



731 Enterprise Drive  
Lexington, KY 40510

Telephone: 859-226-1000  
Facsimile: 859-226-1040  
www.intertek-etlsemko.com

# TEST REPORT

**Report Number:** 100189971-LEX-001  
**Project Number:** G100189971

**Report Issue Date:** 10/22/2010

**Model:** MW-DFR-CELL-2780  
**FCCID:** NEO-DFR-CELL-2780

**Standards:** FCC Part 22 Subpart H

Tested by:  
Intertek Testing Services NA, Inc.  
731 Enterprise Drive  
Lexington, KY 40510

Client:  
Axell Wireless  
Aerial House  
Chesham  
Buckinghamshire  
HP5 2QD  
United Kingdom

Report prepared by

Jason Centers, Senior Project Engineer

Report reviewed by

Bryan Taylor, Team Leader



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**TABLE OF CONTENTS**

**1 Introduction and Conclusion..... 3**

**2 Test Summary ..... 3**

**3 Description of Equipment Under Test ..... 4**

**4 Conducted Output Power..... 6**

**5 Occupied Bandwidth ..... 8**

**6 Conducted Spurious Emissions at Antenna Terminals..... 15**

**7 Radiated Spurious Emissions (Transmitter)..... 38**

**8 Measurement Uncertainty ..... 43**

**9 Revision History..... 44**

## 1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

## 2 Test Summary

Page	Test full name	FCC Reference	Result
6	Conducted Output Power	§2.1046	Pass
8	Occupied Bandwidth	§2.1049, §22.917(b)(d)	Pass
15	Conducted Spurious Emissions	§2.1049, §2.1051, §22.917(a)(b)	Pass
38	Radiated Spurious Emissions (Transmitter)	§2.1053, §22.917(a)(b)	Pass
-	Frequency Stability	§2.1055	Not Required <sup>1</sup>

<sup>1</sup> The device does not translate frequency.

**3 Description of Equipment Under Test**

<b>Equipment Under Test</b>	
<b>Manufacturer</b>	Axell Wireless
<b>Model Number</b>	MW-DFR-CELL-2780
<b>Serial Number</b>	1008D1027
<b>FCC Identifier</b>	NEO-DFR-CELL-2780
<b>Receive Date</b>	8/27/2010
<b>Test Start Date</b>	8/30/2010
<b>Test End Date</b>	9/30/2010
<b>Device Received Condition</b>	Good
<b>Test Sample Type</b>	Production
<b>Frequency Band</b>	824MHz - 849MHz (Uplink) 869MHz – 894MHz (Downlink)
<b>Modulation Type</b>	CDMA, W-CDMA, GSM
<b>Transmission Control</b>	Signal Generator
<b>Maximum Output Power (Conducted)</b>	27.26 dBm (Uplink) 27.04 dBm (Downlink)
<b>Antenna Type</b>	External, User provided
<b>Operating Voltage</b>	120VAC

**Description of Equipment Under Test**

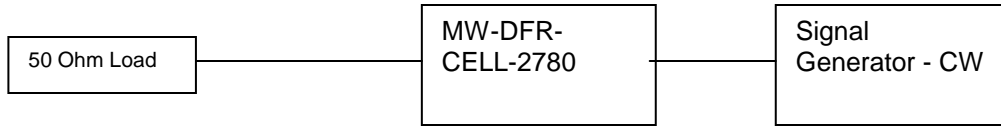
The test sample was a cell booster device manufactured by Axell Wireless.

**Operating modes of the EUT:**

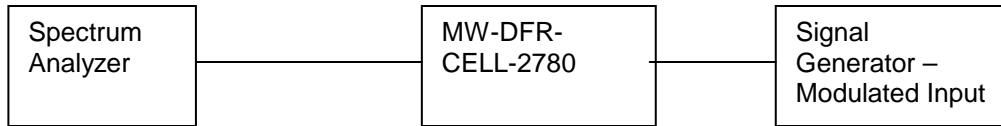
<b>No.</b>	<b>Descriptions of EUT Exercising</b>
1	Device was set at max gain and tested at maximum output power at the low, mid and high frequencies in each band with CDMA, GSM and W-CDMA modulations for conducted tests.
2	Device was set at max gain and tested at maximum output power at the low, mid and high frequencies in each band with a CW for radiated spurious tests.

**3.1 System setup including cable interconnection details, support equipment and simplified block diagram**

**3.2 EUT Block Diagram:**



Block Diagram for Radiated Tests



Block Diagram for Conducted Tests at the Antenna Port

**3.3 Cables:**

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
AC Power Cable	5 ft.	None	None	120 VAC Power Source	AC Input
Coax Cable	50 ft.	Yes	None	Signal Source	RF Input
Coax Cable	10 ft.	Yes	None	RF Output	Termination
Cat 5 Cable	6 ft.	Yes	None	Laptop	Management Port
Cat 5 Cable	6 ft.	No	None	Alarm Contacts	Unterminated

**3.4 Support Equipment:**

No support equipment was used in this evaluation.

## 4 Conducted Output Power

### 4.1 Test Limits

#### § 2.1046

- (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8).

### 4.2 Test Procedure

The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a spectrum analyzer. A vector signal generator was used to generate the desired modulation. The signal generator level was set to obtain the maximum signal channel output from the amplifier. The channel power function of the spectrum analyzer was used to measure the output power. Tests were performed at three frequencies (low, middle, and high channels) in the uplink and downlink bands.

### 4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011
Base Station Simulator	837198089	Rohde & Schwarz	CMU200	7/28/2010	7/28/2011
Vector Signal Generator	MY48180846	Agilent	N51882A	8/20/2010	8/20/2011
Vector Signal Generator	ESG-3000A	Hewlett Packard	ESG-3000A	10/19/2009	10/19/2010

**4.4 Results:**

<b>Band</b>	<b>Modulation</b>	<b>Channel</b>	<b>Power (dBm)</b>
Uplink	CDMA	Low	26.89
Uplink	CDMA	Mid	27.26
Uplink	CDMA	High	26.98
Downlink	CDMA	Low	26.33
Downlink	CDMA	Mid	26.85
Downlink	CDMA	High	25.6
Uplink	GSM	Low	26.44
Uplink	GSM	Mid	26.75
Uplink	GSM	High	26.03
Downlink	GSM	Low	26.91
Downlink	GSM	Mid	27.04
Downlink	GSM	High	26.31
Uplink	W-CDMA	Low	26.83
Uplink	W-CDMA	Mid	26.3
Uplink	W-CDMA	High	26.07
Downlink	W-CDMA	Low	26.36
Downlink	W-CDMA	Mid	26.95
Downlink	W-CDMA	High	26.24

## 5 Occupied Bandwidth

### 5.1 Test Limits

#### §2.1049:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

### 5.2 Test Procedure

The EUT was connected to a spectrum analyzer using a calibrated coaxial cable. A vector signal generator was used to generate the desired modulation. The occupied bandwidth function of the analyzer was used to automatically generate the occupied bandwidth plots of the input and output signals at the maximum output power.

### 5.3 Test Equipment Used:

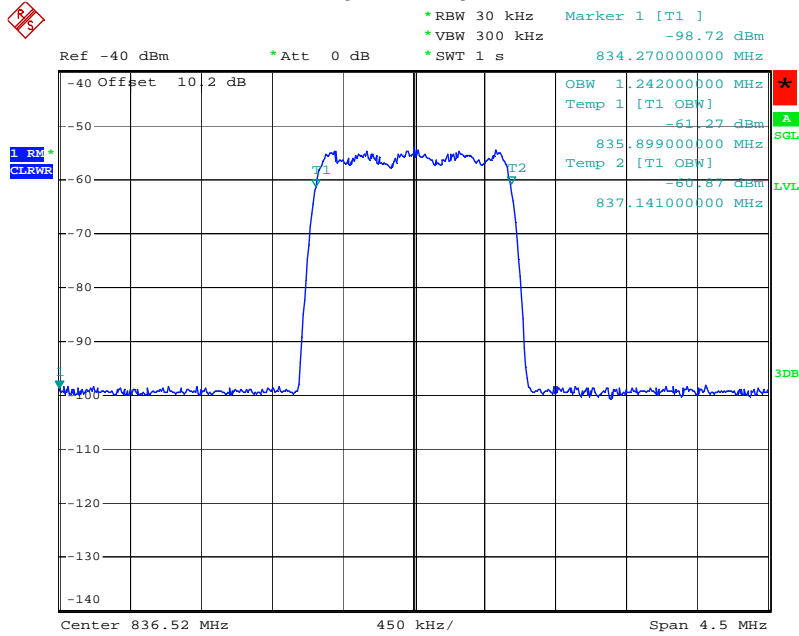
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011
Base Station Simulator	837198089	Rohde & Schwarz	CMU200	7/28/2010	7/28/2011
Vector Signal Generator	MY48180846	Agilent	N51882A	8/20/2010	8/20/2011
Vector Signal Generator	ESG-3000A	Hewlett Packard	ESG-3000A	10/19/2009	10/19/2010

### 5.4 Results:

Modulation	Band	Occupied Bandwidth – Input (MHz)	Occupied Bandwidth – Output (MHz)
CDMA	Uplink	1.24	1.25
CDMA	Downlink	1.25	1.26
GSM	Uplink	0.248	0.244
GSM	Downlink	0.248	0.244
W-CDMA	Uplink	4.18	4.18
W-CDMA	Downlink	4.18	4.16

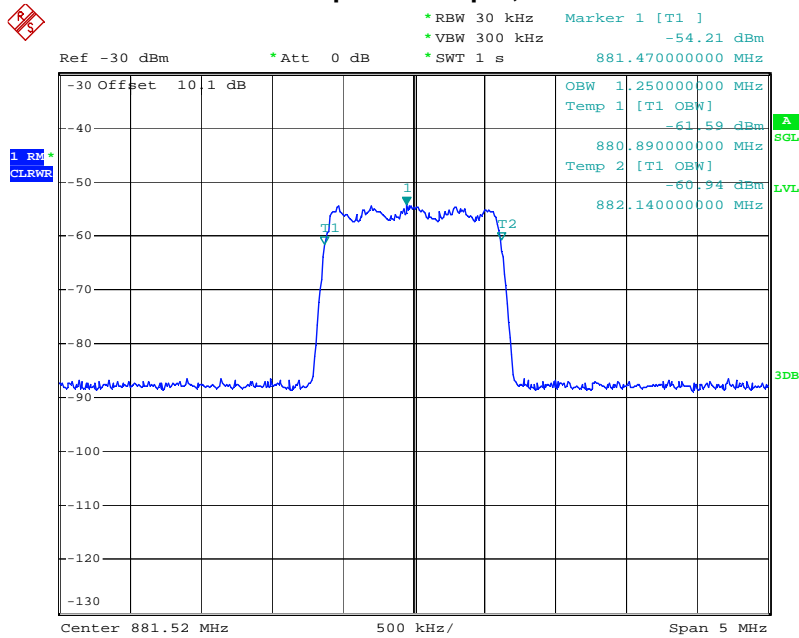


Uplink – Input, CDMA



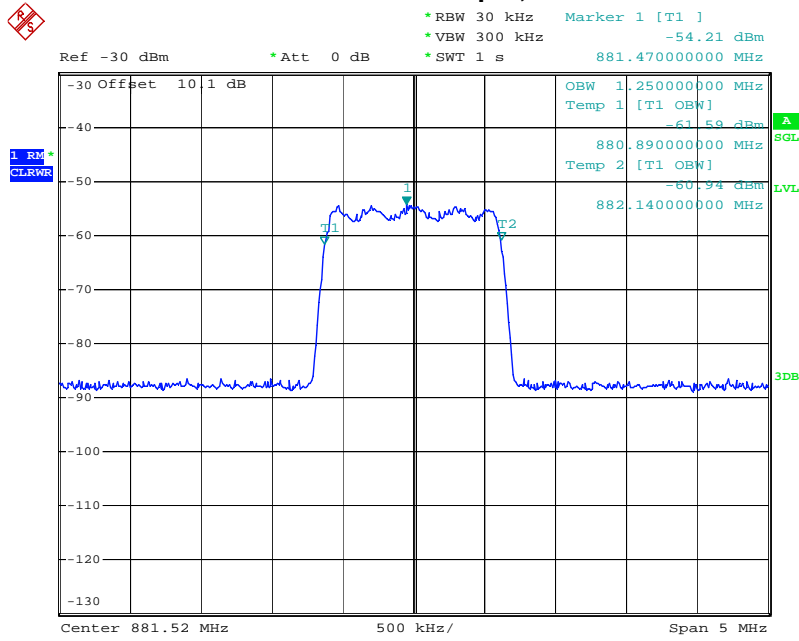
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Uplink – Output, CDMA



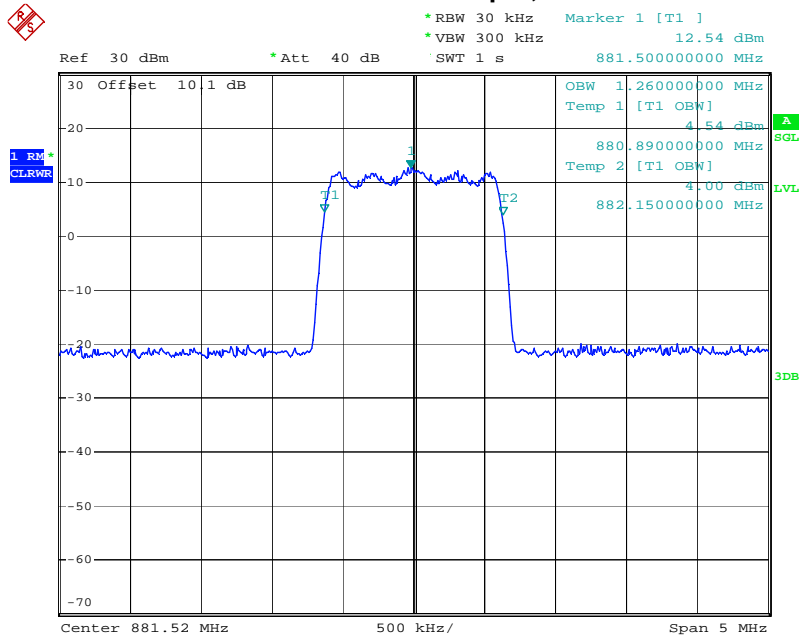
Date: 16.SEP.2010 16:09:09

Downlink – Input, CDMA



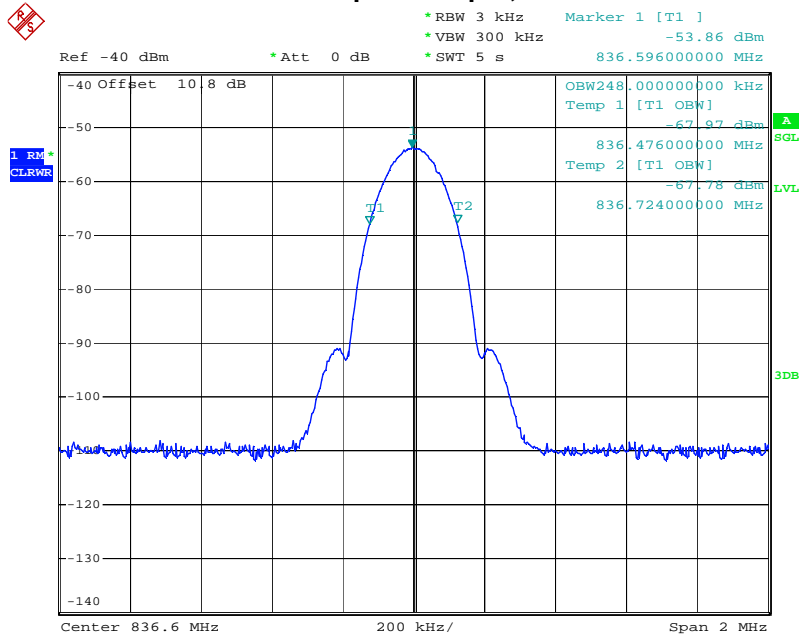
Date: 16.SEP.2010 16:09:09

Downlink – Output, CDMA



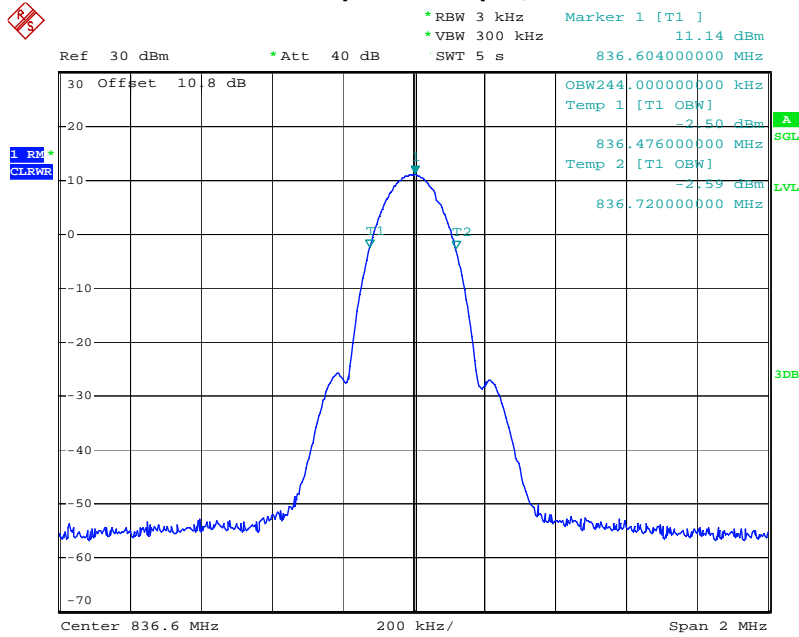
Date: 16.SEP.2010 16:12:58

Uplink – Input, GSM



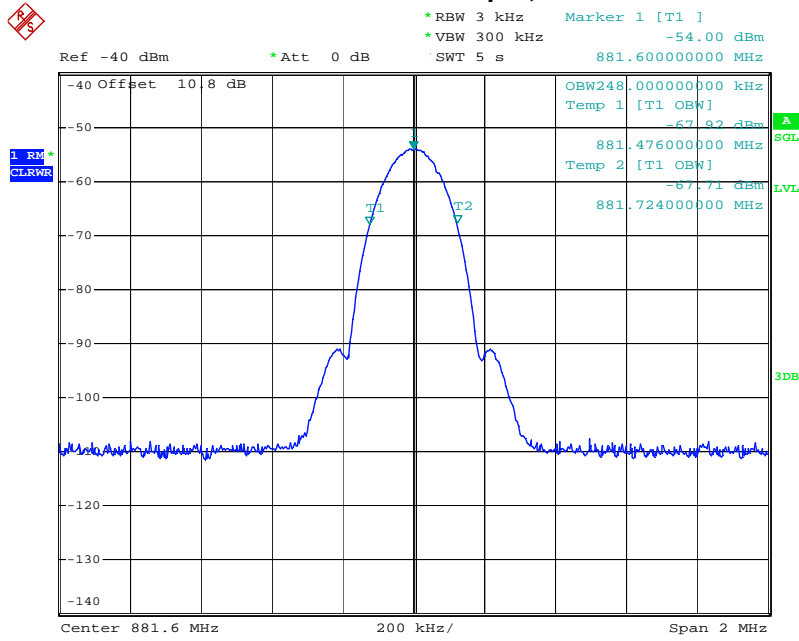
Date: 17.SEP.2010 16:25:55

Uplink – Output, GSM



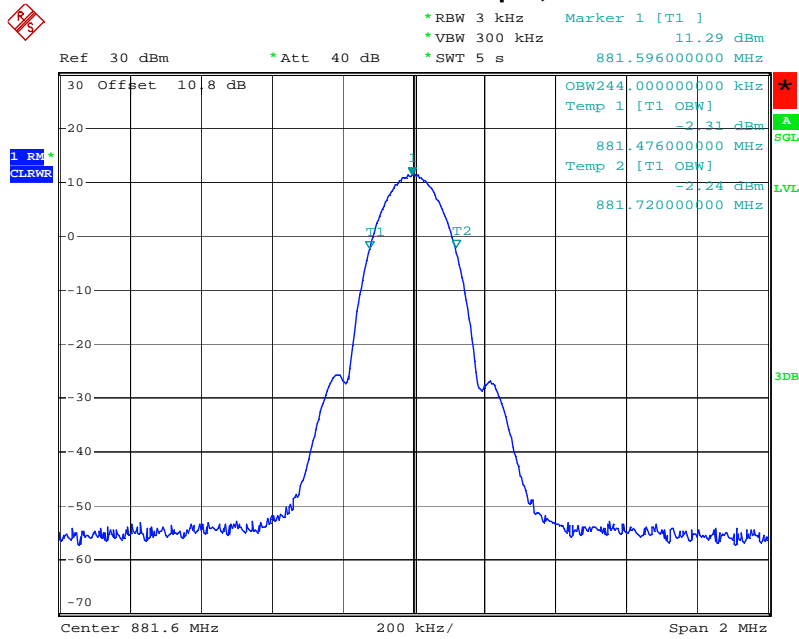
Date: 17.SEP.2010 16:28:04

Downlink - Input, GSM



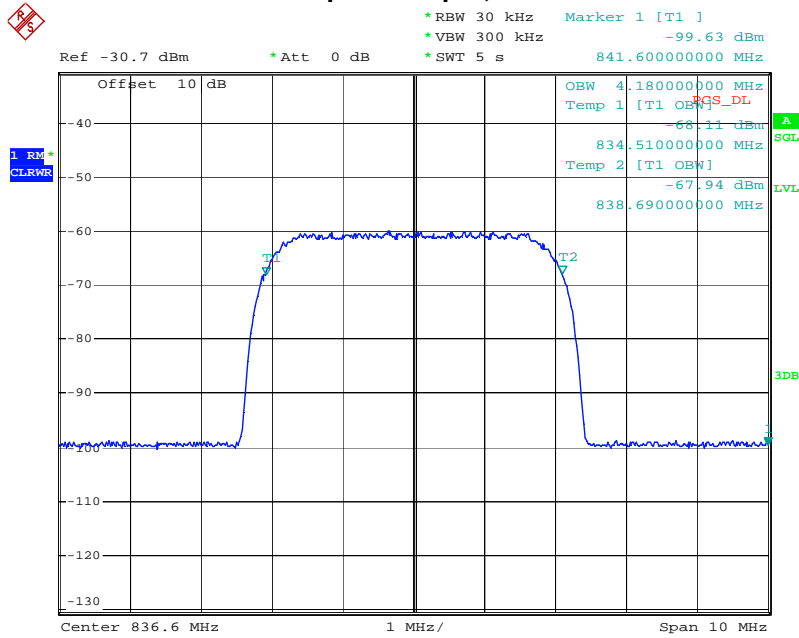
Date: 17.SEP.2010 16:02:33

Downlink - Output, GSM



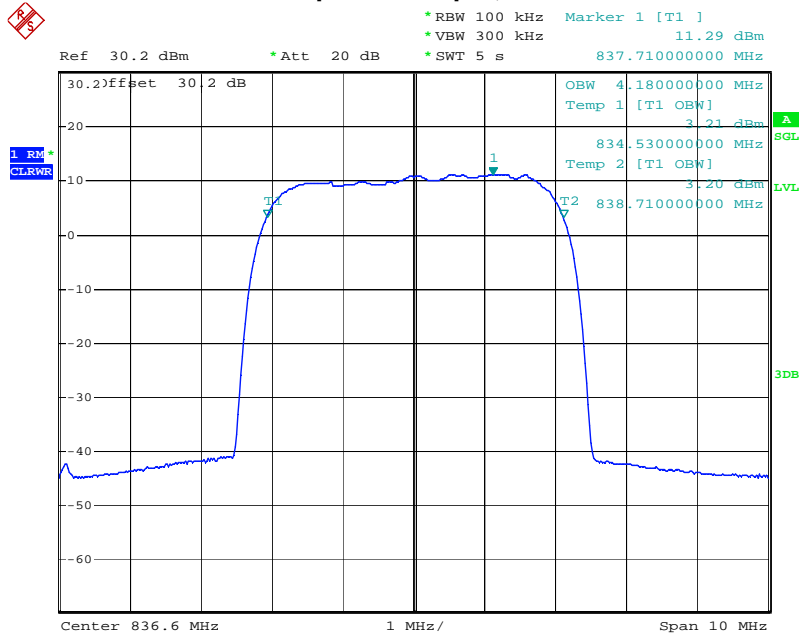
Date: 17.SEP.2010 16:00:44

### Uplink – Input, W-CDMA



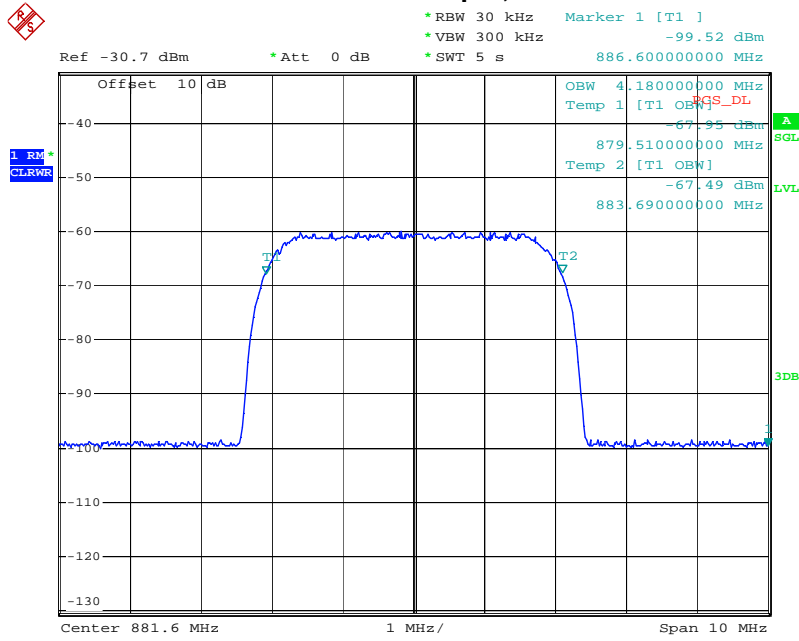
Date: 22.SEP.2010 13:12:50

### Uplink – Output, W-CDMA



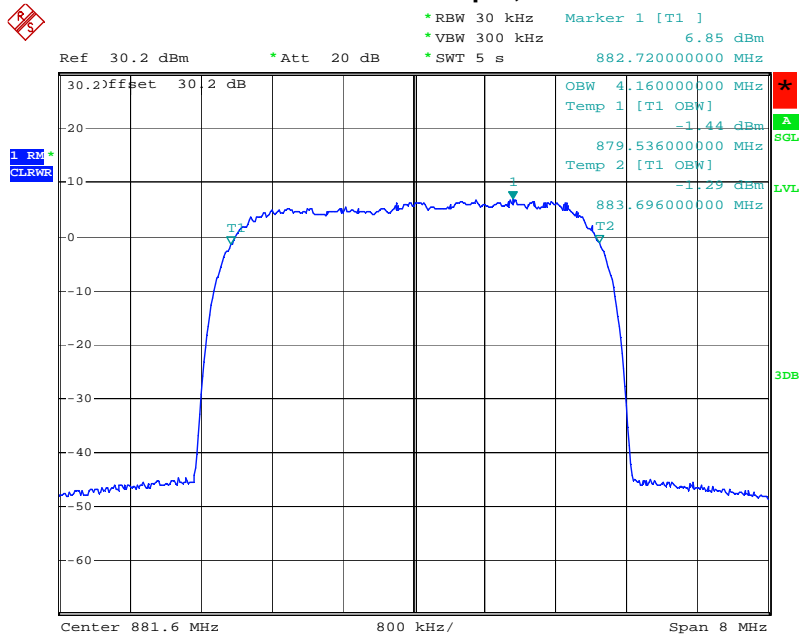
Date: 22.SEP.2010 10:20:14

Downlink – Input, W-CDMA



Date: 22.SEP.2010 13:15:30

Downlink – Output, W-CDMA



Date: 22.SEP.2010 10:06:20

## 6 Conducted Spurious Emissions at Antenna Terminals

### 6.1 Test Limits

#### § 2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

- (h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

#### § 2.1051

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

#### § 22.917

- (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.
- (b) Measurement procedure. 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.

## 6.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. A vector signal generator was used to generate the desired modulation. The output of the signal generated was adjusted to obtain the maximum output power of the amplifier. The resolution bandwidth of the spectrum analyzer was set at 1MHz. Sufficient scans were taken to show the out of band Emissions if any up to 10th harmonic.

## 6.3 Test Equipment Used:

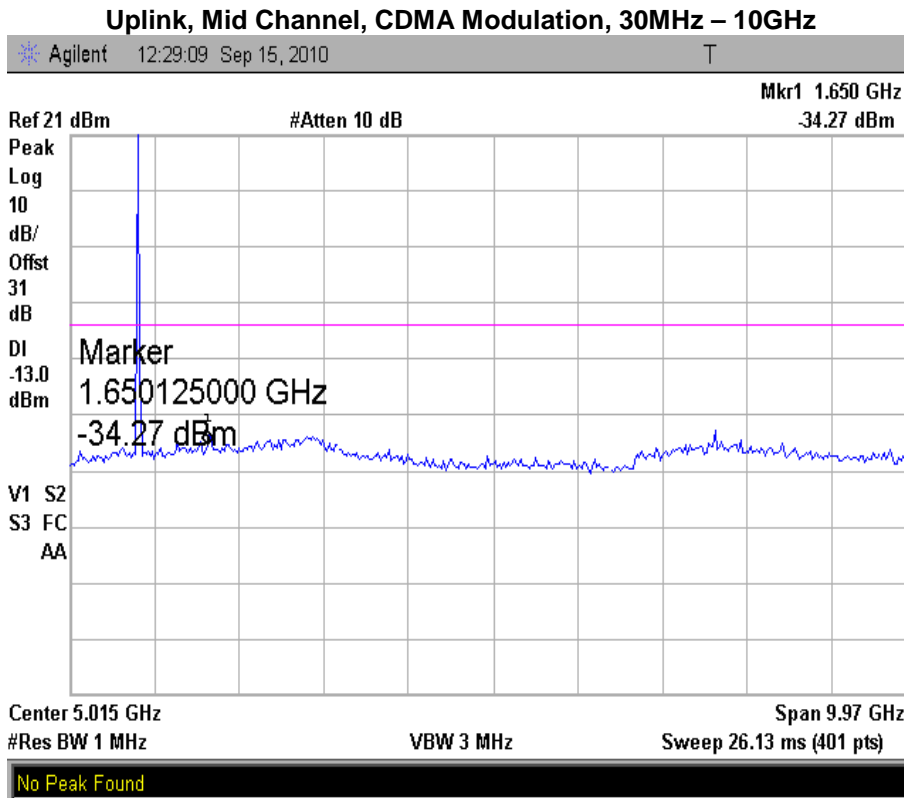
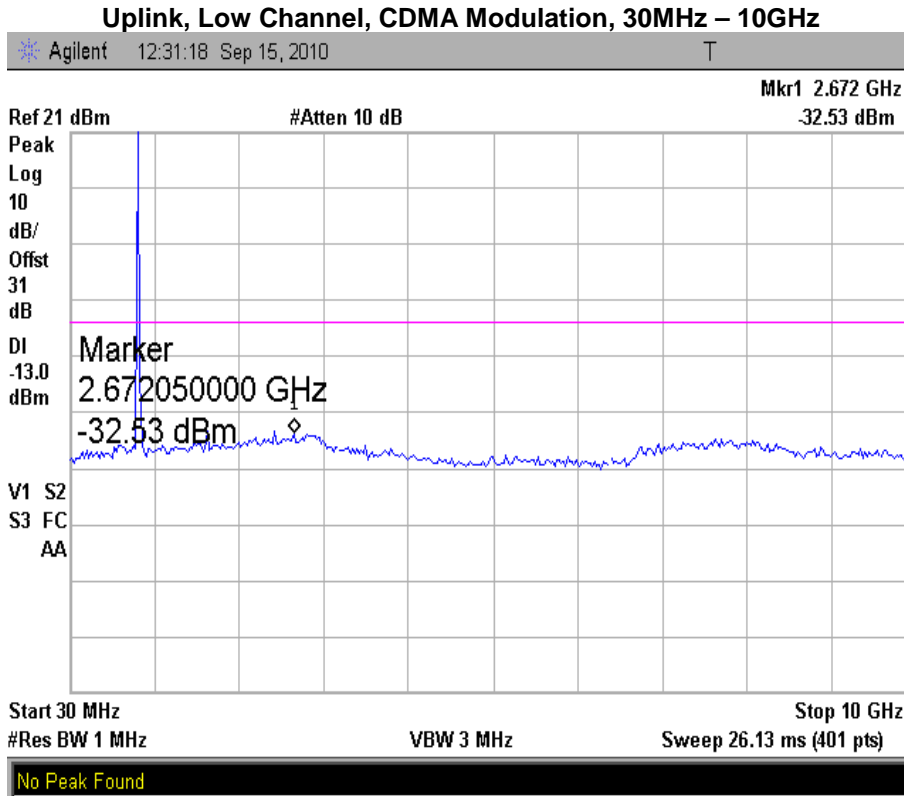
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	8/27/2010	8/27/2011
EMC Analyzer	2142	HP	E7405	9/1/2010	9/1/2011
Base Station Simulator	837198089	Rohde & Schwarz	CMU200	7/28/2010	7/28/2011
Vector Signal Generator	MY48180846	Agilent	N51882A	8/20/2010	8/20/2011
Vector Signal Generator	ESG-3000A	Hewlett Packard	ESG-3000A	10/19/2009	10/19/2010

## 6.4 Results:

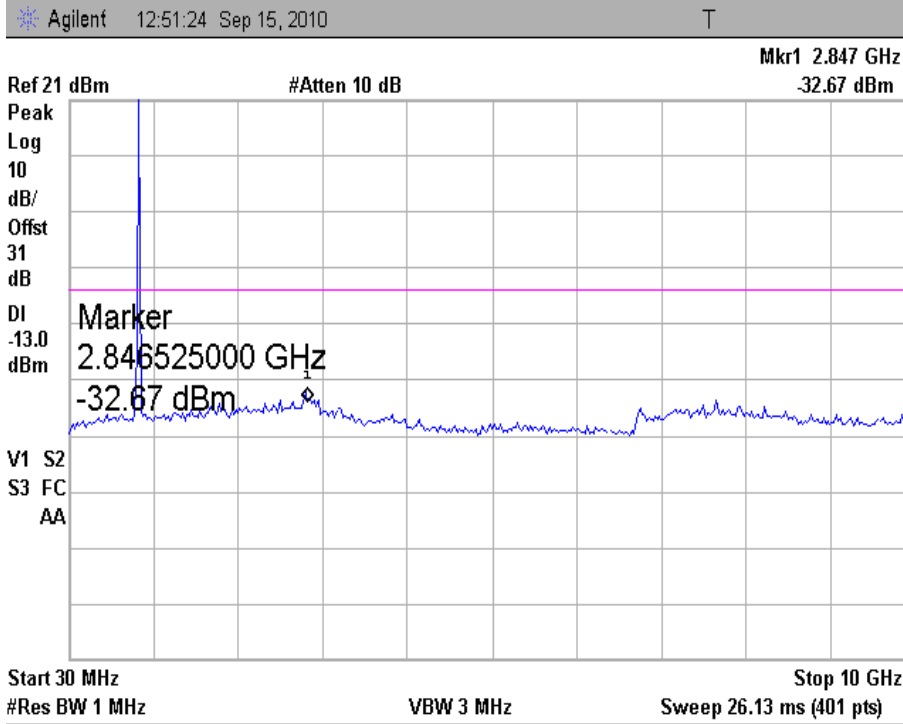
The following plots show that all spurious emissions are attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. Plots for emissions within 1MHz of the band edge as well as for emission outside of this range are shown.



**Plots for emissions more than 1MHz from the band edge:**

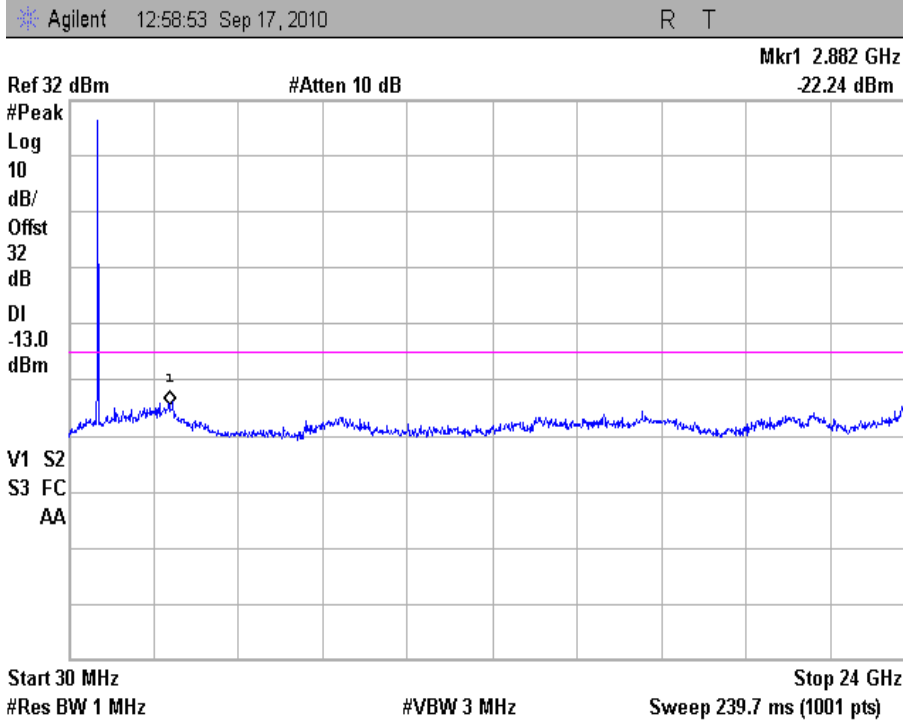


Uplink, High Channel, CDMA Modulation, 30MHz – 10GHz



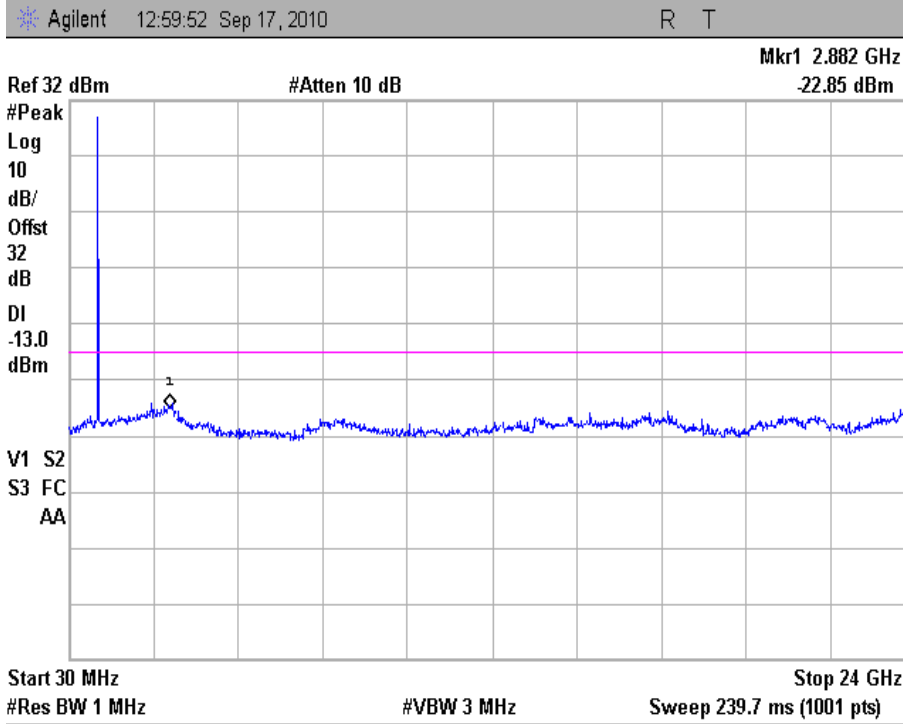
No Peak Found

Uplink, Low Channel, GSM Modulation, 30MHz – 10GHz



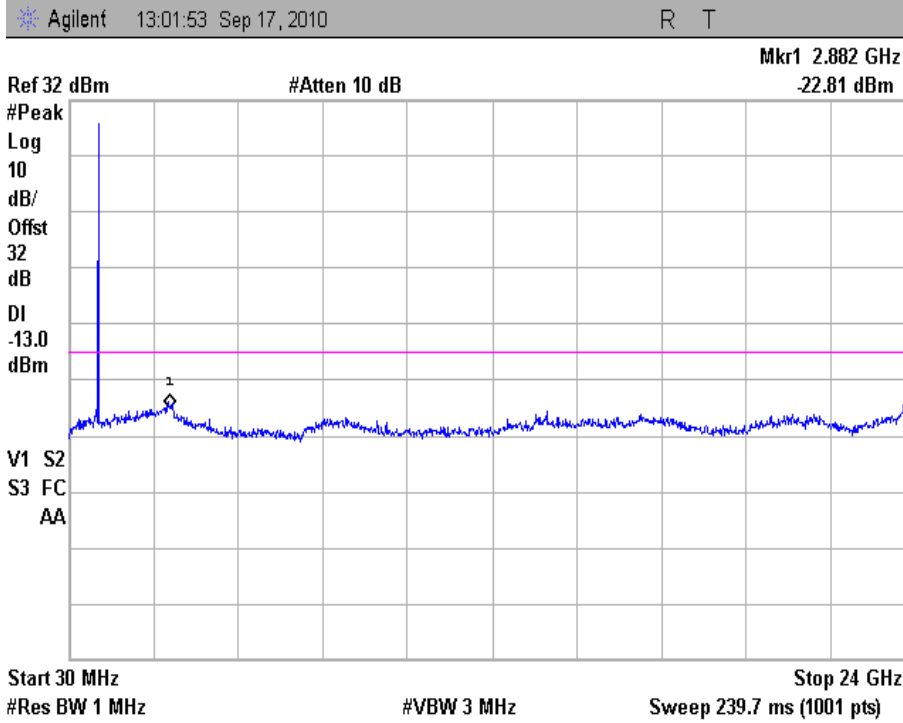
Option not installed

Uplink, Mid Channel, GSM Modulation, 30MHz – 10GHz



Option not installed

Uplink, High Channel, GSM Modulation, 30MHz – 10GHz

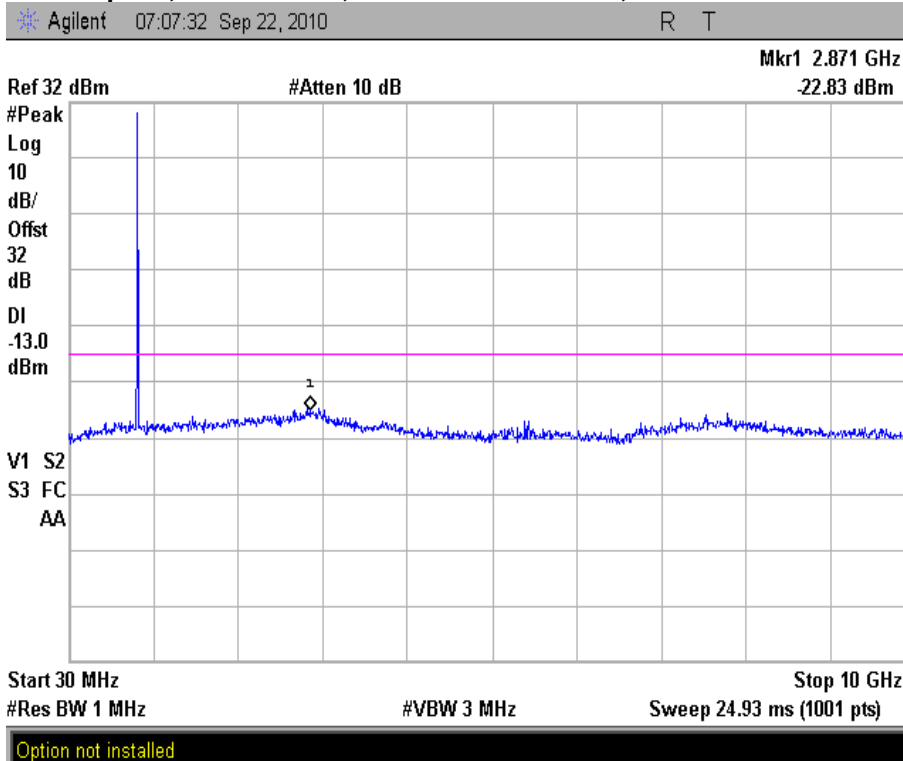


Option not installed

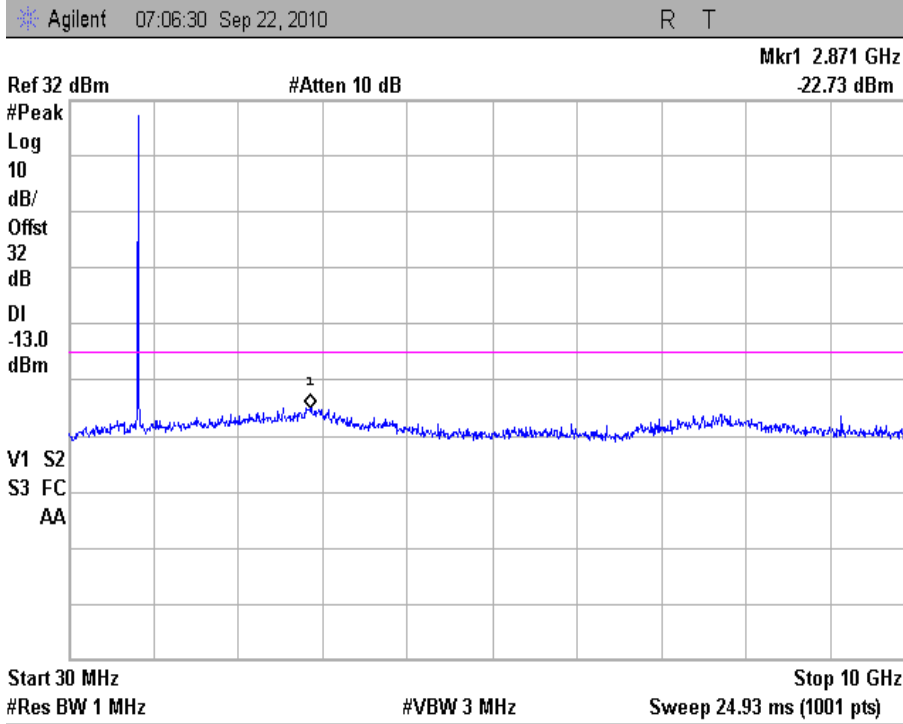
**Uplink, Low Channel, W-CDMA Modulation, 30MHz – 10GHz**



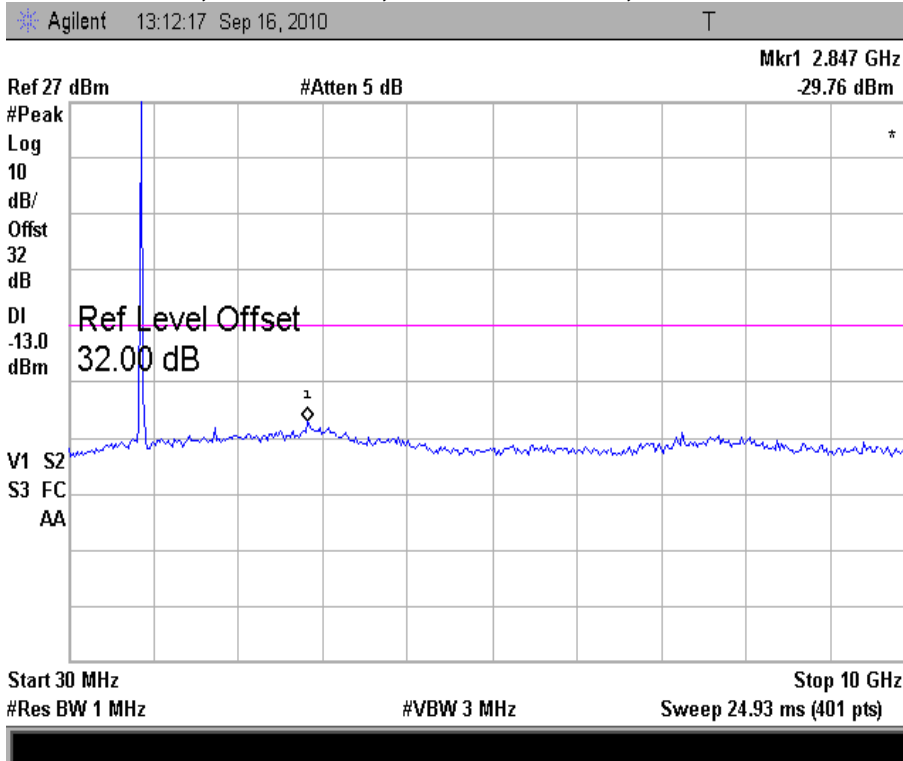
**Uplink, Mid Channel, W-CDMA Modulation, 30MHz – 10GHz**



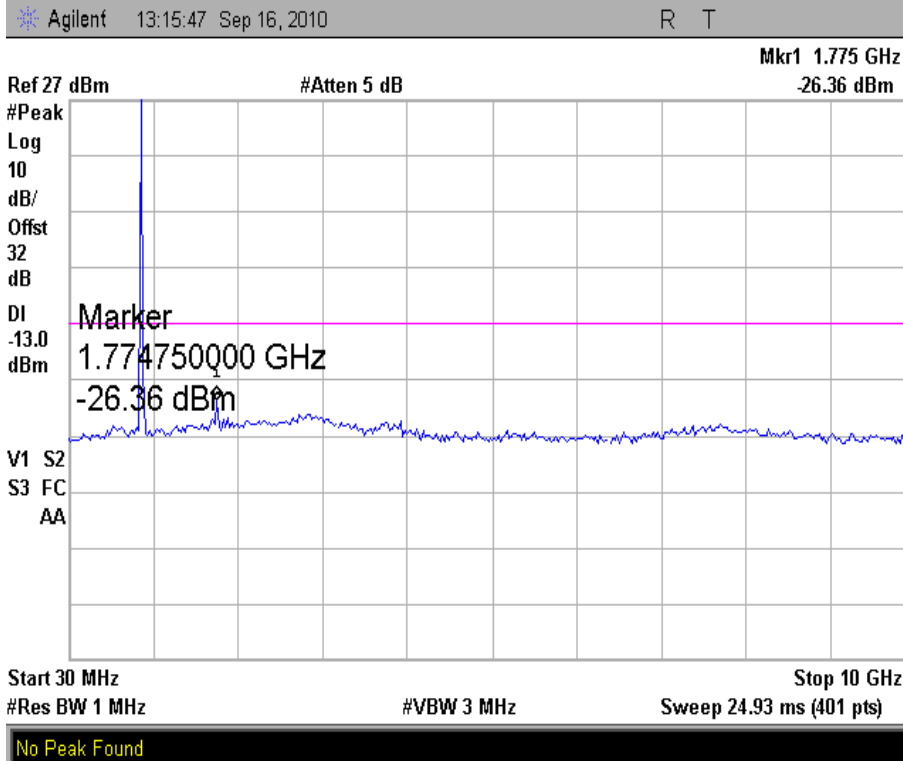
Uplink, High Channel, W-CDMA Modulation, 30MHz – 10GHz



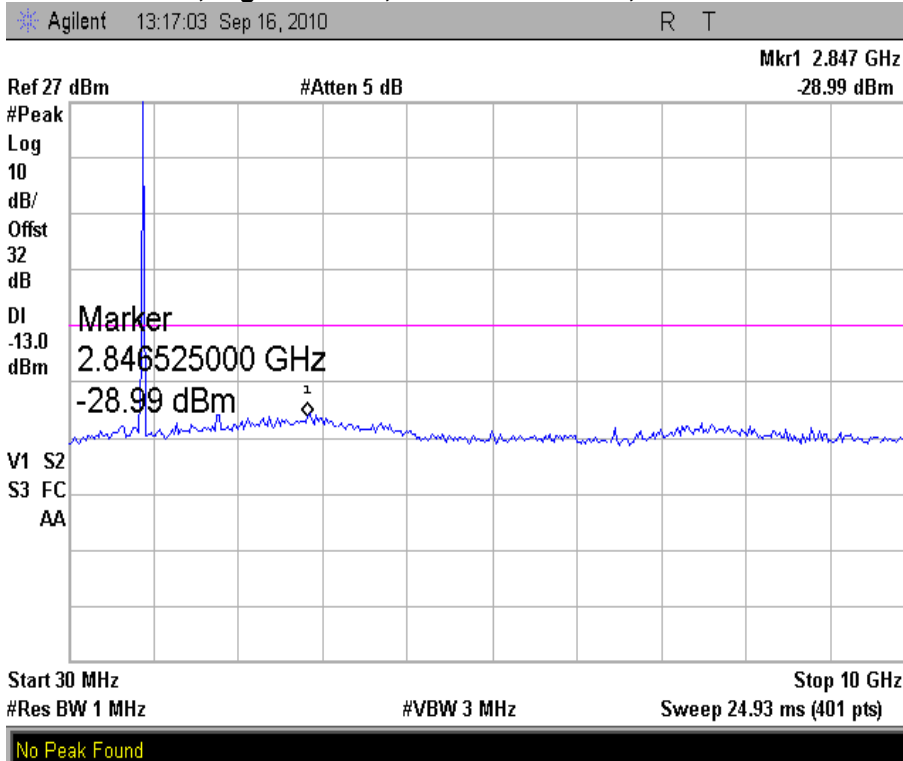
Downlink, Low Channel, CDMA Modulation, 30MHz – 10GHz



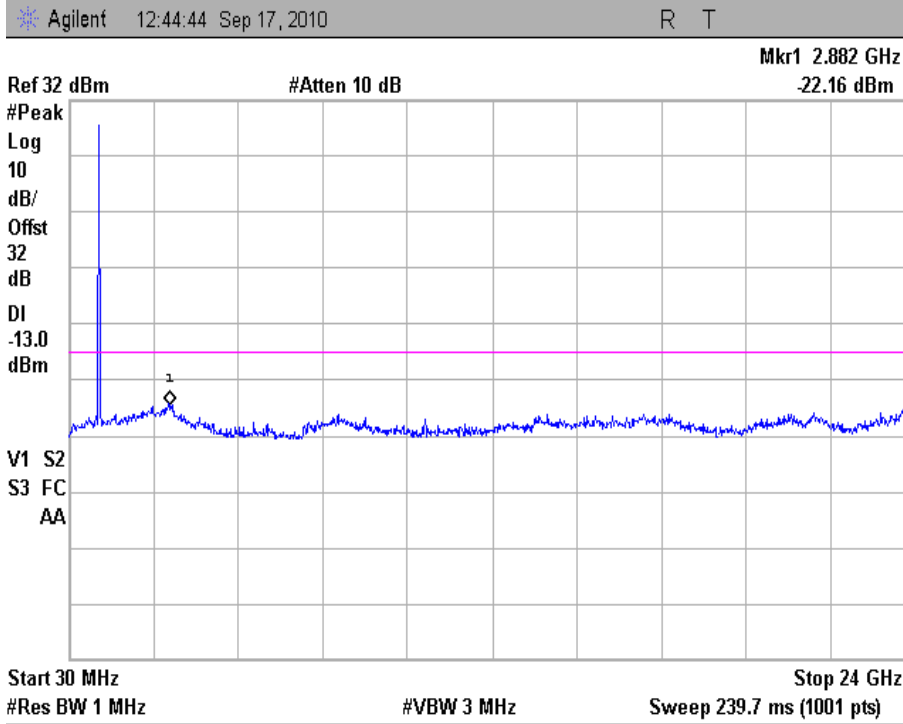
Downlink, Mid Channel, CDMA Modulation, 30MHz – 10GHz



Downlink, High Channel, CDMA Modulation, 30MHz – 10GHz

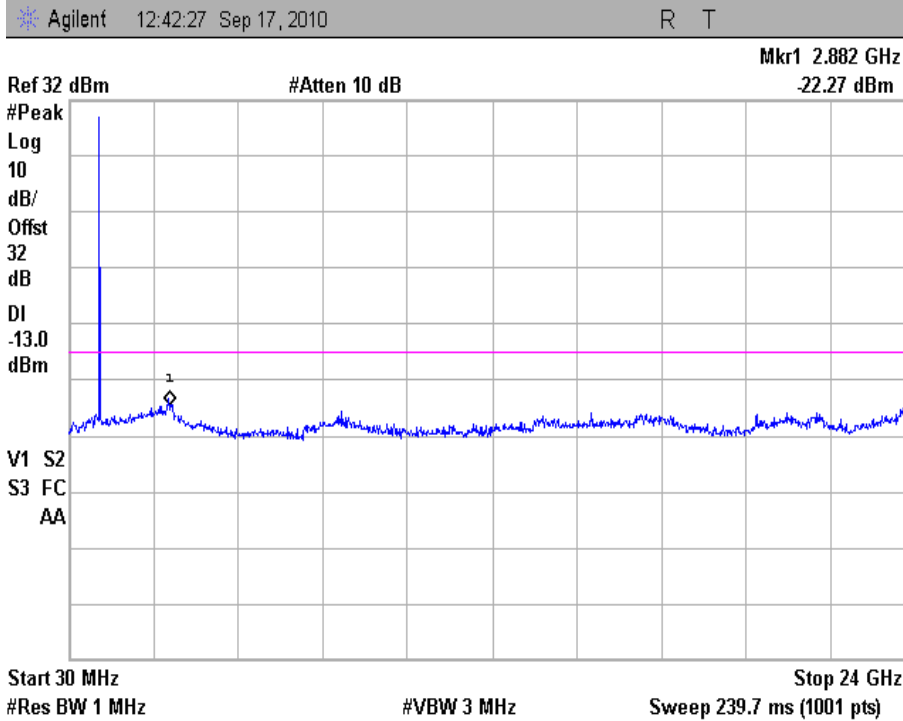


Downlink, Low Channel, GSM Modulation, 30MHz – 10GHz



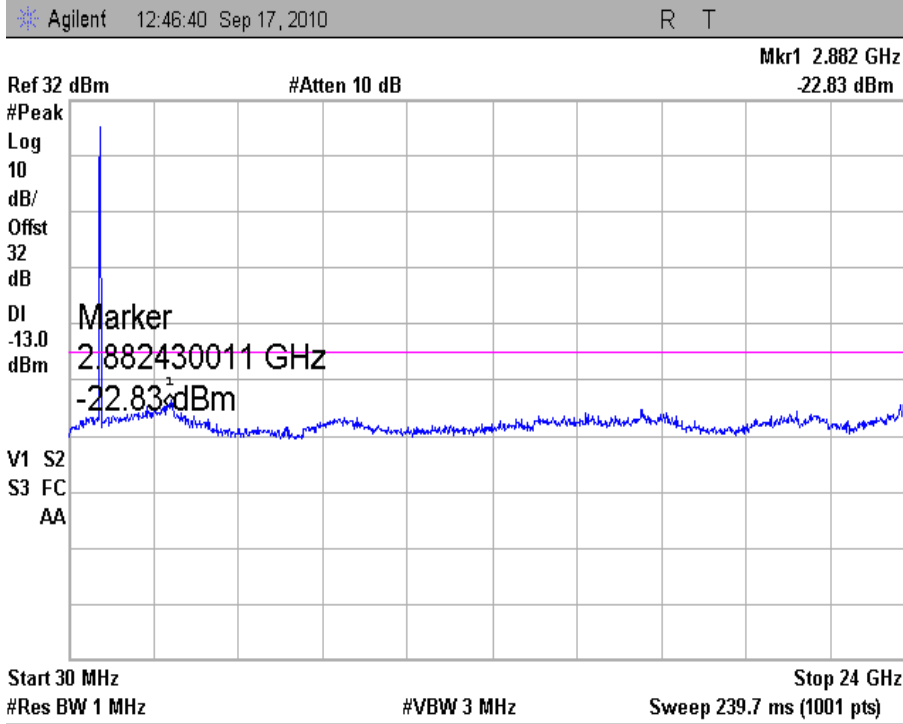
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Downlink, Mid Channel, GSM Modulation, 30MHz – 10GHz



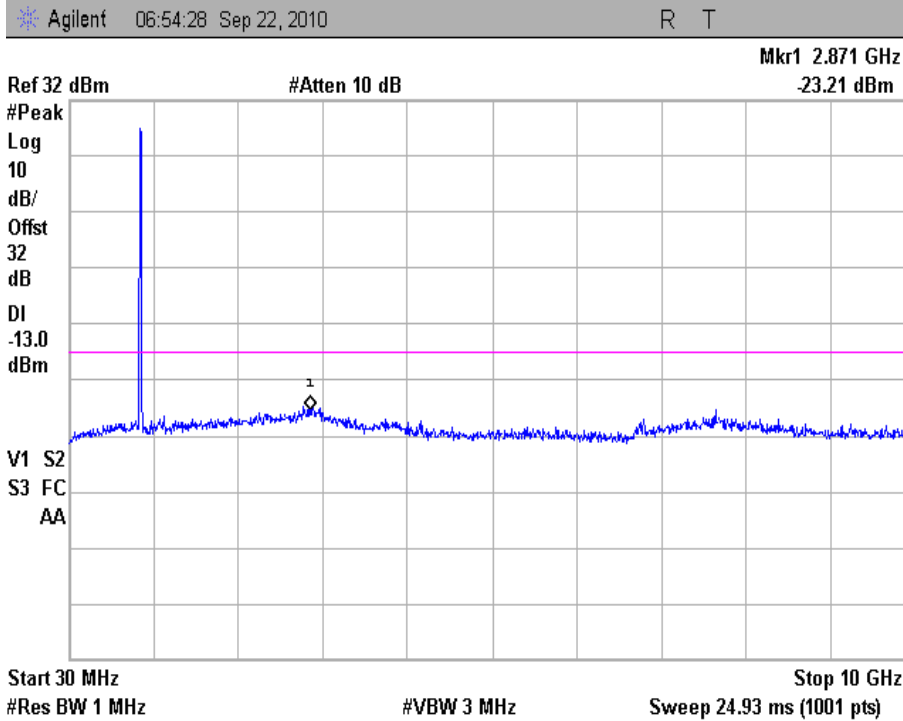
Option not installed

Downlink, High Channel, GSM Modulation, 30MHz – 10GHz



Option not installed

Downlink, Low Channel, W-CDMA Modulation, 30MHz – 10GHz

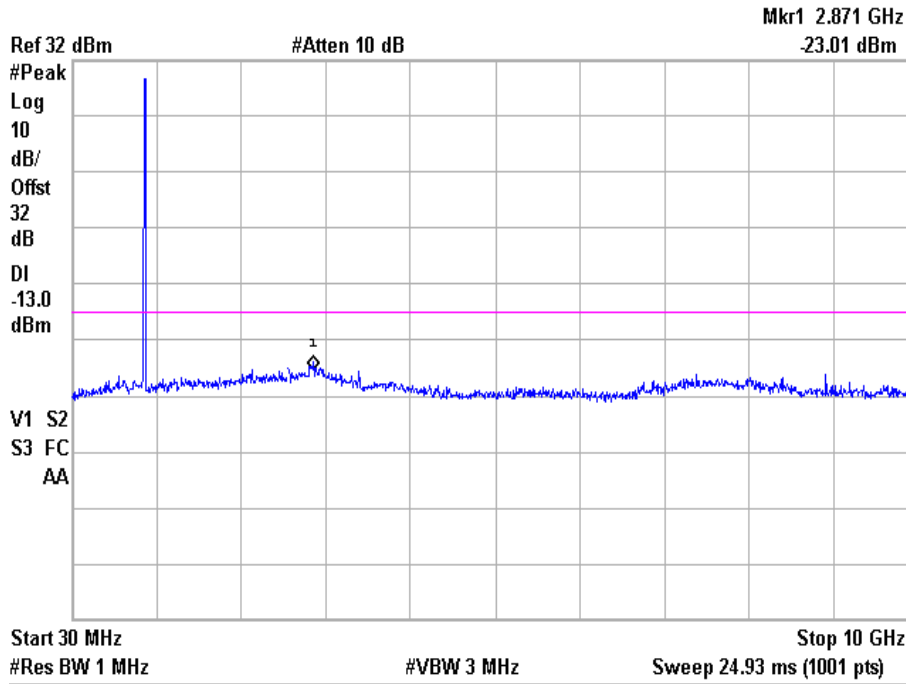


Option not installed



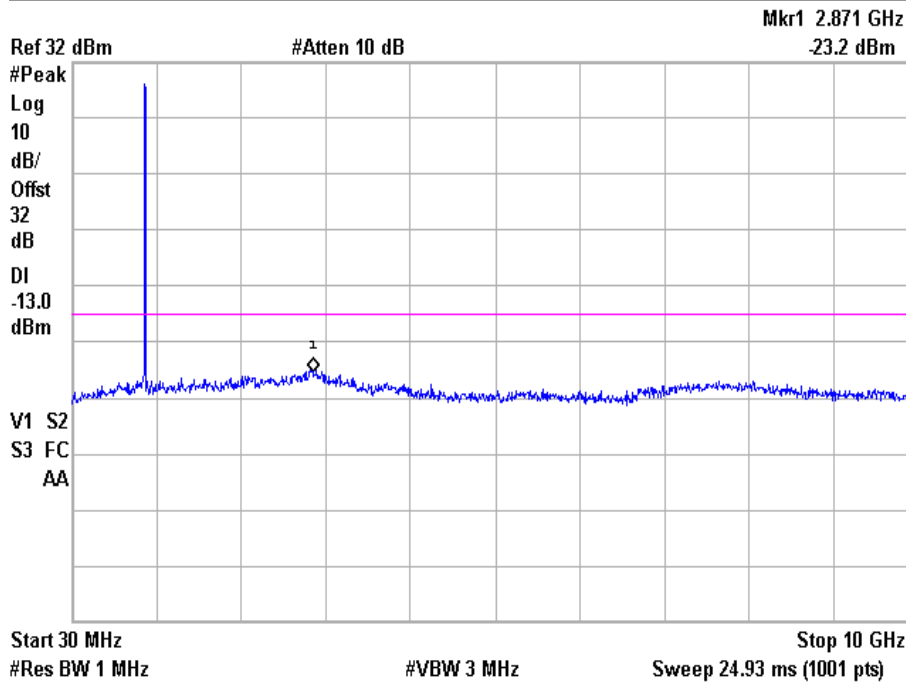
**Downlink, Mid Channel, W-CDMA Modulation, 30MHz – 10GHz**

Agilent 06:53:26 Sep 22, 2010 R T



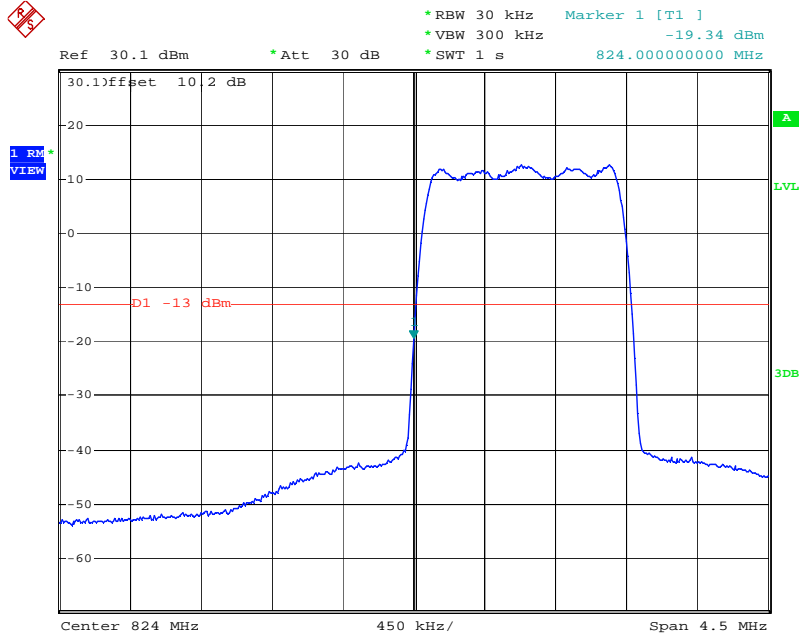
**Downlink, High Channel, W-CDMA Modulation, 30MHz – 10GHz**

Agilent 06:51:45 Sep 22, 2010 R T



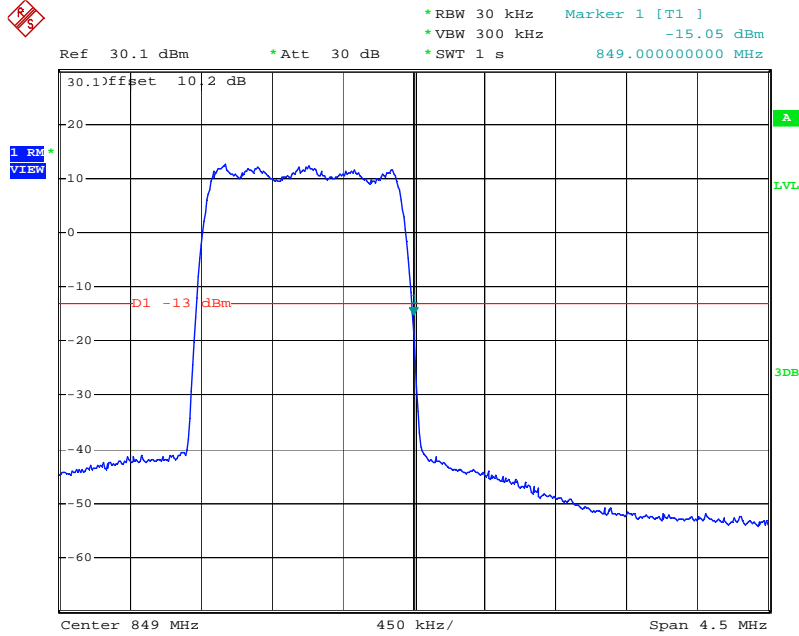
**Emissions within 1MHz of the band edge:**

**Uplink - Low Band Edge, CDMA Modulation**



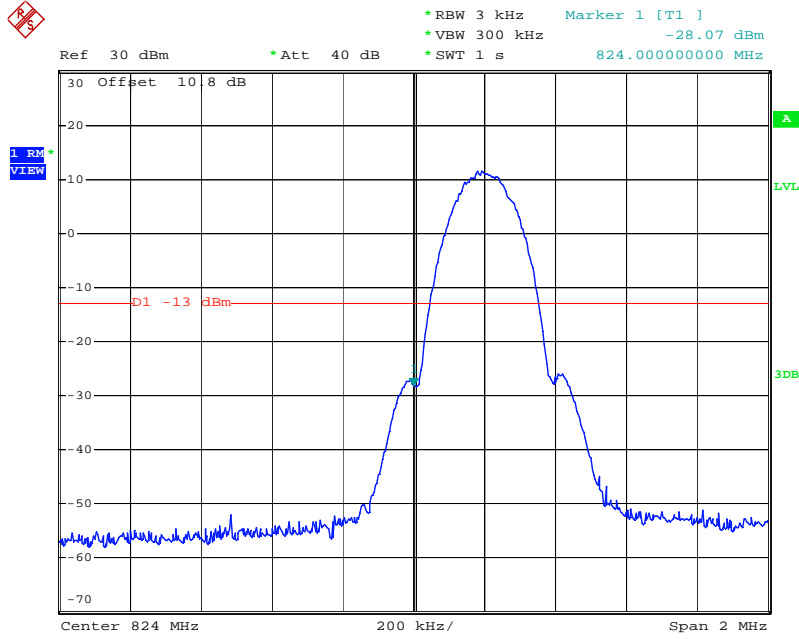
Date: 15.SEP.2010 15:24:31

**Uplink - High Band Edge, CDMA Modulation**



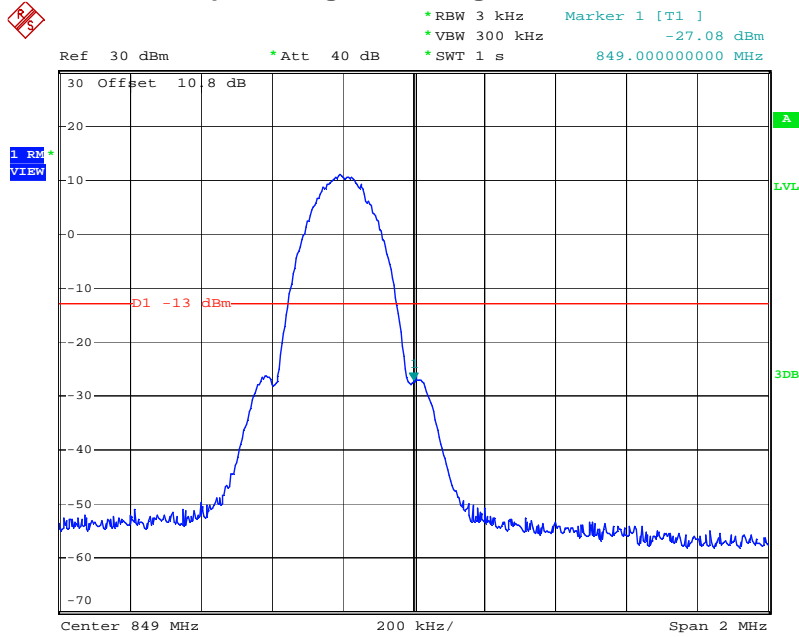
Date: 15.SEP.2010 15:23:05

### Uplink - Low Band Edge, GSM Modulation



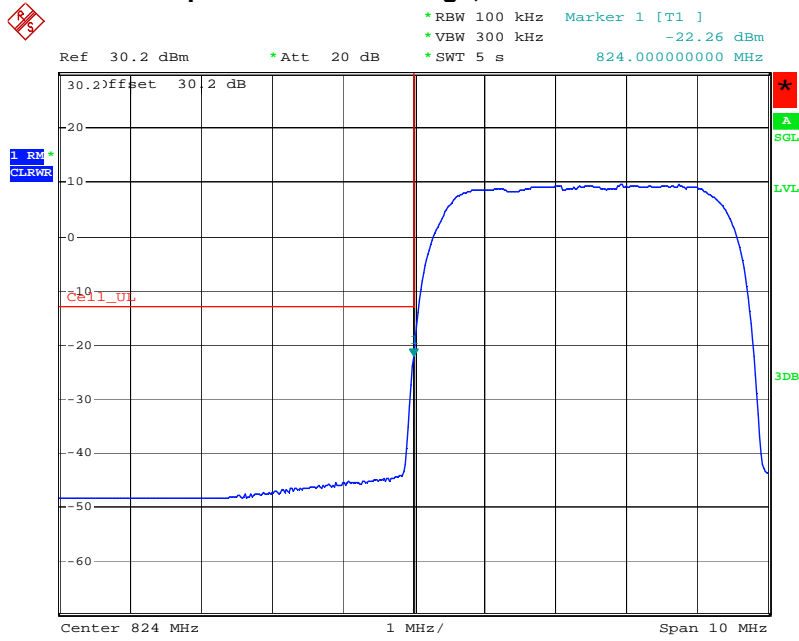
Date: 17.SEP.2010 16:34:07

### Uplink - High Band Edge, GSM Modulation



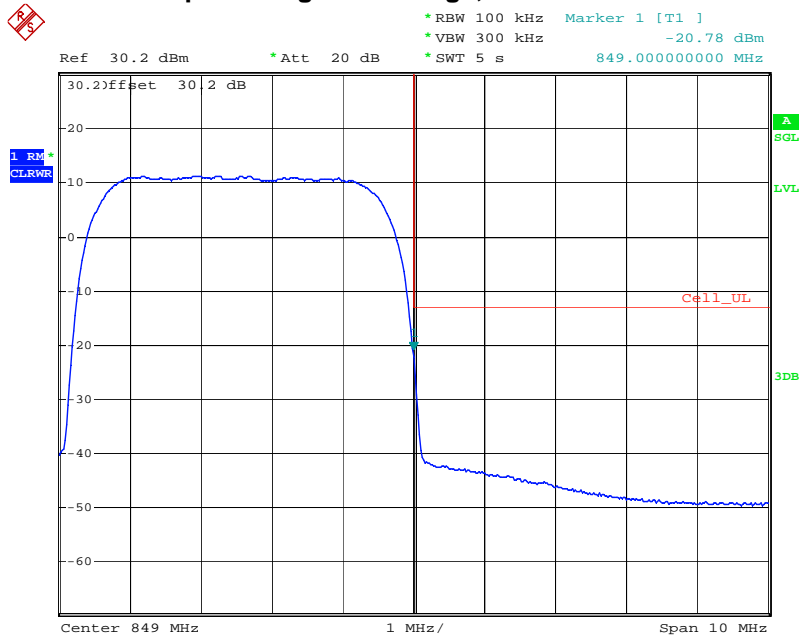
Date: 17.SEP.2010 16:33:22

### Uplink - Low Band Edge, W-CDMA Modulation



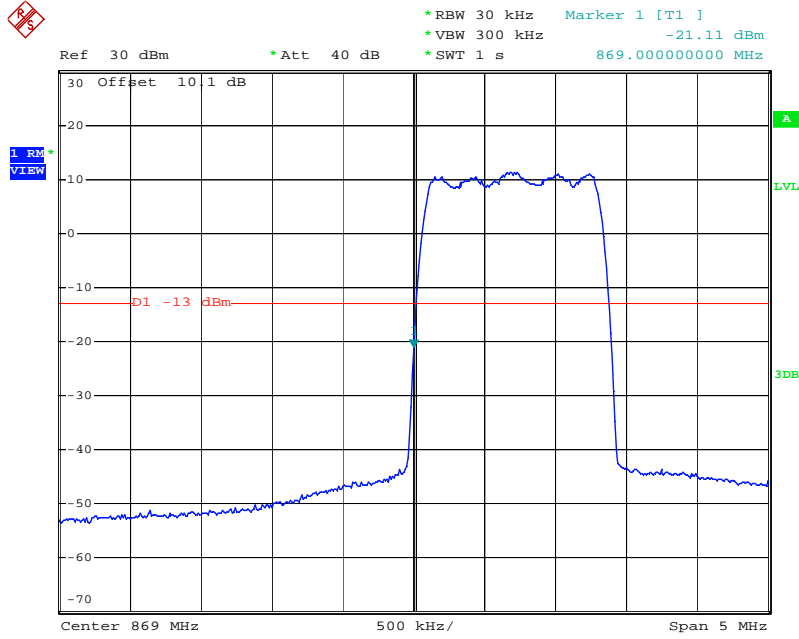
Date: 22.SEP.2010 10:18:50

### Uplink - High Band Edge, W-CDMA Modulation



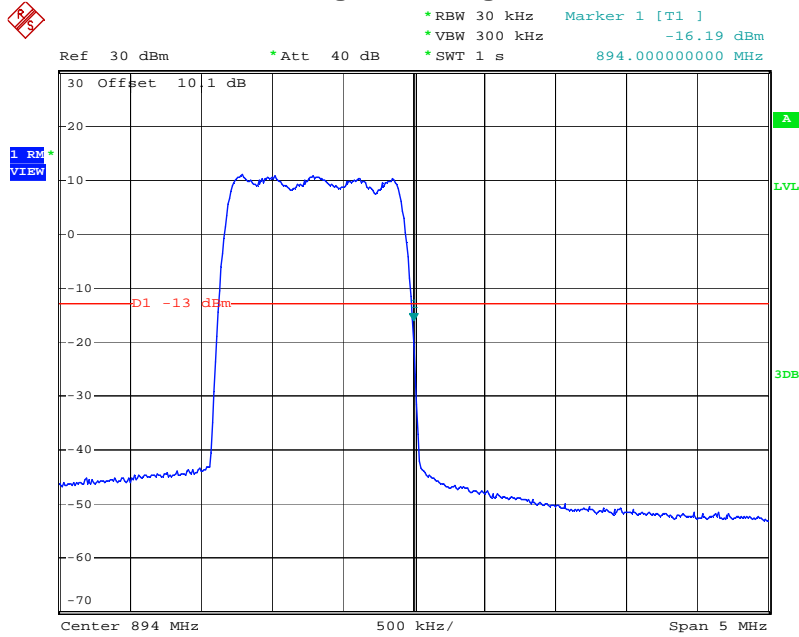
Date: 22.SEP.2010 10:19:38

### Downlink - Low Band Edge, CDMA Modulation



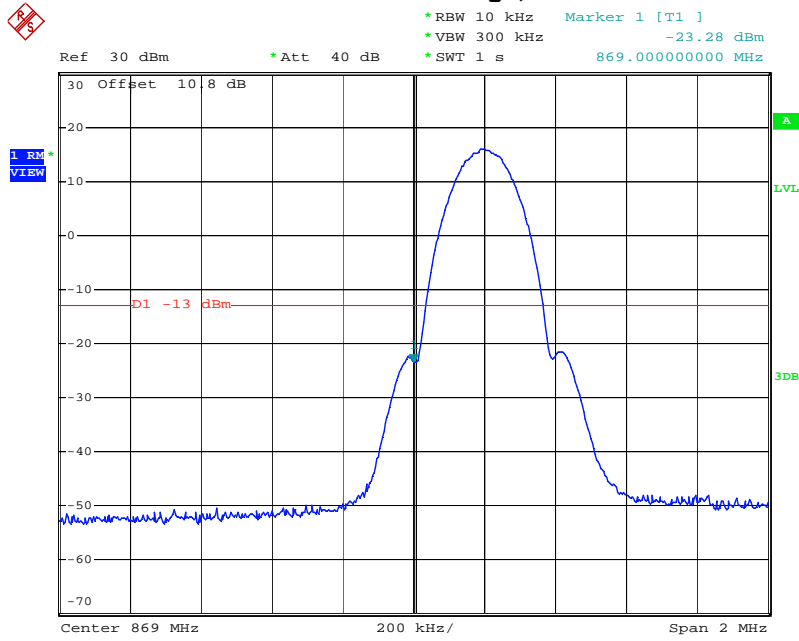
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### Downlink - High Band Edge, CDMA Modulation



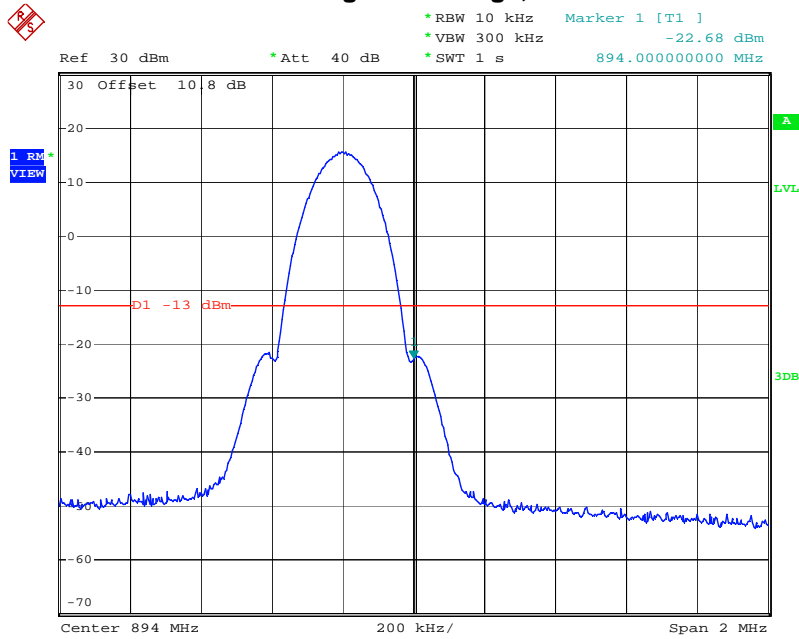
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### Downlink - Low Band Edge, GSM Modulation



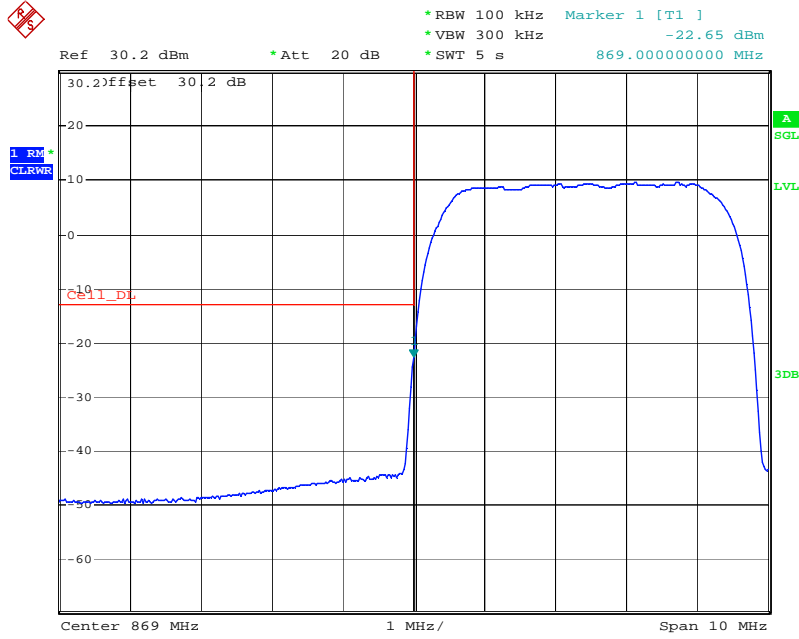
Date: 17.SEP.2010 15:53:37

### Downlink - High Band Edge, GSM Modulation



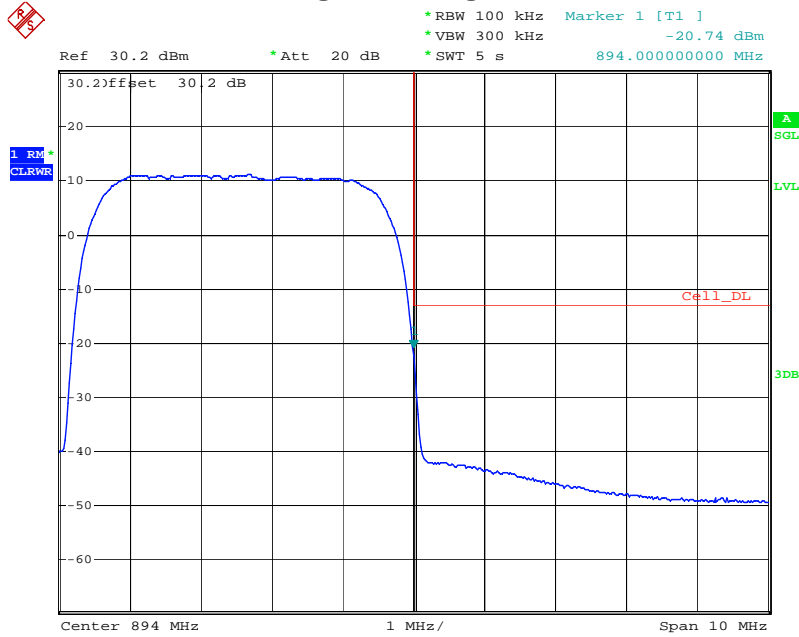
Date: 17.SEP.2010 15:54:16

### Downlink - Low Band Edge, W-CDMA Modulation



Date: 22.SEP.2010 10:10:51

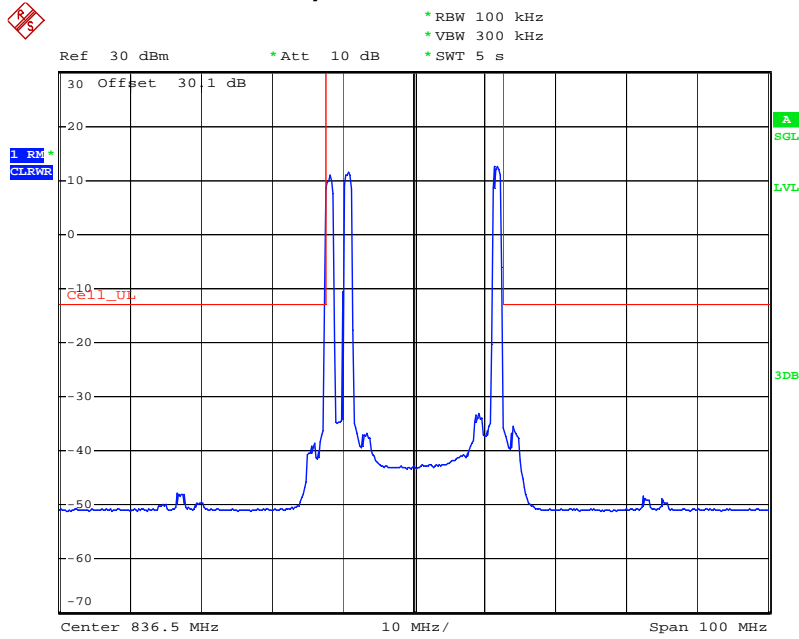
### Downlink - High Band Edge, W-CDMA Modulation



Date: 22.SEP.2010 10:11:55

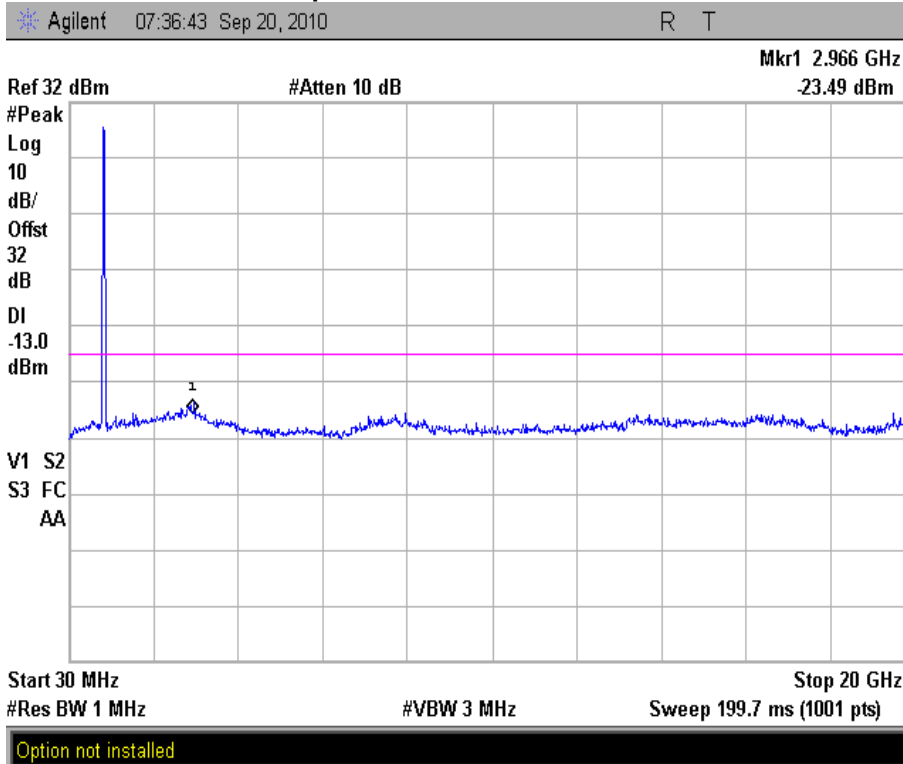
**Intermodulation – 3 tone test:**

**Uplink - CDMA Modulation**



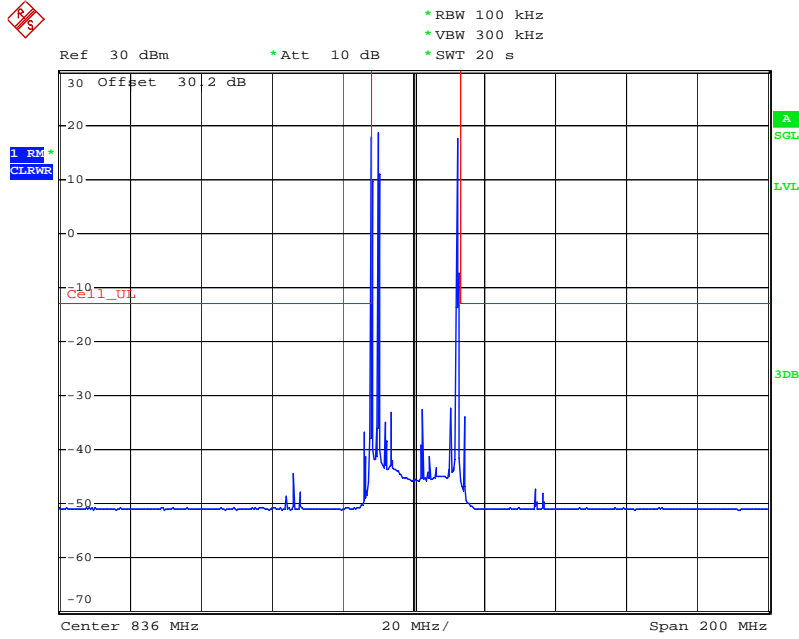
Date: 20.SEP.2010 10:55:29

**Uplink - CDMA Modulation**



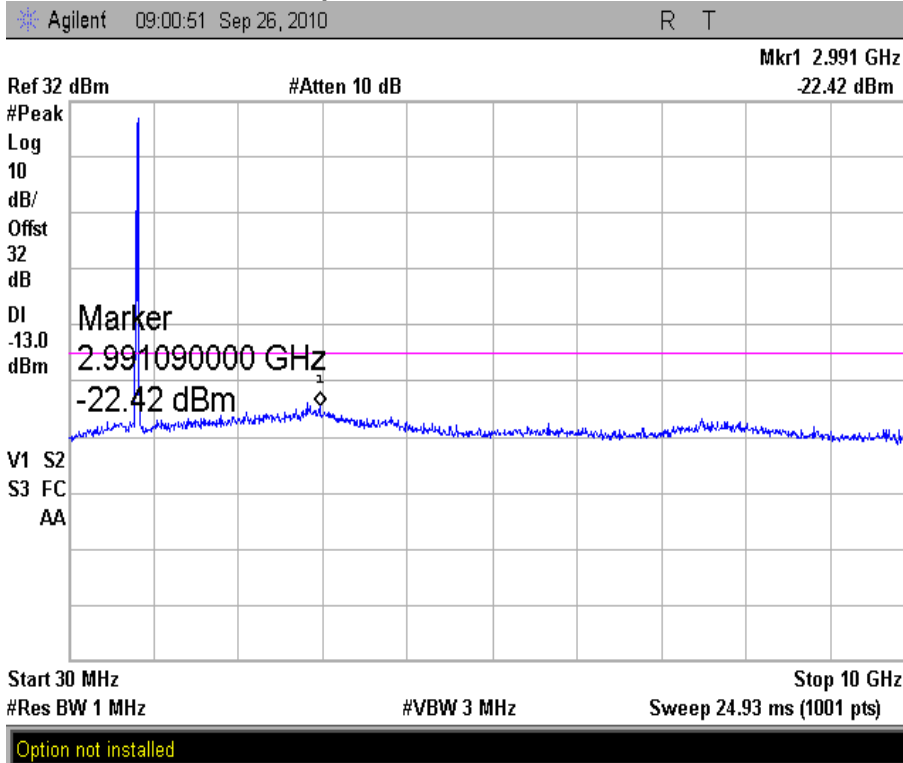


### Uplink - GSM Modulation

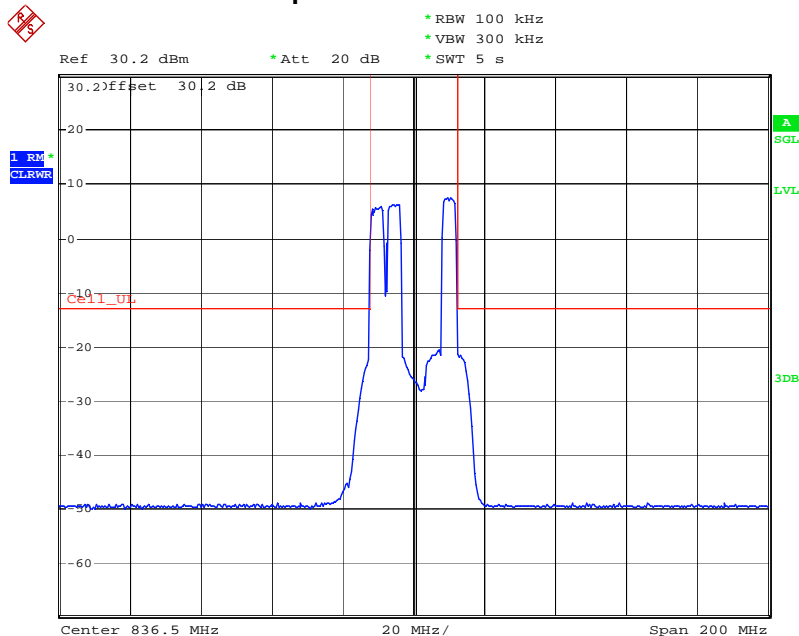


Date: 26.SEP.2010 12:31:18

### Uplink - GSM Modulation

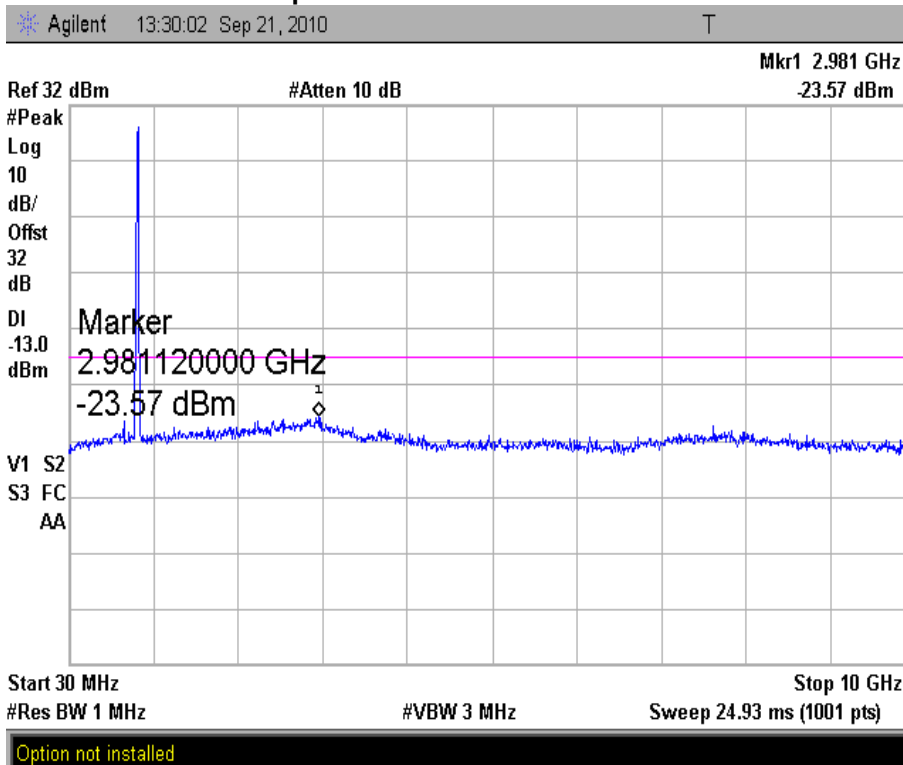


Uplink – W-CDMA Modulation

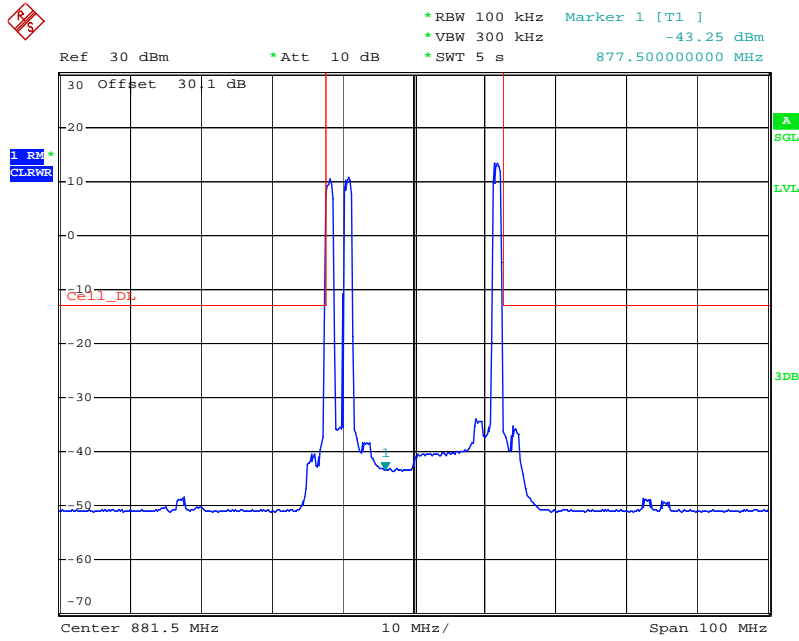


Date: 21.SEP.2010 16:49:26

Uplink – W-CDMA Modulation

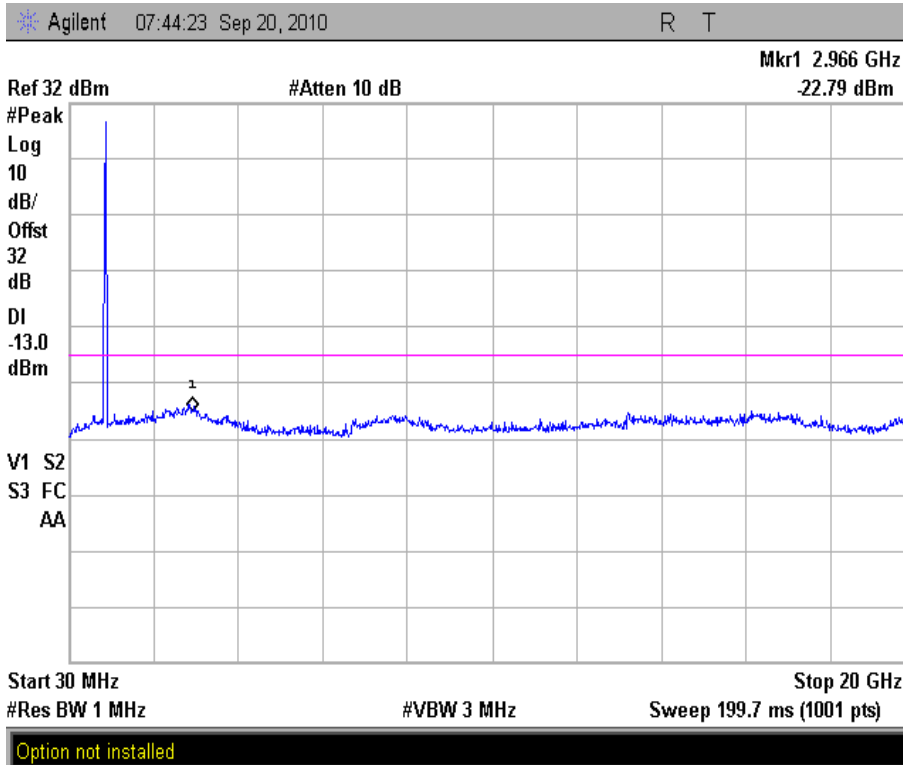


Downlink - CDMA Modulation

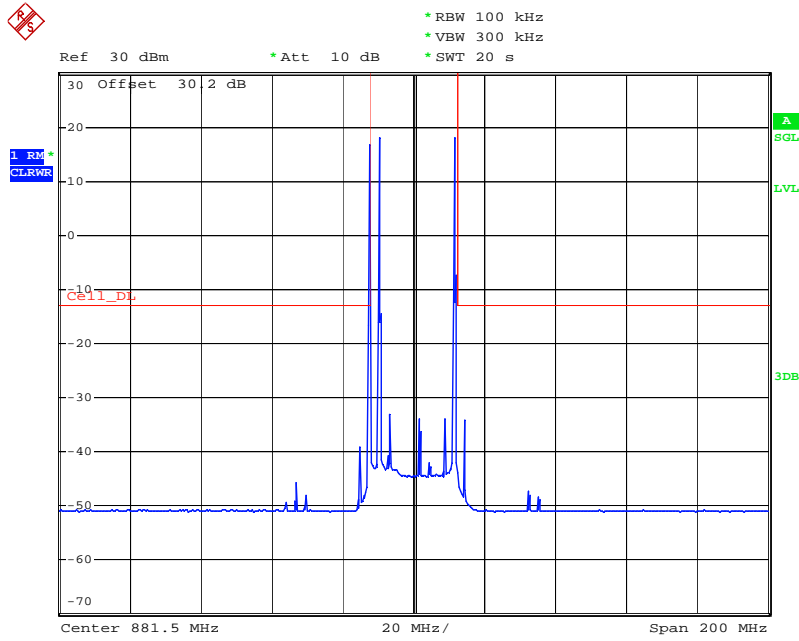


Date: 20.SEP.2010 11:11:12

Downlink - CDMA Modulation

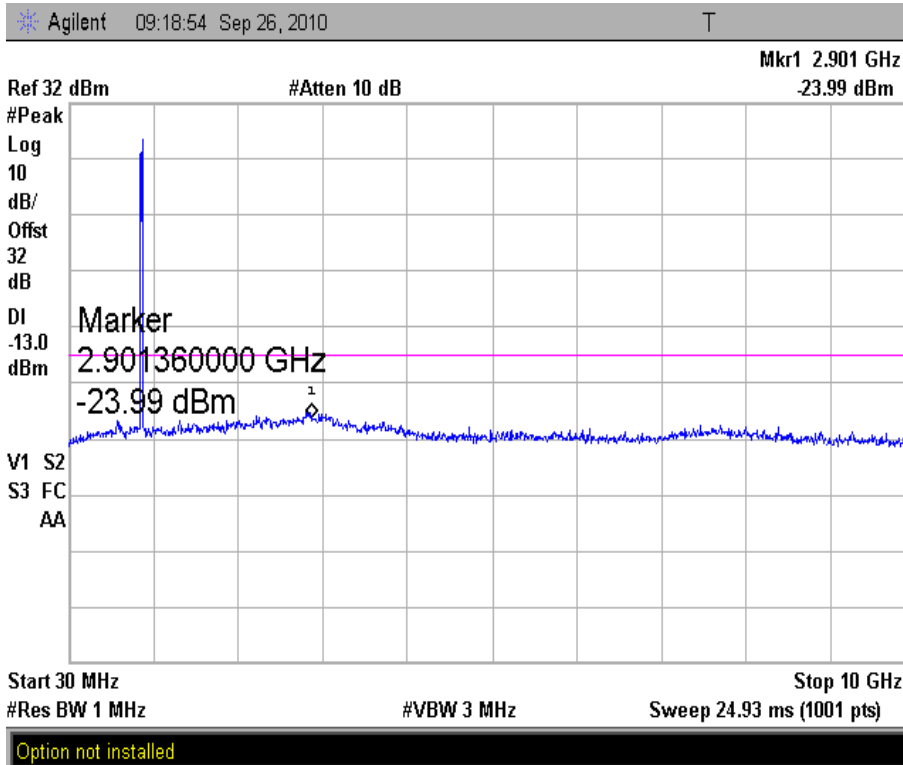


Downlink - GSM Modulation

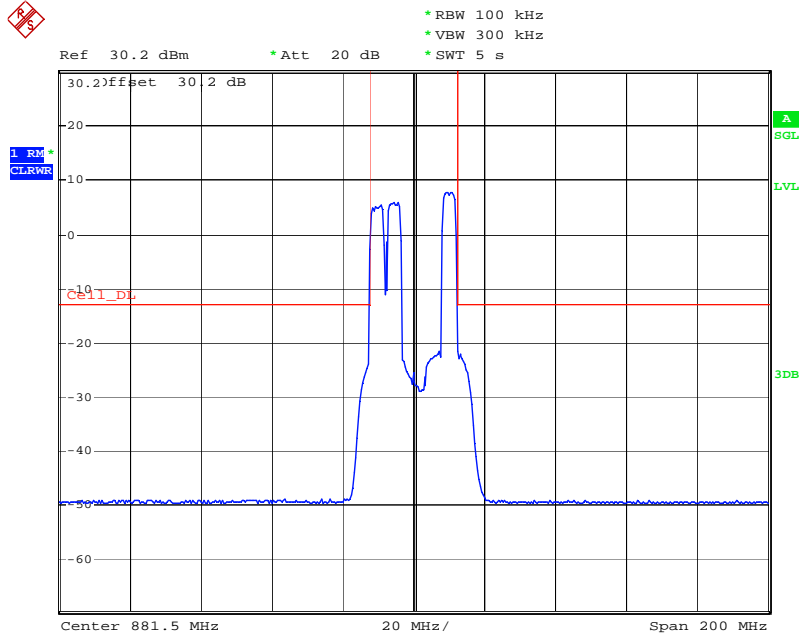


Date: 26.SEP.2010 12:37:53

Downlink - GSM Modulation

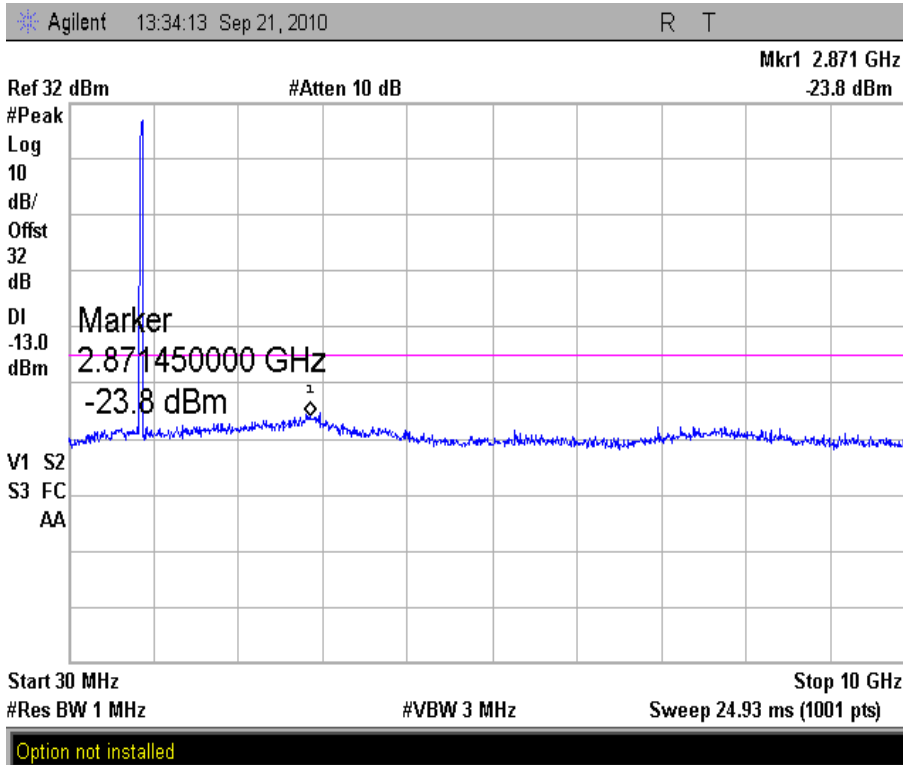


Downlink – W-CDMA Modulation



Date: 21.SEP.2010 16:58:25

Downlink – W-CDMA Modulation



## 7 Radiated Spurious Emissions (Transmitter)

### 7.1 Test Limits

#### § 2.1053

- (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

#### § 22.917

- (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.
- (b) Measurement procedure. 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.

## 7.2 Test Procedure

The EUT was placed on a non-conductive turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. The EUT was forced to transmit at its maximum output power setting. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to tenth harmonic was investigated in order to identify the spurious emission. Once the spurious emissions were identified, the power of the emission was determined using the substitution method described in TIA-603-C. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and at the spurious emissions frequency.

The amplifier was tested using a CW input signal that resulted in the rated output power. The output was connected to a 50Ω termination.

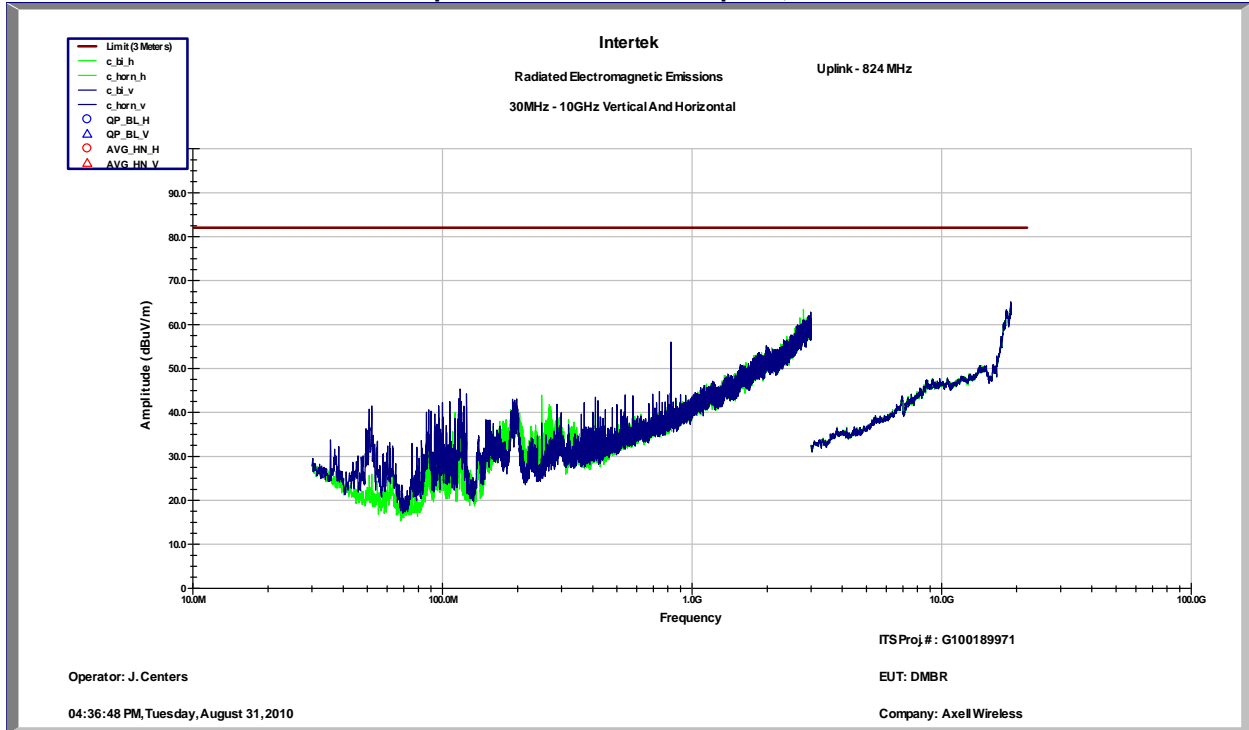
## 7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	6/29/2010	6/29/2011
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	6/17/2010	6/17/2011
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	2/12/2010	2/12/2011
Biconnilog Antenna	00051864	ETS	3142C	12/21/2009	12/21/2010
Horn Antenna	6556	ETS	3115	7/8/2010	7/8/2011
Horn Antenna	1096	Antenna Research	DRG-118/A	8/9/2010	8/9/2011
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	2/10/2010	2/10/2011
Vector Signal Generator	U537040988	Hewlett Packard	ESG-3000A	10/19/2009	10/19/2010
50Ω termination	2307	Bird	50-T-MN	2/10/2010	2/10/2011

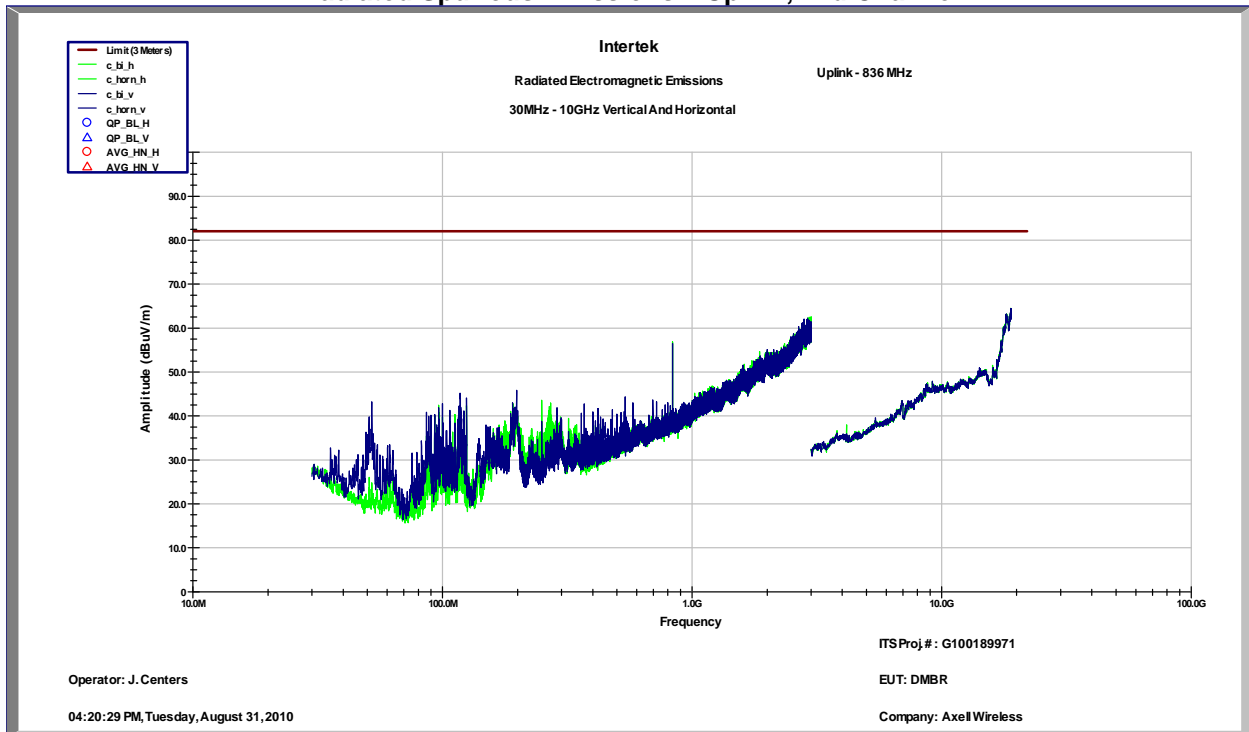
7.4 Results:

All radiated spurious emissions were attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. Radiated spurious emissions from the device were investigated up to the tenth harmonic of the fundamental. There were no radiated spurious emissions within 20dB of the limit.

Radiated Spurious Emissions – Uplink, Low Channel

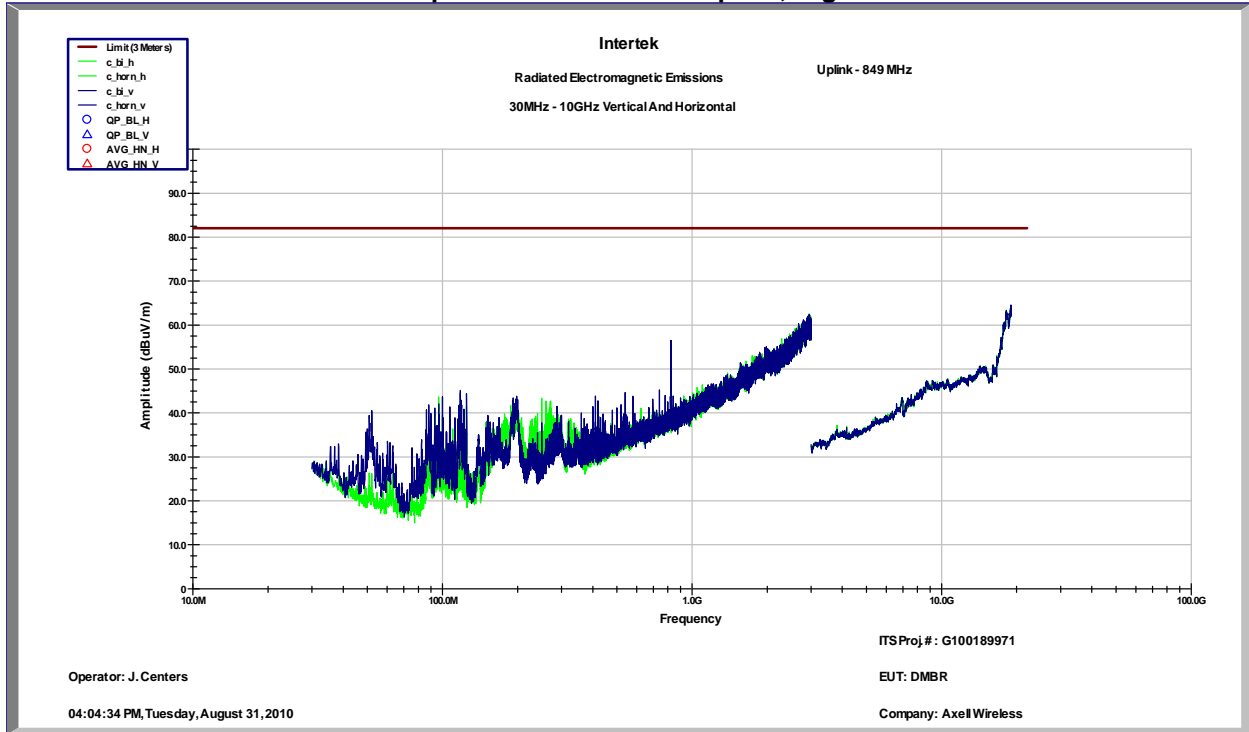


Radiated Spurious Emissions – Uplink, Mid Channel

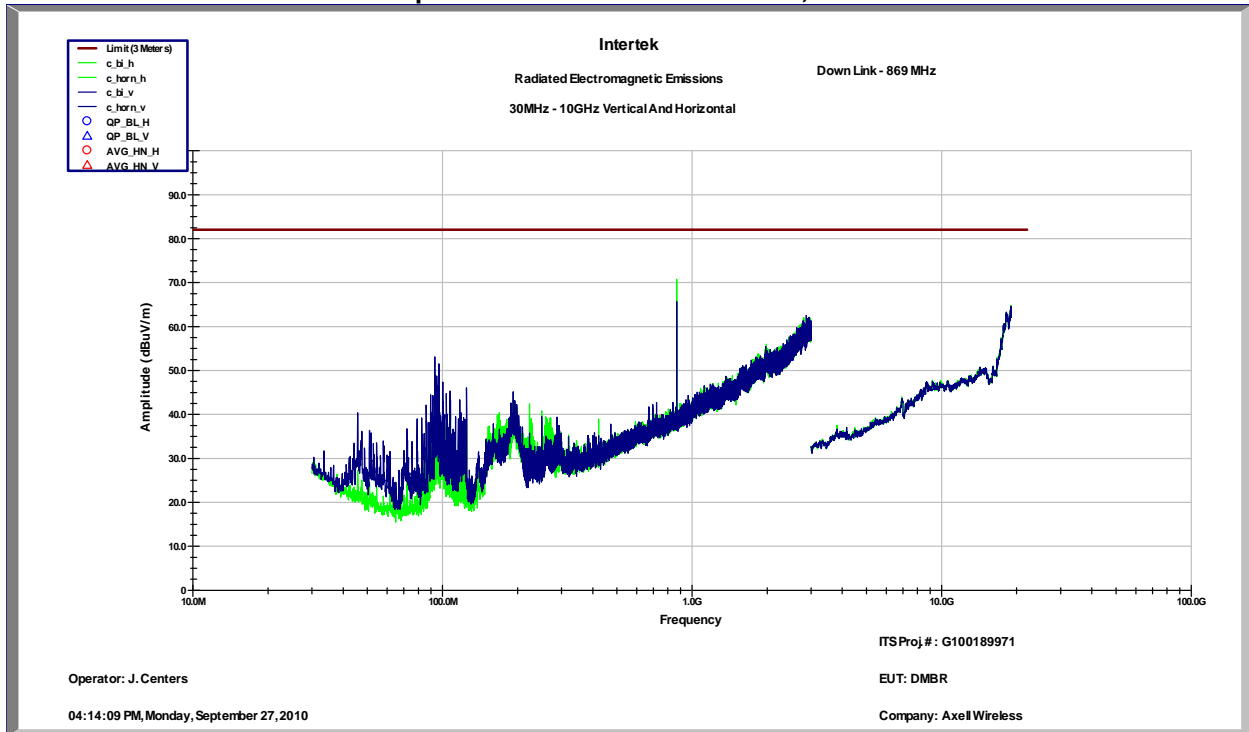




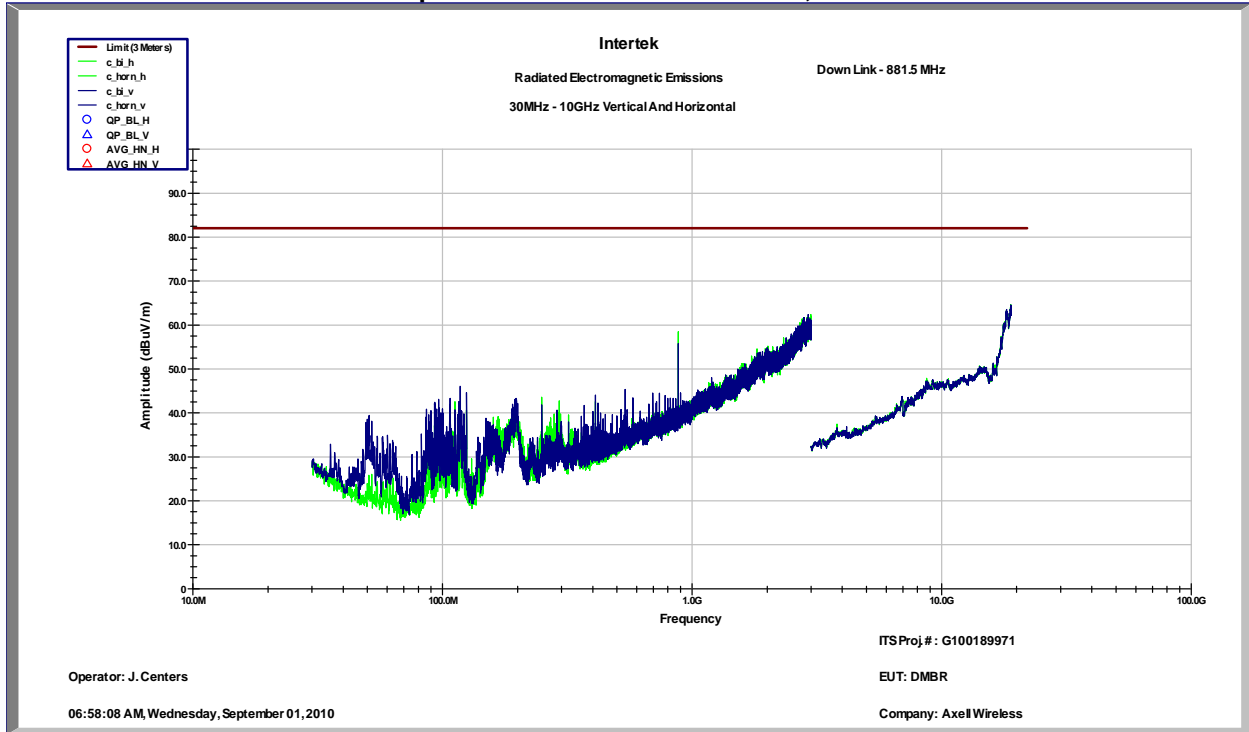
Radiated Spurious Emissions – Uplink, High Channel



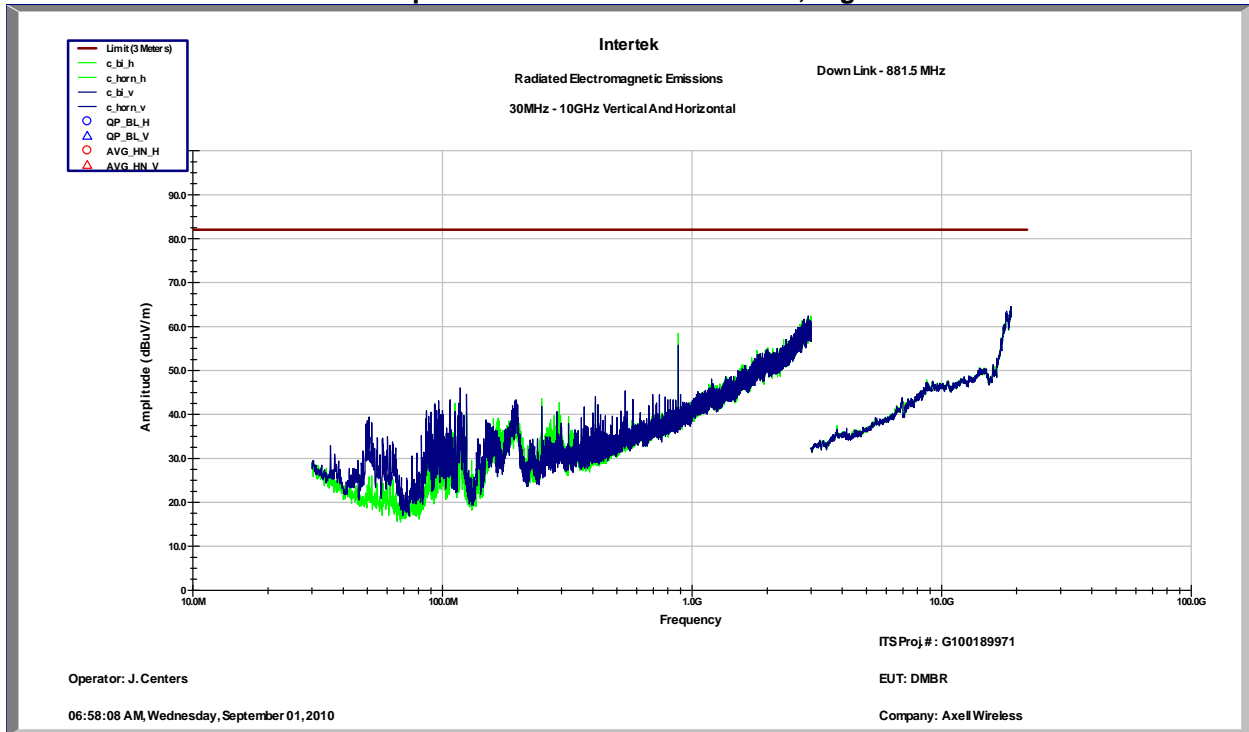
Radiated Spurious Emissions – Downlink, Low Channel



Radiated Spurious Emissions – Downlink, Mid Channel



Radiated Spurious Emissions – Downlink, High Channel



## 8 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of  $k = 2$ , providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	+3.9dB	
Radiated emissions, 1 to 18 GHz	+4.2dB	
Radiated emissions, 18 to 40 GHz	+4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	+2.8dB	

**9 Revision History**

Revision Level	Date	Report Number	Notes
0	10/22/2010	100189971-LEX-001	Original Issue