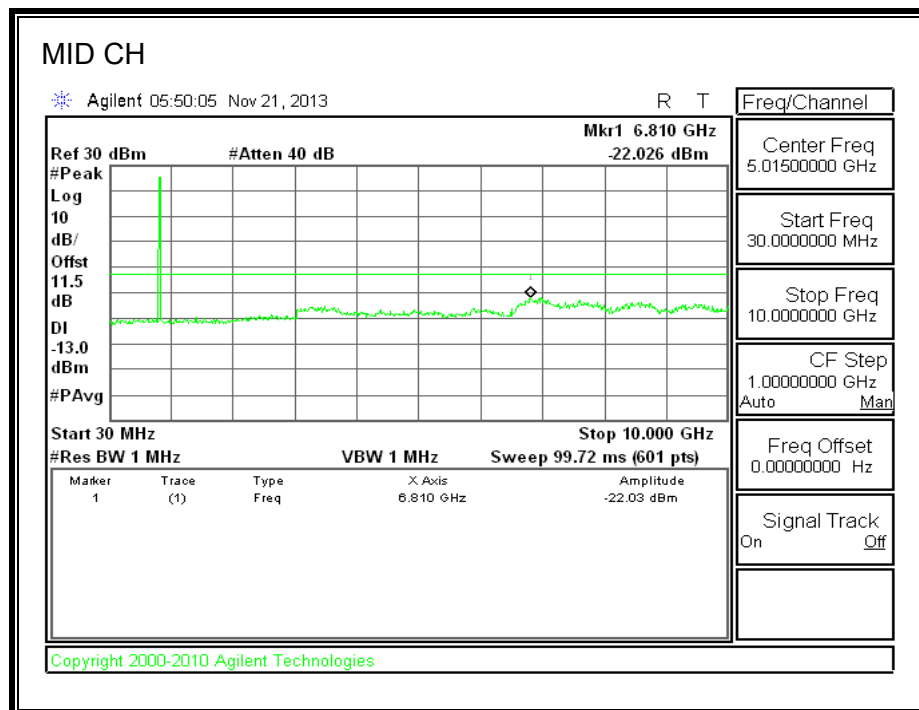
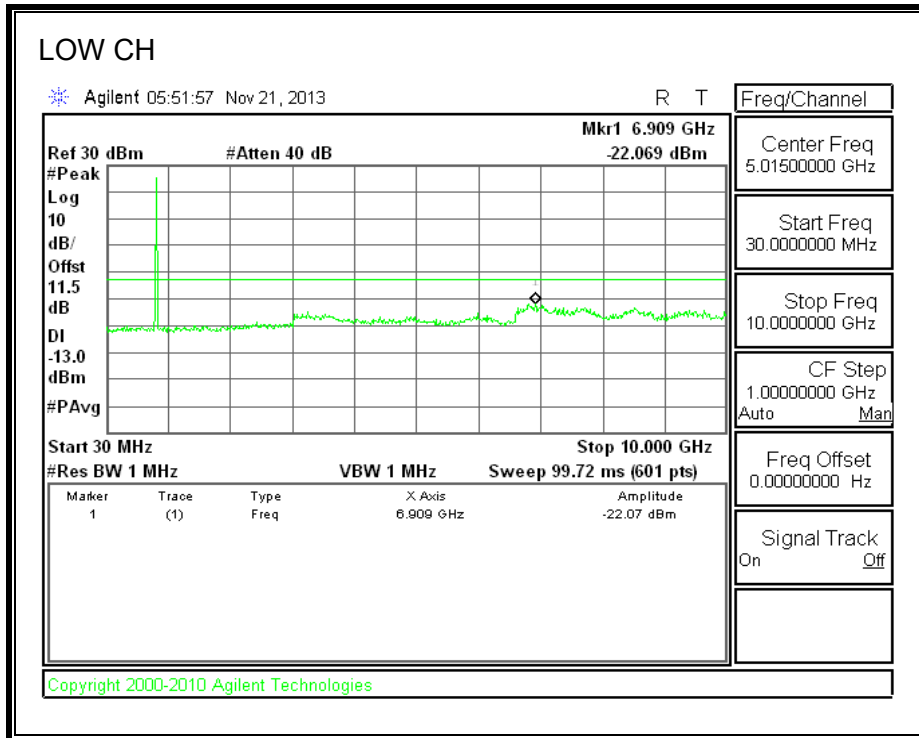
## EGPRS850

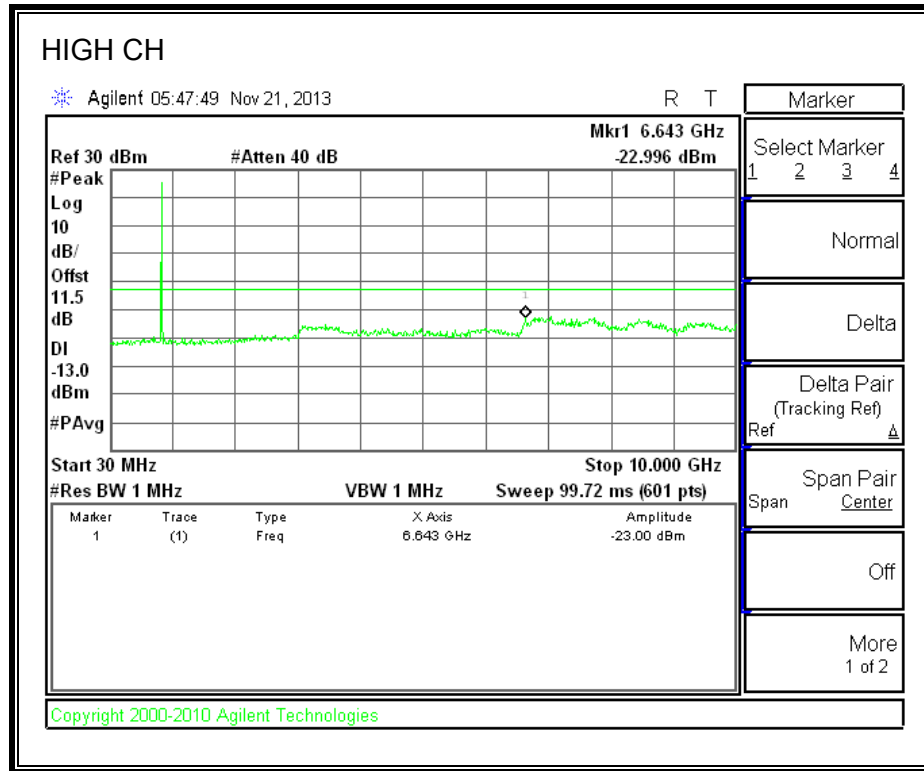




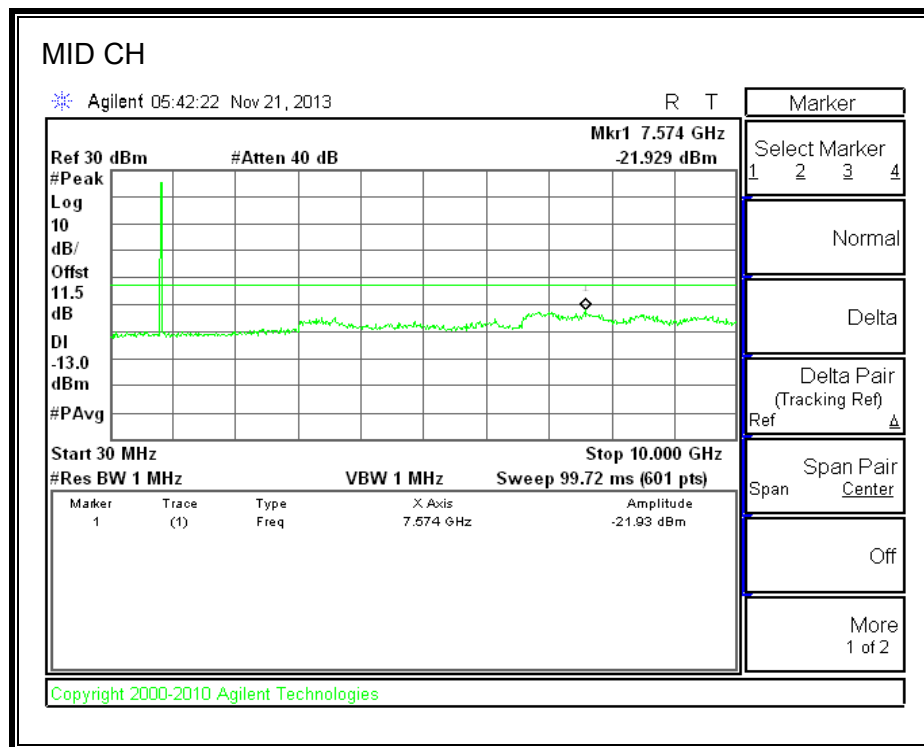
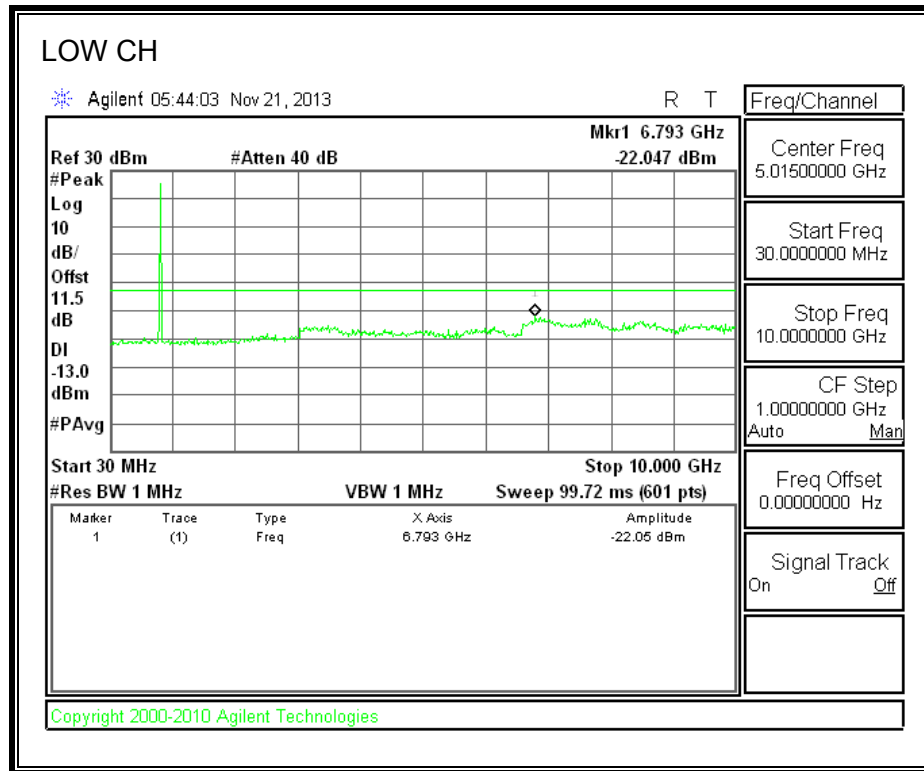
**UMTS850**

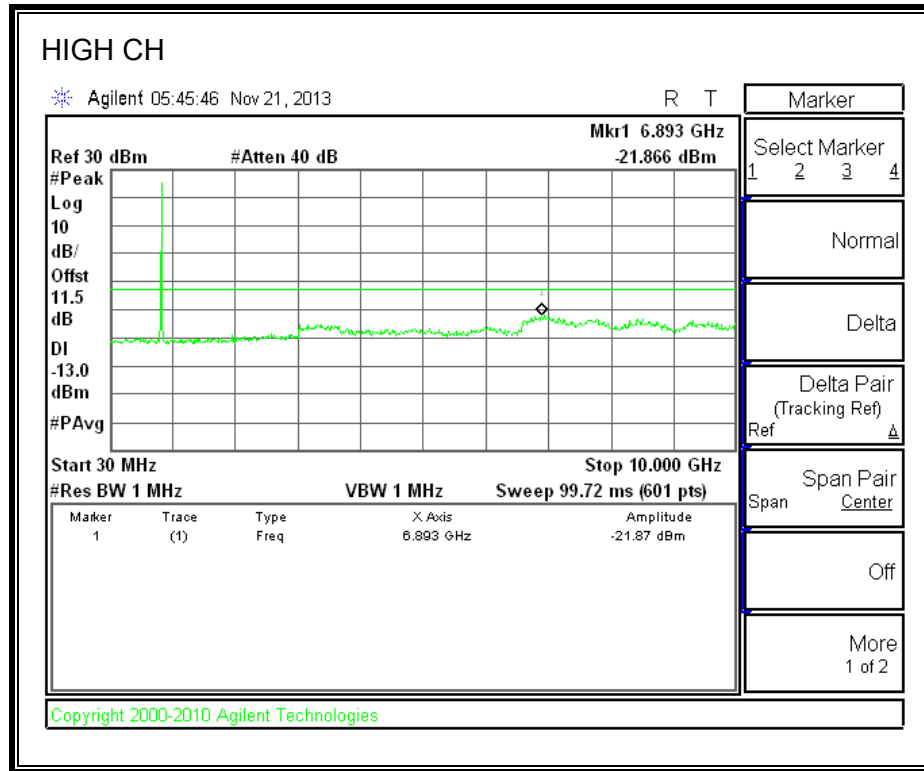
**REL 99 (Cell Band)**



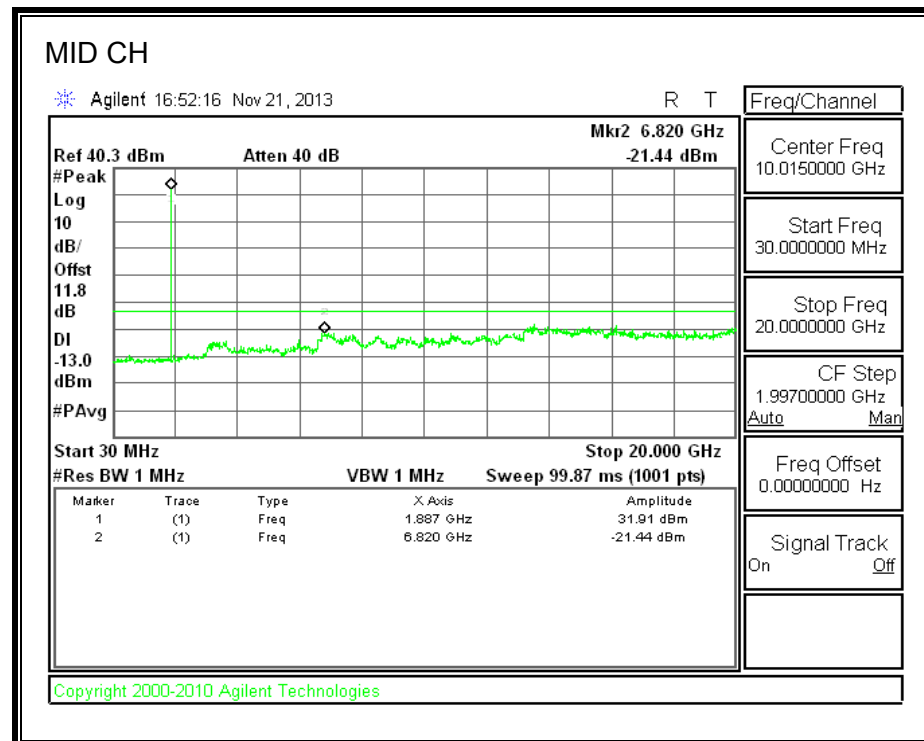
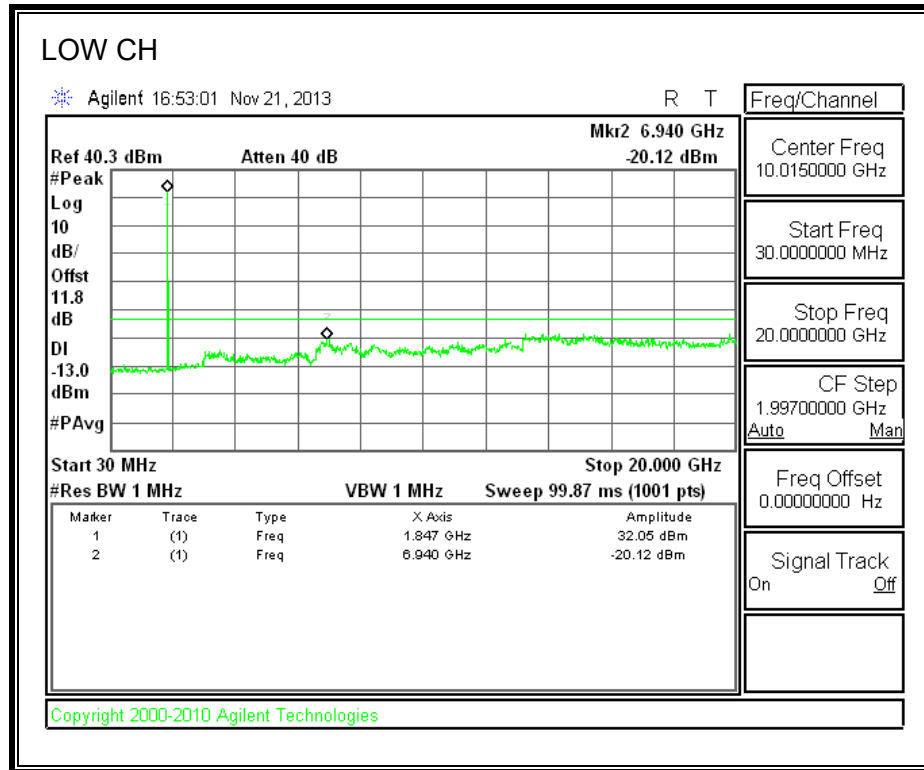


**HSDPA (Cell Band)**

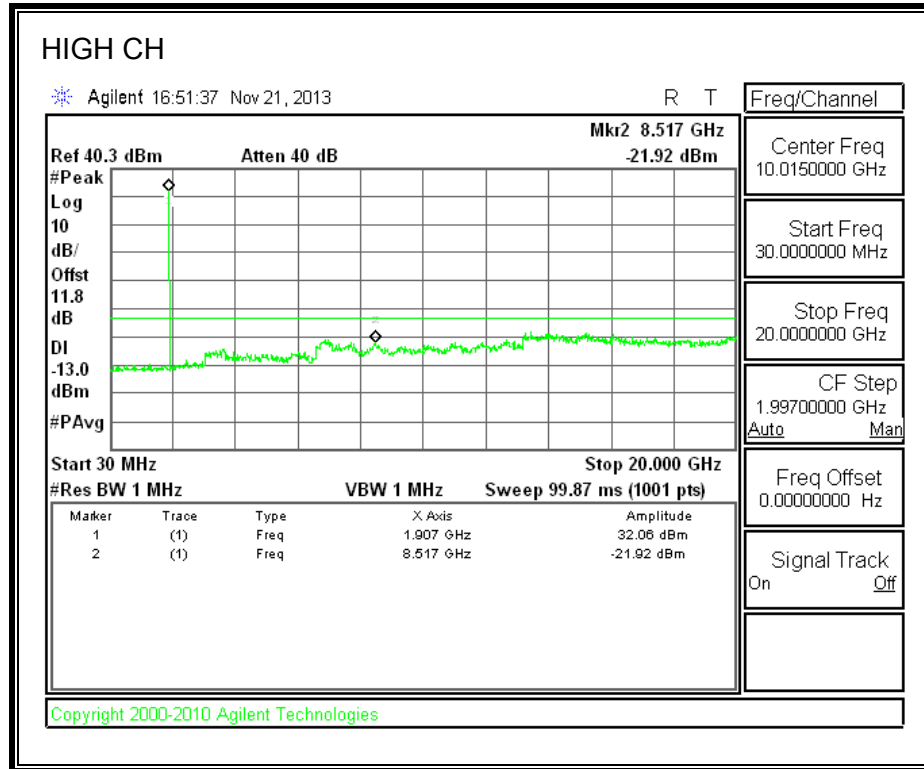




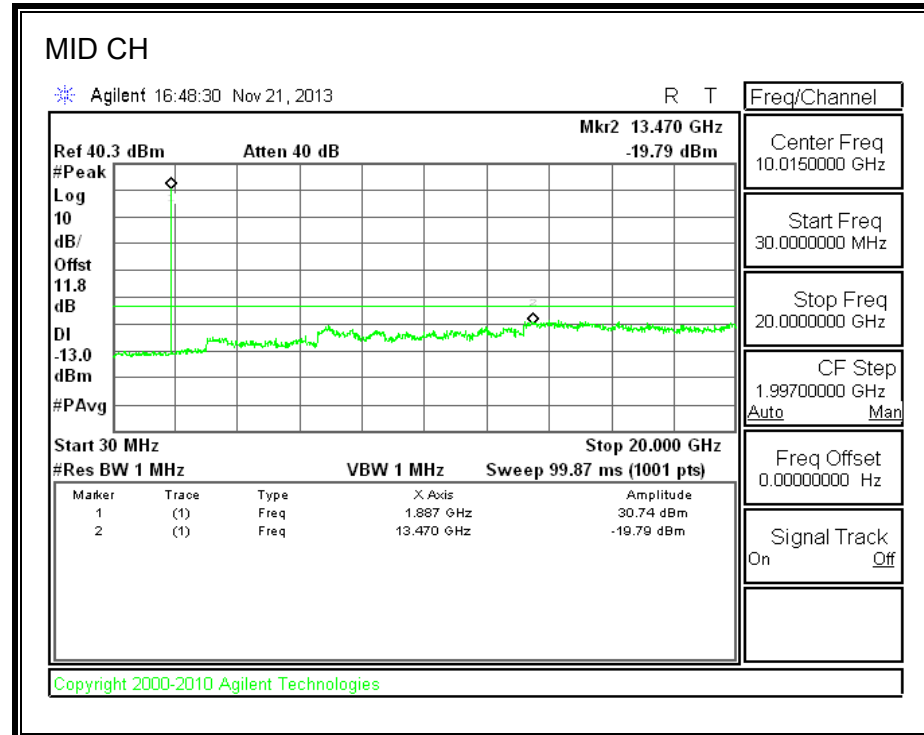
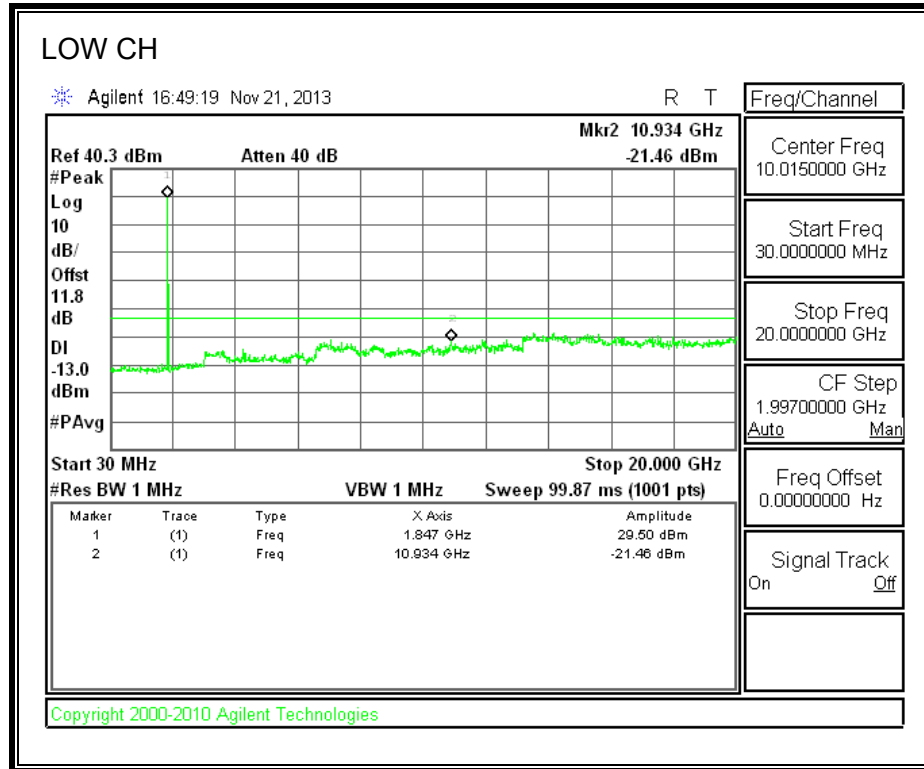
**GPRS1900**

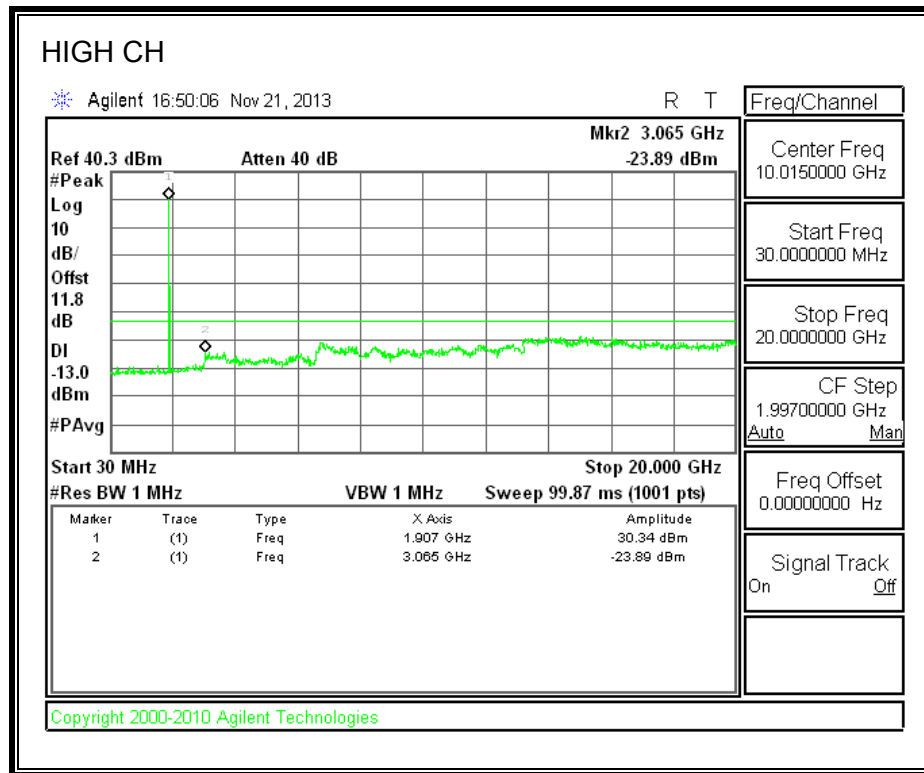






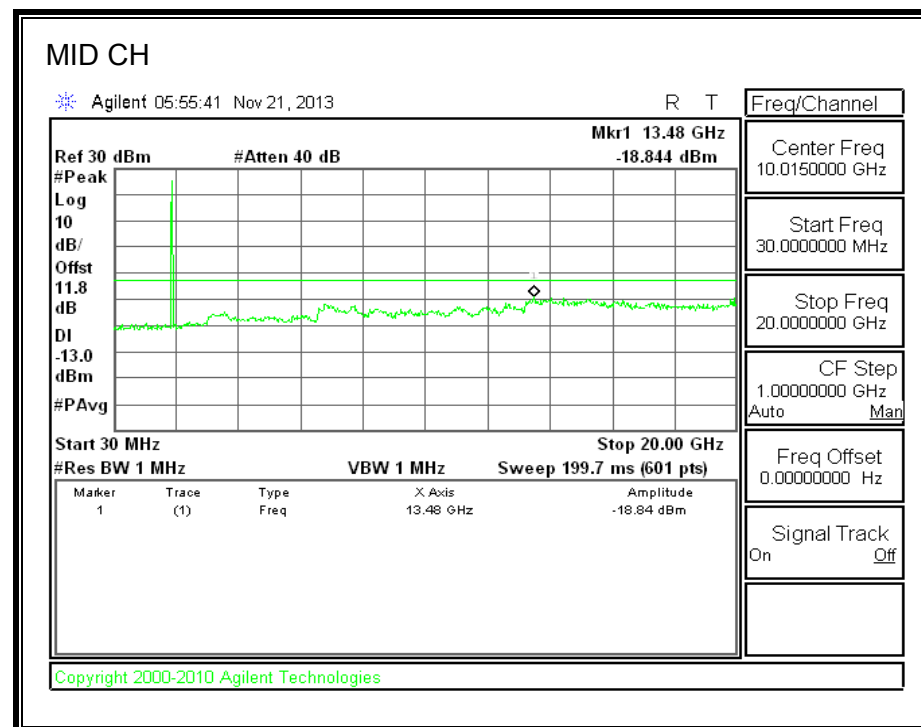
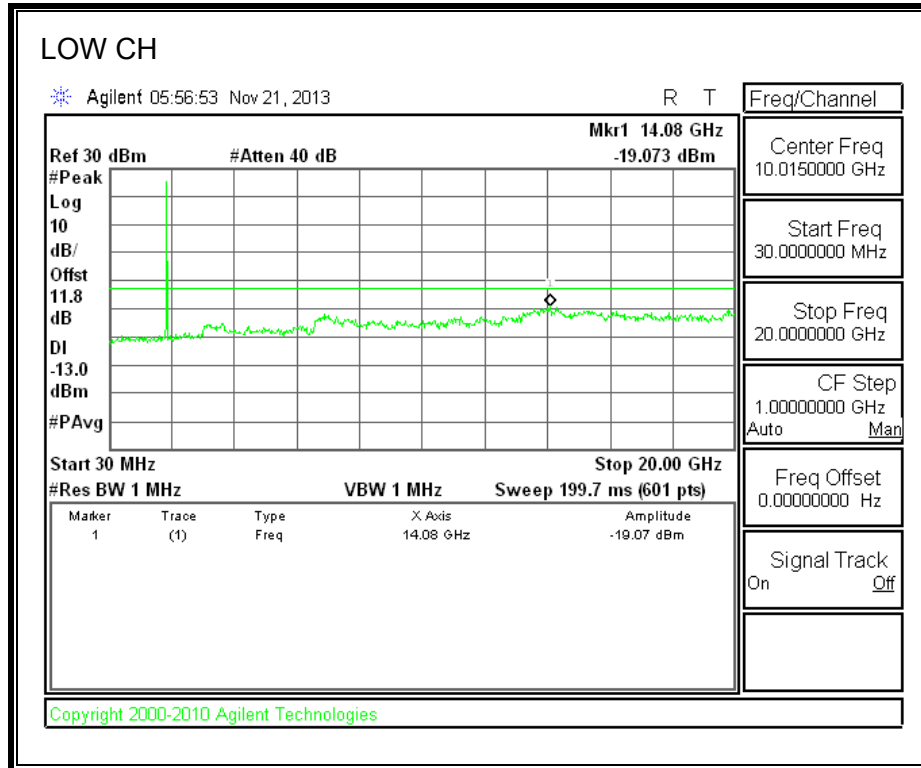
**EGPRS 1900**

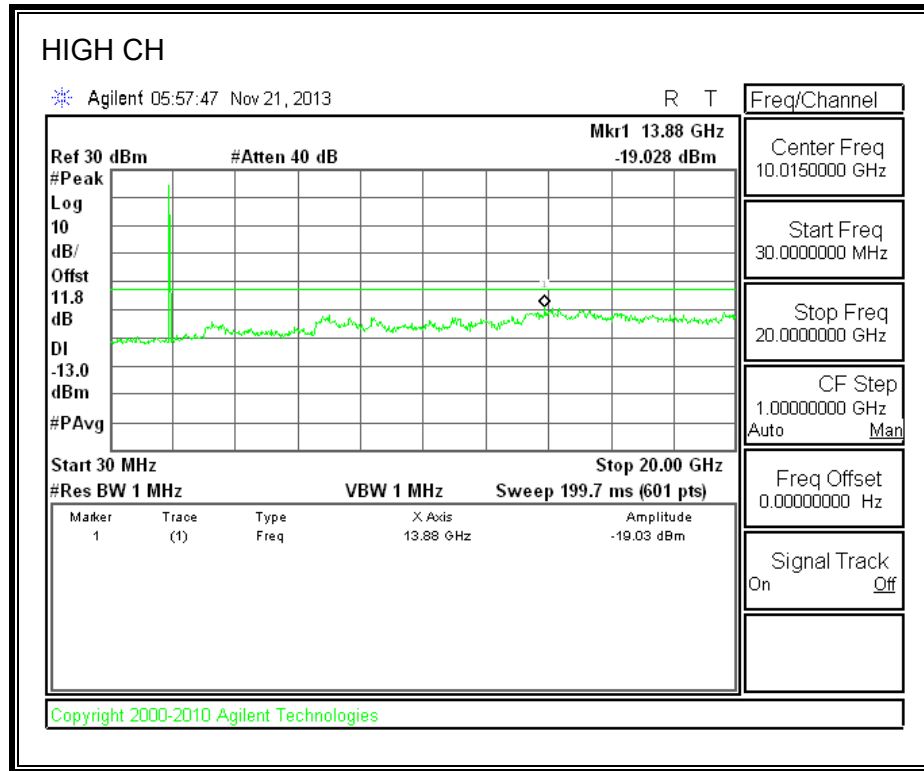




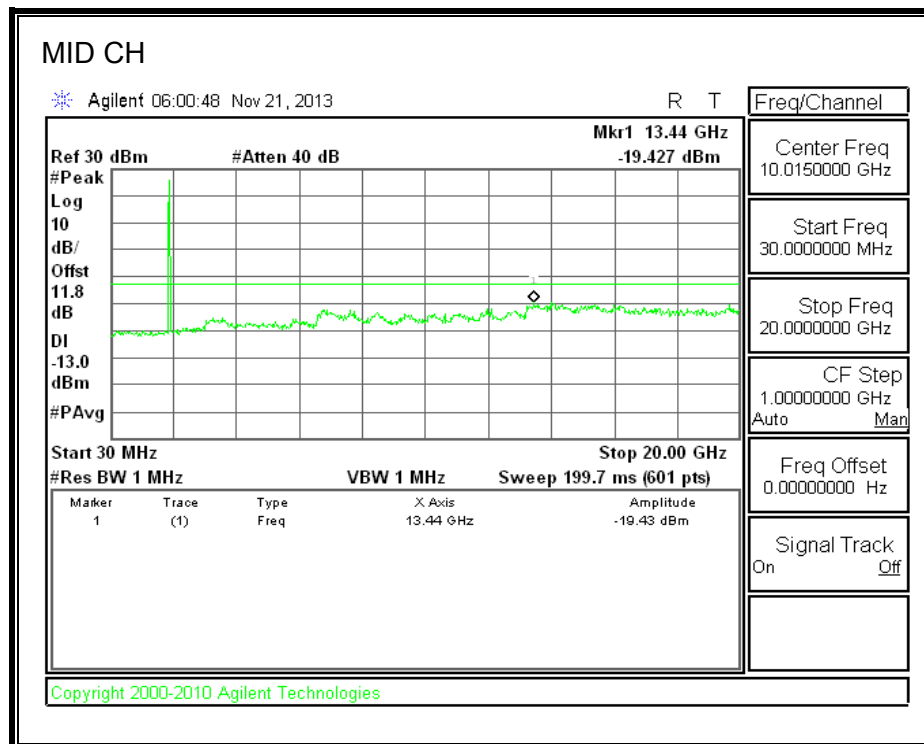
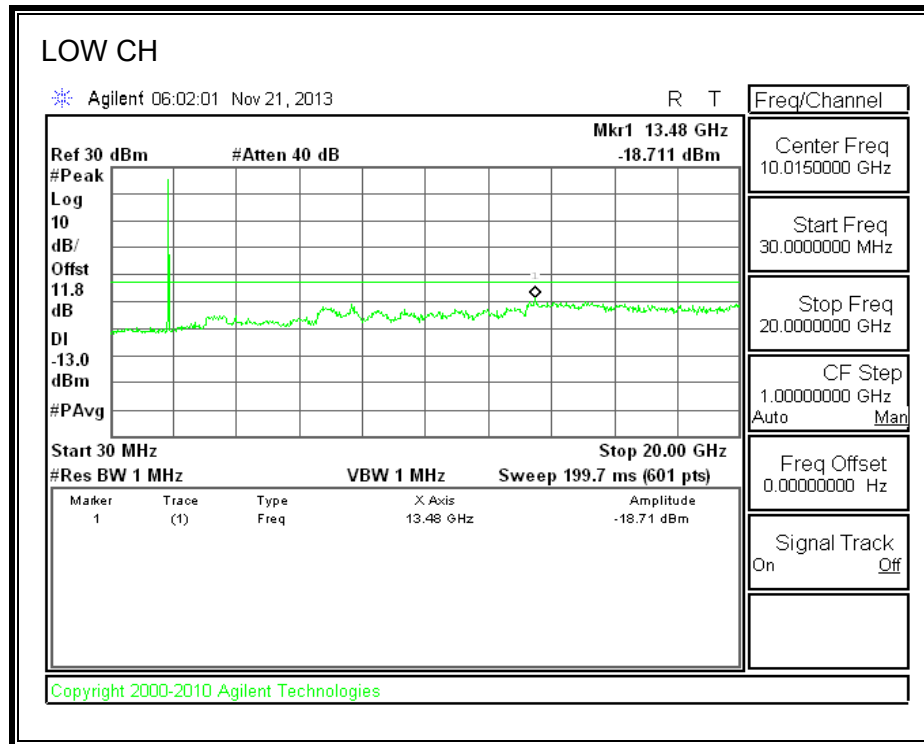
**UMTS1900**

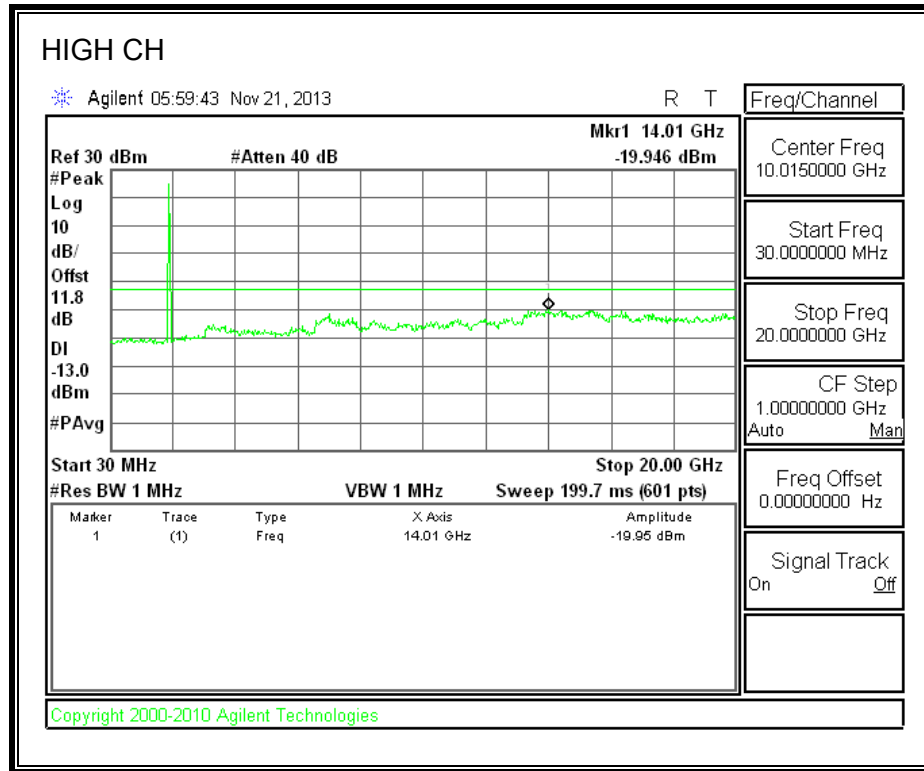
**REL 99 (PCS Band)**





**HSDPA (PCS Band)**





## **8.4. 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  $\pm 2.5$  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. =  $-30^{\circ}$  to  $+50^{\circ}\text{C}$
- Voltage = (85% - 115%)

#### **Frequency Stability vs Temperature:**

The EUT is placed inside a temperature chamber. The temperature is set to  $20^{\circ}\text{C}$  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  $+50^{\circ}\text{C}$  is reached.

#### **Frequency Stability vs Voltage:**

The peak frequency error is recorded (worst-case).

### **MODES TESTED**

- GPRS;EGPRS 850MHz, 1900MHz
- WCDMA ; REL 99

### **RESULTS**



**CELL, GPRS MODULATION – MID CHANNEL**

Reference Frequency: Cellular Mid Channel 836.600011 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.599989	0.026	2.5
3.80	40	836.600010	0.001	2.5
3.80	30	836.600016	-0.006	2.5
<b>3.80</b>	<b>20</b>	<b>836.600011</b>	<b>0</b>	<b>2.5</b>
3.80	10	836.600014	-0.004	2.5
3.80	0	836.600017	-0.007	2.5
3.80	-10	836.600015	-0.005	2.5
3.80	-20	836.600018	-0.008	2.5
3.80	-30	836.599991	0.024	2.5

Reference Frequency: Cellular Mid Channel 836.600011MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>836.600011</b>	<b>0</b>	<b>2.5</b>
4.20	20	836.600016	-0.006	2.5
3.40	20	836.600012	-0.001	2.5
End Volt(3.2)	20	836.600013	-0.002	2.5

**PCS, GPRS MODULATION – MID CHANNEL**

Reference Frequency: PCS Mid Channel 1879.999987 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999968	0.010	2.5
3.80	40	1879.999971	0.009	2.5
3.80	30	1879.999975	0.006	2.5
<b>3.80</b>	<b>20</b>	<b>1879.999987</b>	<b>0</b>	<b>2.5</b>
3.80	10	1879.999979	0.004	2.5
3.80	0	1879.999976	0.006	2.5
3.80	-10	1879.999971	0.009	2.5
3.80	-20	1879.999968	0.010	2.5
3.80	-30	1879.999966	0.011	2.5

Reference Frequency: PCS Mid Channel 1879.999987 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>1879.999987</b>	<b>0.00000</b>	<b>2.5</b>
4.20	20	1879.999973	0.00745	2.5
3.40	20	1879.999958	0.01543	2.5
End Volt(3.2)	20	1879.999967	0.01064	2.5

**CELL, EGPRS MODULATION – MID CHANNEL**

Reference Frequency: Cellular Mid Channel 836.600010 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.599993	0.020	2.5
3.80	40	836.600006	0.005	2.5
3.80	30	836.600008	0.002	2.5
<b>3.80</b>	<b>20</b>	<b>836.600010</b>	<b>0</b>	<b>2.5</b>
3.80	10	836.600008	0.002	2.5
3.80	0	836.600002	0.010	2.5
3.80	-10	836.600008	0.002	2.5
3.80	-20	836.600012	-0.002	2.5
3.80	-30	836.600011	-0.001	2.5

Reference Frequency: Cellular Mid Channel 836.600010MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>836.600010</b>	<b>0</b>	<b>2.5</b>
4.20	20	836.600006	0.005	2.5
3.40	20	836.600009	0.001	2.5
End Volt(3.2)	20	836.600007	0.004	2.5

**PCS, EGPRS MODULATION – MID CHANNEL**

Reference Frequency: PCS Mid Channel 1879.999984 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999965	0.010	2.5
3.80	40	1879.999967	0.009	2.5
3.80	30	1879.999970	0.007	2.5
<b>3.80</b>	<b>20</b>	<b>1879.999984</b>	<b>0</b>	<b>2.5</b>
3.80	10	1879.999996	-0.006	2.5
3.80	0	1879.999971	0.007	2.5
3.80	-10	1879.999974	0.005	2.5
3.80	-20	1879.999968	0.009	2.5
3.80	-30	1879.999967	0.009	2.5

Reference Frequency: PCS Mid Channel 1879.999984 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>1879.999984</b>	<b>0.00000</b>	<b>2.5</b>
4.20	20	1879.999970	0.00745	2.5
3.40	20	1879.999969	0.00814	2.5
End Volt(3.2)	20	1879.999967	0.00904	2.5

**CELL WCDMA – MID CHANNEL**

Reference Frequency: CELL Mid Channel 835.999997 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 2090.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.000006	-0.011	2.5
3.80	40	836.000003	-0.007	2.5
3.80	30	835.999998	-0.001	2.5
<b>3.80</b>	<b>20</b>	<b>835.999997</b>	<b>0</b>	<b>2.5</b>
3.80	10	835.999991	0.007	2.5
3.80	0	835.999995	0.002	2.5
3.80	-10	835.999996	0.002	2.5
3.80	-20	835.999996	0.002	2.5
3.80	-30	835.999995	0.002	2.5

Reference Frequency: CELL Mid Channel 835.999997 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 2090.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>835.999997</b>	<b>0.00000</b>	<b>2.5</b>
4.20	20	835.999995	0.00239	2.5
3.40	20	835.999994	0.00359	2.5
End Volt(3.2)	20	835.999988	0.01077	2.5

**PCS, WCDMA – MID CHANNEL**

Reference Frequency: PCS Mid Channel 1879.999994 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999982	0.006	2.5
3.80	40	1879.999983	0.006	2.5
3.80	30	1879.999986	0.004	2.5
<b>3.80</b>	<b>20</b>	<b>1879.999994</b>	<b>0</b>	<b>2.5</b>
3.80	10	1879.999988	0.003	2.5
3.80	0	1879.999986	0.004	2.5
3.80	-10	1879.999983	0.006	2.5
3.80	-20	1879.999984	0.005	2.5
3.80	-30	1879.999986	0.004	2.5

Reference Frequency: PCS Mid Channel 1879.999994 MHz @ 20°C Limit: within the authorized block or +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>1879.999994</b>	<b>0.00000</b>	<b>2.5</b>
4.20	20	1879.999986	0.00409	2.5
3.40	20	1879.999983	0.00573	2.5
End Volt(3.2)	20	1879.999982	0.00621	2.5

## 9. RADIATED TEST RESULTS

### 9.1. RADIATED POWER (ERP & EIRP)

#### RULE PART(S)

FCC: §2.1046, §22.913, §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 (Peak)	
			dBm	mW
GPRS	128	824.2	32.85	1927.52
	190	836.6	32.98	1986.09
	251	848.8	<b>33.08</b>	2032.36
EGPRS	128	824.2	30.95	1244.51
	190	836.6	30.90	1230.27
	251	848.8	<b>31.13</b>	1297.18

Mode	Channel	f (MHz)	EIRP (Peak)	
			dBm	mW
GPRS	512	1850.2	32.75	1883.65
	661	1880.0	<b>32.83</b>	1918.67
	810	1909.8	32.61	1823.90
EGPRS	512	1850.2	32.55	1798.87
	661	1880.0	<b>32.63</b>	1832.31
	810	1909.8	32.51	1782.38

Mode	Channel	f (MHz)	ERP (Average)	
			dBm	mW
UMTS,REL 99	4357	826.4	23.05	201.84
	4405	836.0	23.50	223.87
	4455	846.0	<b>23.58</b>	228.03
UMTS, HSDPA	4357	826.4	21.55	142.89
	4405	836.0	22.00	158.49
	4455	846.0	<b>22.48</b>	177.01

Mode	Channel	f (MHz)	EIRP (Peak)	
			dBm	mW
UMTS, REL 99	9662	1852.4	28.05	638.26
	9800	1880.0	<b>28.13</b>	650.13
	9938	1907.6	27.84	608.14
UMTS, HSDPA	9662	1852.4	27.15	518.80
	9800	1880.0	<b>27.33</b>	540.75
	9938	1907.6	27.01	502.34

**GPRS (Cellular Band)**

### High Frequency Substitution Measurement UL Fremont Radiated Chamber D

**Company:** Apple  
**Project #:** 13U16584  
**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	29.14	V	0.6	0.0	28.52	38.5	-9.9	
824.20	33.47	H	0.6	0.0	32.85	38.5	-5.6	
Mid Ch								
836.60	28.25	V	0.6	0.0	27.63	38.5	-10.8	
836.60	33.60	H	0.6	0.0	32.98	38.5	-5.5	
High Ch								
848.80	27.62	V	0.6	0.0	27.00	38.5	-11.4	
848.80	33.70	H	0.6	0.0	33.08	38.5	-5.4	

Rev. 10.24.13

**EGPRS (Cellular Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		12/18/13						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		EDGE 850MHz						
<b>Test Equipment:</b>								
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
<b>Low Ch</b>								
824.20	26.94	V	0.6	0.0	26.32	38.5	-12.1	
824.20	31.57	H	0.6	0.0	30.95	38.5	-7.5	
<b>Mid Ch</b>								
836.60	26.05	V	0.6	0.0	25.43	38.5	-13.0	
836.60	31.52	H	0.6	0.0	30.90	38.5	-7.5	
<b>High Ch</b>								
848.80	25.02	V	0.6	0.0	24.40	38.5	-14.0	
848.80	31.75	H	0.6	0.0	31.13	38.5	-7.3	
Rev. 10.24.13								

**GPRS (PCS Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		01/07/14						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		GSM 1900MHz						
<b>Test Equipment:</b>								
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	32.35	33.0	-0.6	
1.851	26.4	H	1.53	7.88	32.75	33.0	-0.3	
Mid Ch								
1.880	25.9	V	1.53	7.86	32.25	33.0	-0.8	
1.880	26.5	H	1.53	7.86	32.83	33.0	-0.2	
High Ch								
1.910	26.0	V	1.53	7.84	32.33	33.0	-0.7	
1.910	26.3	H	1.53	7.84	32.61	33.0	-0.4	
Rev. 10.24.13								



**EGPRS (PCS Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber E								
Company:		Apple						
Project #:		13U16584						
Date:		01/09/14						
Test Engineer:		M. Hua						
Configuration:		EUT Only						
Mode:		EDGE 1900MHz						
<b>Test Equipment:</b>								
Receiving: Horn T346 and Chamber E 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	25.9	V	1.53	7.88	32.25	33.0	-0.8	
1.851	26.2	H	1.53	7.88	32.55	33.0	-0.5	
Mid Ch								
1.880	25.6	V	1.53	7.86	31.93	33.0	-1.1	
1.880	26.3	H	1.53	7.86	32.63	33.0	-0.4	
High Ch								
1.910	25.8	V	1.53	7.84	32.11	33.0	-0.9	
1.910	26.2	H	1.53	7.84	32.51	33.0	-0.5	
Rev. 10.24.13								

**UMTS REL 99 (Cellular Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		12/18/13						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		WCDMA Rel 99 850MHz						
<b>Test Equipment:</b>								
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
<b>Low Ch</b>								
826.40	20.94	V	0.6	0.0	20.32	38.5	-18.1	
826.40	23.67	H	0.6	0.0	23.05	38.5	-15.4	
<b>Mid Ch</b>								
836.00	19.55	V	0.6	0.0	18.93	38.5	-19.5	
836.00	24.12	H	0.6	0.0	23.50	38.5	-14.9	
<b>High Ch</b>								
846.00	19.72	V	0.6	0.0	19.10	38.5	-19.3	
846.00	24.20	H	0.6	0.0	23.58	38.5	-14.9	
Rev. 10.24.13								

**UMTS HSDPA (Cellular Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		12/18/13						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		WCDMA HSPA 850MHz						
<b>Test Equipment:</b>								
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
<b>Low Ch</b>								
826.40	19.24	V	0.6	0.0	18.62	38.5	-19.8	
826.40	22.17	H	0.6	0.0	21.55	38.5	-16.9	
<b>Mid Ch</b>								
836.00	17.95	V	0.6	0.0	17.33	38.5	-21.1	
836.00	22.62	H	0.6	0.0	22.00	38.5	-16.4	
<b>High Ch</b>								
846.00	18.22	V	0.6	0.0	17.60	38.5	-20.8	
846.00	23.10	H	0.6	0.0	22.48	38.5	-16.0	
Rev. 10.24.13								

**UMTS REL 99 (PCS Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		01/07/14						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		WCDMA Rel 99 1900MHz						
<b>Test Equipment:</b>								
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
<b>Low Ch</b>								
1.852	21.5	V	1.53	7.88	27.85	33.0	-5.2	
1.852	21.7	H	1.53	7.88	28.05	33.0	-5.0	
<b>Mid Ch</b>								
1.880	21.7	V	1.53	7.86	28.02	33.0	-5.0	
1.880	21.8	H	1.53	7.86	28.13	33.0	-4.9	
<b>High Ch</b>								
1.908	21.2	V	1.53	7.84	27.55	33.0	-5.5	
1.908	21.5	H	1.53	7.84	27.84	33.0	-5.2	
Rev. 10.24.13								

**UMTS HSDPA (PCS Band)**

High Frequency Substitution Measurement UL Fremont Radiated Chamber D								
<b>Company:</b>		Apple						
<b>Project #:</b>		13U16584						
<b>Date:</b>		01/08/14						
<b>Test Engineer:</b>		M. Hua						
<b>Configuration:</b>		EUT Only						
<b>Mode:</b>		WCDMA HSPA 1900MHz						
<b>Test Equipment:</b>								
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
<b>Low Ch</b>								
1.852	20.3	V	1.53	7.88	26.65	33.0	-6.4	
1.852	20.8	H	1.53	7.88	27.15	33.0	-5.9	
<b>Mid Ch</b>								
1.880	20.0	V	1.53	7.86	26.33	33.0	-6.7	
1.880	21.0	H	1.53	7.86	27.33	33.0	-5.7	
<b>High Ch</b>								
1.908	20.3	V	1.53	7.84	26.61	33.0	-6.4	
1.908	20.7	H	1.53	7.84	27.01	33.0	-6.0	
Rev. 10.24.13								

## **9.2. 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										
<div style="display: flex; justify-content: space-between;"> <div> <b>Company:</b>  <b>Project #:</b> 13U16584  <b>Date:</b> 12/5/13  <b>Test Engineer:</b> O. Su  <b>Configuration:</b> EUT only  <b>Mode:</b> Cell GSM 850, GPRS </div> </div>										
Chamber		Pre-amplifier		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
<b>Low Ch, (824.2MHz)</b>										
1.65	-57.6	V	3.0	44.71	37.6	1.0	-49.4	-13.0	-36.4	
2.47	-52.1	V	3.0	48.34	38.0	1.0	-40.7	-13.0	-27.7	
1.65	-57.5	H	3.0	43.82	37.6	1.0	-50.3	-13.0	-37.3	
2.47	-55.3	H	3.0	48.50	38.0	1.0	-43.8	-13.0	-30.8	
<b>Mid Ch, (836.6MHz)</b>										
1.67	-63.3	V	3.0	44.9	37.6	1.0	-55.0	-13.0	-42.0	
2.51	-65.4	V	3.0	48.4	37.9	1.0	-53.8	-13.0	-40.8	
1.67	-56.0	H	3.0	44.1	37.6	1.0	-48.4	-13.0	-35.4	
2.51	-59.3	H	3.0	48.6	37.9	1.0	-47.6	-13.0	-34.6	
<b>High Ch, (848.8MHz)</b>										
1.70	-57.2	V	3.0	45.2	37.6	1.0	-48.6	-13.0	-35.6	
2.55	-59.2	V	3.0	48.5	38.0	1.0	-47.7	-13.0	-34.7	
1.70	-57.6	H	3.0	44.4	37.6	1.0	-49.8	-13.0	-36.8	
2.55	-60.5	H	3.0	48.7	38.0	1.0	-48.8	-13.0	-35.8	
Rev. 09.23.13										

**EGPRS (Cellular Band)**

<b>3m Radiated Emissions Chamber</b> <b>Above 1GHz High Frequency Substitution Measurement</b>										
<b>Company:</b> <b>Project #:</b> 13U16584 <b>Date:</b> 12/6/13 <b>Test Engineer:</b> O. Su <b>Configuration:</b> EUT Only <b>Mode:</b> Cell GSM 850, EGPRS										
<b>Chamber</b>		<b>Pre-amplifier</b>		<b>Filter</b>		<b>Limit</b>				
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
<b>Low Ch, (824.2MHz)</b>										
1.65	-57.1	V	3.0	44.71	37.6	1.0	-48.9	-13.0	-35.9	
2.47	-64.8	V	3.0	48.34	38.0	1.0	-53.5	-13.0	-40.5	
1.65	-63.1	H	3.0	43.82	37.6	1.0	-55.8	-13.0	-42.8	
2.47	-56.4	H	3.0	48.50	38.0	1.0	-44.9	-13.0	-31.9	
<b>Mid Ch, (836.6MHz)</b>										
1.67	-64.7	V	3.0	44.9	37.6	1.0	-56.3	-13.0	-43.3	
2.51	-65.9	V	3.0	48.4	37.9	1.0	-54.4	-13.0	-41.4	
1.67	-64.9	H	3.0	44.1	37.6	1.0	-57.3	-13.0	-44.3	
2.51	-66.8	H	3.0	48.6	37.9	1.0	-55.1	-13.0	-42.1	
<b>High Ch, (848.8MHz)</b>										
1.70	-59.8	V	3.0	45.2	37.6	1.0	-51.2	-13.0	-38.2	
2.55	-65.8	V	3.0	48.5	38.0	1.0	-54.3	-13.0	-41.3	
1.70	-56.6	H	3.0	44.4	37.6	1.0	-48.8	-13.0	-35.8	
2.55	-63.6	H	3.0	48.7	38.0	1.0	-52.0	-13.0	-39.0	
Rev. 09.23.13										



**UMTS REL 99 (Cellular Band)**

<b>3m Radiated Emissions Chamber</b> <b>Above 1GHz High Frequency Substitution Measurement</b>										
<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"> <p><b>Company:</b></p> <p><b>Project #:</b> 13U16583</p> <p><b>Date:</b> 12/9/13</p> <p><b>Test Engineer:</b> R.ZHENG</p> <p><b>Configuration:</b> EUT only</p> <p><b>Mode:</b> UMTS B5 REL 99</p> </div> <div style="width: 60%;"></div> </div>										
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Chamber</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Pre-amplifier</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Filter</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Limit</div> </div> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">3m Chamber E</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">3m Chamber E</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Filter 1</div> <div style="border: 1px solid black; padding: 2px 10px; background-color: #e0f7fa;">Part 22</div> </div>										
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
<b>Low Ch. (826.4MHz)</b>										
1.65	-51.8	V	3.0	44.75	37.6	1.0	-43.6	-13.0	-30.6	
2.48	-59.6	V	3.0	48.36	38.0	1.0	-48.2	-13.0	-35.2	
1.65	-57.9	H	3.0	43.87	37.6	1.0	-50.6	-13.0	-37.6	
2.48	-59.7	H	3.0	48.52	38.0	1.0	-48.1	-13.0	-35.1	
<b>Mid Ch. (836MHz)</b>										
1.67	-53.3	V	3.0	44.9	37.6	1.0	-44.9	-13.0	-31.9	
2.51	-59.1	V	3.0	48.4	37.9	1.0	-47.6	-13.0	-34.6	
1.67	-57.3	H	3.0	44.1	37.6	1.0	-49.8	-13.0	-36.8	
2.51	-57.7	H	3.0	48.6	37.9	1.0	-46.0	-13.0	-33.0	
<b>High Ch. (846MHz)</b>										
1.69	-52.3	V	3.0	45.1	37.6	1.0	-43.8	-13.0	-30.8	
2.54	-59.6	V	3.0	48.5	38.0	1.0	-48.1	-13.0	-35.1	
1.69	-56.0	H	3.0	44.3	37.6	1.0	-48.3	-13.0	-35.3	
2.54	-59.2	H	3.0	48.6	38.0	1.0	-47.5	-13.0	-34.5	
Rev. 09.23.13										

**UMTS HSDPA (Cellular Band)**

<b>3m Radiated Emissions Chamber</b> <b>Above 1GHz High Frequency Substitution Measurement</b>										
<b>Company:</b> <b>Project #:</b> 13U16584 <b>Date:</b> 12/6/13 <b>Test Engineer:</b> O. Su <b>Configuration:</b> EUT Only <b>Mode:</b> PCS 1900, GPRS										
<b>Chamber</b>		<b>Pre-amplifier</b>		<b>Filter</b>		<b>Limit</b>				
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
<b>Low Ch, (1850.2MHz)</b>										
3.70	-66.7	V	3.0	50.90	38.6	1.0	-53.3	-13.0	-40.3	
5.55	-67.5	V	3.0	53.79	38.0	1.0	-50.6	-13.0	-37.6	
3.70	-66.8	H	3.0	51.00	38.6	1.0	-53.3	-13.0	-40.3	
5.55	-67.6	H	3.0	53.60	38.0	1.0	-51.0	-13.0	-38.0	
<b>Mid Ch, (1880MHz)</b>										
3.76	-67.8	V	3.0	51.1	38.6	1.0	-54.3	-13.0	-41.3	
5.64	-68.2	V	3.0	53.9	38.0	1.0	-51.2	-13.0	-38.2	
3.76	-66.9	H	3.0	51.2	38.6	1.0	-53.3	-13.0	-40.3	
5.64	-66.4	H	3.0	53.7	38.0	1.0	-49.6	-13.0	-36.6	
<b>High Ch, (1909.8MHz)</b>										
3.82	-67.0	V	3.0	51.2	38.6	1.0	-53.3	-13.0	-40.3	
5.73	-68.2	V	3.0	54.0	37.9	1.0	-51.1	-13.0	-38.1	
3.82	-66.6	H	3.0	51.3	38.6	1.0	-52.8	-13.0	-39.8	
5.73	-67.6	H	3.0	53.9	37.9	1.0	-50.6	-13.0	-37.6	
Rev. 09.23.13										

**GPRS (PCS Band)**

3m Radiated Emissions Chamber Above 1GHz High Frequency Substitution Measurement										
<div style="display: flex; justify-content: space-between;"> <div> <b>Company:</b>  <b>Project #:</b> 13U16584  <b>Date:</b> 12/6/13  <b>Test Engineer:</b> O. Su  <b>Configuration:</b> EUT Only  <b>Mode:</b> PCS 1900, GPRS </div> </div>										
Chamber		Pre-amplifier		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
<b>Low Ch. (1850.2MHz)</b>										
3.70	-66.7	V	3.0	50.90	38.6	1.0	-53.3	-13.0	-40.3	
5.55	-67.5	V	3.0	53.79	38.0	1.0	-50.6	-13.0	-37.6	
3.70	-66.8	H	3.0	51.00	38.6	1.0	-53.3	-13.0	-40.3	
5.55	-67.6	H	3.0	53.60	38.0	1.0	-51.0	-13.0	-38.0	
<b>Mid Ch. (1880MHz)</b>										
3.76	-67.8	V	3.0	51.1	38.6	1.0	-54.3	-13.0	-41.3	
5.64	-68.2	V	3.0	53.9	38.0	1.0	-51.2	-13.0	-38.2	
3.76	-66.9	H	3.0	51.2	38.6	1.0	-53.3	-13.0	-40.3	
5.64	-66.4	H	3.0	53.7	38.0	1.0	-49.6	-13.0	-36.6	
<b>High Ch. (1909.8MHz)</b>										
3.82	-67.0	V	3.0	51.2	38.6	1.0	-53.3	-13.0	-40.3	
5.73	-68.2	V	3.0	54.0	37.9	1.0	-51.1	-13.0	-38.1	
3.82	-66.6	H	3.0	51.3	38.6	1.0	-52.8	-13.0	-39.8	
5.73	-67.6	H	3.0	53.9	37.9	1.0	-50.6	-13.0	-37.6	
Rev. 09.23.13										

**EGPRS (PCS Band)**

3m Radiated Emissions Chamber Above 1GHz High Frequency Substitution Measurement										
<div style="display: flex; justify-content: space-between;"> <div> <b>Company:</b>  <b>Project #:</b> 13U16584  <b>Date:</b> 12/6/13  <b>Test Engineer:</b> O. Su  <b>Configuration:</b> EUT only  <b>Mode:</b> PCS 1900, EGPRS </div> </div>										
Chamber		Pre-amplifier		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
<b>Low Ch. (1850.2MHz)</b>										
3.70	-66.7	V	3.0	50.90	38.6	1.0	-53.3	-13.0	-40.3	
5.55	-67.5	V	3.0	53.79	38.0	1.0	-50.6	-13.0	-37.6	
3.70	-66.8	H	3.0	51.00	38.6	1.0	-53.3	-13.0	-40.3	
5.61	-67.5	H	3.0	53.68	38.0	1.0	-50.8	-13.0	-37.8	
<b>Mid Ch. (1880MHz)</b>										
3.76	-66.5	V	3.0	51.1	38.6	1.0	-53.0	-13.0	-40.0	
5.64	-67.8	V	3.0	53.9	38.0	1.0	-50.8	-13.0	-37.8	
3.76	-66.9	H	3.0	51.2	38.6	1.0	-53.3	-13.0	-40.3	
5.61	-67.5	H	3.0	53.7	38.0	1.0	-50.8	-13.0	-37.8	
<b>High Ch. (1909.8MHz)</b>										
3.82	-66.9	V	3.0	51.2	38.6	1.0	-53.2	-13.0	-40.2	
5.73	-67.2	V	3.0	54.0	37.9	1.0	-50.1	-13.0	-37.1	
3.82	-66.8	H	3.0	51.3	38.6	1.0	-53.1	-13.0	-40.1	
5.73	-68.3	H	3.0	53.9	37.9	1.0	-51.4	-13.0	-38.4	
Rev. 09.23.13										

**UMTS REL 99 (PCS Band)**

<b>3m Radiated Emissions Chamber</b> <b>Above 1GHz High Frequency Substitution Measurement</b>										
<b>Company:</b> <b>Project #:</b> 13U16584 <b>Date:</b> 12/11/13 <b>Test Engineer:</b> R.ZHENG <b>Configuration:</b> EUT only <b>Mode:</b> PCS 1900, REL99										
<b>Chamber</b>		<b>Pre-amplifier</b>		<b>Filter</b>		<b>Limit</b>				
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
<b>Low Ch, (1852.4MHz)</b>										
3.70	-54.9	V	3.0	50.92	38.6	1.0	-41.6	-13.0	-28.6	
5.56	-57.1	V	3.0	53.80	38.0	1.0	-40.3	-13.0	-27.3	
3.70	-55.4	H	3.0	51.02	38.6	1.0	-42.0	-13.0	-29.0	
5.56	-57.2	H	3.0	53.60	38.0	1.0	-40.6	-13.0	-27.6	
<b>Mid Ch, (1880MHz)</b>										
3.76	-55.3	V	3.0	51.1	38.6	1.0	-41.8	-13.0	-28.8	
5.64	-57.4	V	3.0	53.9	38.0	1.0	-40.4	-13.0	-27.4	
3.76	-55.0	H	3.0	51.2	38.6	1.0	-41.4	-13.0	-28.4	
5.64	-58.4	H	3.0	53.7	38.0	1.0	-41.6	-13.0	-28.6	
<b>High Ch, (1907.6MHz)</b>										
3.82	-55.2	V	3.0	51.2	38.6	1.0	-41.6	-13.0	-28.6	
5.72	-57.8	V	3.0	54.0	37.9	1.0	-40.7	-13.0	-27.7	
3.82	-54.9	H	3.0	51.3	38.6	1.0	-41.2	-13.0	-28.2	
5.72	-57.3	H	3.0	53.8	37.9	1.0	-40.4	-13.0	-27.4	
Rev. 09.23.13										

**UMTS HSDPA (PCS Band)**

<b>3m Radiated Emissions Chamber</b> <b>Above 1GHz High Frequency Substitution Measurement</b>										
<b>Company:</b> <b>Project #:</b> 13U16583 <b>Date:</b> 12/9/13 <b>Test Engineer:</b> R.ZHENG <b>Configuration:</b> EUT only <b>Mode:</b> PCS 1900, HSDPA										
<b>Chamber</b>		<b>Pre-amplifier</b>		<b>Filter</b>		<b>Limit</b>				
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
<b>Low Ch. (1852.4MHz)</b>										
3.70	-55.8	V	3.0	50.92	38.6	1.0	-42.5	-13.0	-29.5	
5.56	-58.0	V	3.0	53.80	38.0	1.0	-41.2	-13.0	-28.2	
3.70	-56.5	H	3.0	51.02	38.6	1.0	-43.1	-13.0	-30.1	
5.56	-58.1	H	3.0	53.60	38.0	1.0	-41.5	-13.0	-28.5	
<b>Mid Ch. (1880MHz)</b>										
3.76	-55.2	V	3.0	51.1	38.6	1.0	-41.7	-13.0	-28.7	
5.64	-58.2	V	3.0	53.9	38.0	1.0	-41.2	-13.0	-28.2	
3.76	-55.7	H	3.0	51.2	38.6	1.0	-42.1	-13.0	-29.1	
5.64	-58.4	H	3.0	53.7	38.0	1.0	-41.6	-13.0	-28.6	
<b>High Ch. (1907.6MHz)</b>										
3.82	-56.1	V	3.0	51.2	38.6	1.0	-42.5	-13.0	-29.5	
5.72	-58.7	V	3.0	54.0	37.9	1.0	-41.6	-13.0	-28.6	
3.82	-55.8	H	3.0	51.3	38.6	1.0	-42.1	-13.0	-29.1	
5.72	-58.2	H	3.0	53.8	37.9	1.0	-41.3	-13.0	-28.3	
Rev. 09.23.13										