Test Report Summary

FCC CFR 47, Part 22
Subpart H Cellular Radiotelephone Service

Manufacturer: ADC Telecommunications

Name of Equipment: InterReach® picoBTS 800 MHz

Model Number(s): IRB-IBTS-A20N00

Manufacturer's Address: P.O. Box 1101
Minneapolis, MN 55440-1101

Test Report Number: MN090106_Cellular

Test Date(s): 21 November, 2008 (ETL)
1 December, 2008 (ADC)

According to testing performed at Intertek, the above-mentioned unit is in accordance with the applicable electromagnetic compatibility (EMC) portions of the requirements defined in FCC Part 22.

It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

All testing was done in accordance with the Federal Communications Commission's CFR 47 Part 22 and the EUT fulfills the requirements of the Federal Communications Commission's CFR 47 Part 22.

Date: 6 January, 2009

Location:

Intertek Testing Services (ETL)
7250 Hudson Blvd., Suite 100
Oakdale, MN 55128
Phone: (651) 730-1188
Fax: (651) 730-1282

ADC Telecommunications
1187 Park Place
Shakopee, MN 55379
Phone: (952) 403-8340

Testing Conducted by (ADC):
And Report Written by:

Mark F. Miska
Compliance Engineer

EMC Emission – T E S T R E P O R T

Test Report File Number: MN090106_Cellular **Date of Issue:** 6 January, 2009

Model Number(s): IRB-IBTS-A20N00

Product Name: InterReach® picoBTS 800 MHz

Product Type: Base Transceiver Station

Applicant: ADC Telecommunications

Manufacturer: ADC Telecommunications

License Holder: ADC Telecommunications

Address: P.O. Box 1101
Minneapolis, MN 55440-1101

Test Result: ■ **Positive** □ Negative

Test Project Number: 3163123MIN-001
Reference(s)

Total pages including Appendices: 42

1.0 TABLE OF CONTENTS

2.0 REVISION DESCRIPTION

Rev	Total Pages	Date	Description
A	42	6 January, 2009	Original Release

3.0 DOCUMENTATION

3.1 Test Regulations

22.355 Frequency Tolerance
22.913 Effective Radiated Power Limits
22.917 Emission Limitations for Cellular

The emissions tests were performed according to the following regulations:

■ **FCC Part 22**

□ FCC Part 24

□ FCC Part 90

□ IC RSS-131 Issue 2

Environmental Conditions in the lab:

ADC	**ETL**
Temperature: 25º C	15-35º C
Relative Humidity: 48%	30-60%
Atmospheric Pressure: 98.2 kPa	86-106 kPa

Power Supply Utilized:
Power Supply System : 120 VAC, Single Phase

3.2 Test Operation Mode

☐ Standby

☐ Test Program

☐ Practice Operation

■ **Max composite in and out**

3.3 Configuration of the Device Under Test:

Normal Operation – Cellular - 869 to 894 MHz

3.4 Product Options:

None

3.5 EUT Specifications and Requirements:

Length: 16.0”
Width: 17.0”
Height: 3.5”
Weight: 24 pounds

3.6 Cables:

Cable Type	Length	From	To
RF	< 3M	EUT	50 Ohm Load
Power	< 3M	Power	Input Power
Network	> 3M	Ancillary Equip	EUT

3.7 Power Requirements:

Voltage: 120 VAC
Amps: 2.2 A

3.8 Typical Installation and/or Operating Environment:

Indoor only. System is typically employed as an Indoor Base Transceiver Station.

3.9 Other Special Requirements:

None

3.10 EUT Software:

Revision Level: Version V.1.1.3.1
Description: Spirit

3.11 EUT System Components

Description	Model #	Serial #	FCC ID #
picoBTS	IRB-IBTS-A20N00	None	

3.12 Support Equipment

Description	Manufacturer	Model #	FCC ID #
Power Meter	HP	EPM-441A	
Attenuator	Aeroflex	86-30-12	

3.13 Deviations from Standard:

Modifications required to pass:

☐ As indicated on the data sheet(s)

■ **None**

Test Specification Deviations; Additions to or Exclusions from:

☐ As indicated in the Test Plan

■ **None**

3.14 General Remarks:

None.

3.15 Summary:

The requirements according to the technical regulations are

■ **met**

☐ not Met

The equipment under test does

■ **fulfill the general approval requirements mentioned in Section 3.1.**

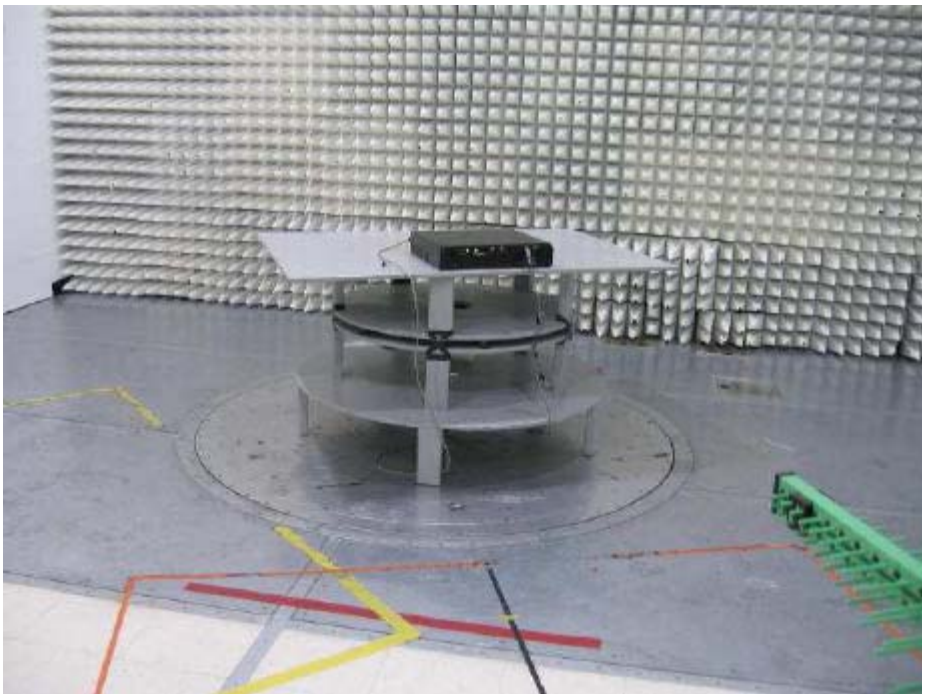
☐ not fulfill the general approval requirements mentioned in Section 3.1.

4.0 TEST SET-UP DRAWINGS AND PHOTOS

Table of Contents; Section 1.0

4.1 Test Set-up Photo, Radiated Emissions

4.2 Test Set-up Photo, Radiated Emissions



4.3 Test Set-up Drawings

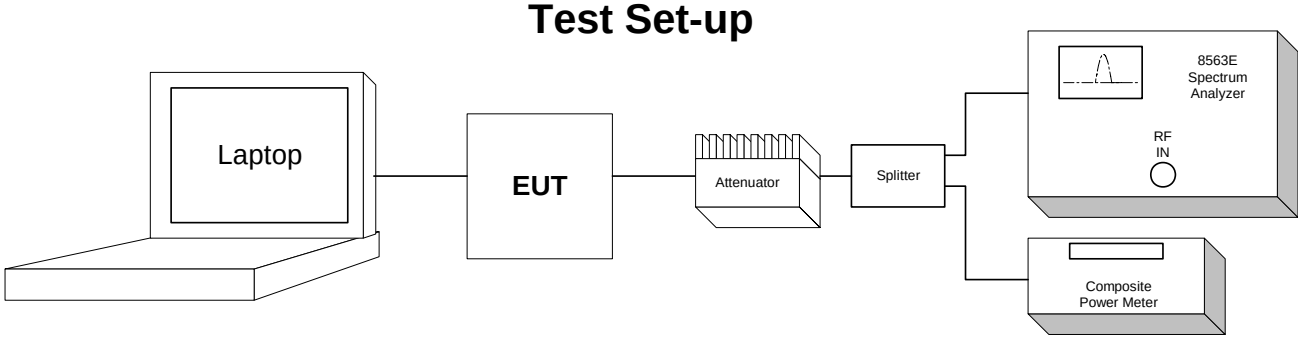
Conducted and Radiated Emission Limits Test

Conducted Output Power Test

Inter-Modulation Test

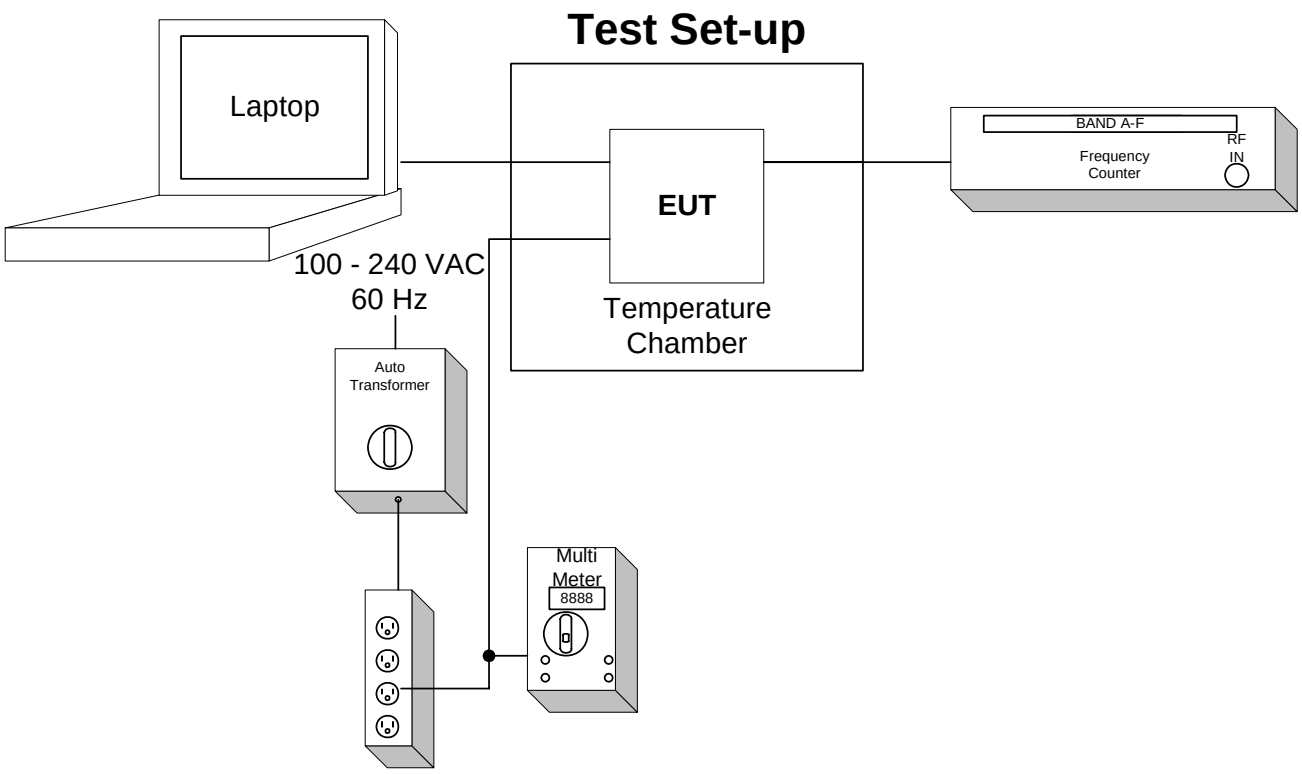
Occupied Bandwidth Modulation Test

Test Set-up



Frequency Tolerance Test

EUT is specified for indoor use with temperature range of -5° to +45° C, and was tested with its range.



5.0 TEST RESULTS

5.1.1 22.913 Effective Radiated Power Limits

Test Summary:

- The requirements are: ■ **MET** □ NOT MET
- Minimum margin of compliance is 33.15 dB at 881.5 MHz (GSM)

Test Location:

□ ETL (Oakdale, MN)

■ **ADC facility (Shakopee, MN)**

Test Distance:

□ 3 Meters

□ 10 Meters

■ **Conducted measurement**

Test Equipment (ADC):
1, 2, 13, 15

Test Limit:
500 Watts or 57 dBm Limit

Test Data:
Conducted Output Power; Section 7.2

Test Engineer: Mark F. Miska
Date: 1 December, 2008

Table of Contents; Section 1.0

5.1.2 22.355 Frequency Tolerance

Test Summary:

- The requirements are: ■ **MET** □ NOT MET
- The fundamental emission stays within the limit.
- Frequency measured over a temperature range of –5 to 45º C and an input voltage range of 100 to 240 VAC.

Test Location:

□ ETL (Oakdale, MN)

■ **ADC facility (Shakopee, MN)**

Test Equipment (ADC):
3, 4, 5, 9, 13

Test Limit:

TABLE C–1.—FREQUENCY TOLERANCE FOR TRANSMITTERS IN THE PUBLIC MOBILE SERVICES

Frequency range (MHz)	Base, fixed (ppm)	Mobile ≤3 watts (ppm)	Mobile <=3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10.0	n/a	n/a

Test Data:
Frequency Stability; Section 7.3

Test Engineer: Mark F. Miska
Date: 1 December, 2008

Table of Contents; Section 1.0

5.1.3 22.917 Emission Limitations Cellular

Test Summary:

- The requirements are: ■ **MET** □ NOT MET
- Out of band emissions were less than –13 dBm.
- Outside the emission bandwidth of the carrier, all emissions are attenuated at least 26 dB below the transmitter power.

Test Location:

□ ETL (Oakdale, MN)

■ **ADC facility (Shakopee, MN)**

Test Equipment (ADC):
1, 2, 13, 15

Test Limit:
Out of band emissions:
Attenuated below the transmitting power (P) by a factor of at least 43 + 10log(P) dB, or –13 dBm.

Outside of the carrier emissions bandwidth:
26 dB below the transmitter power

Test Data:
Conducted Emissions; Section 7.1
Intermodulation; Section 7.4
Occupied Bandwidth; Section 7.5
Radiated Emissions; (Appendix B)

Test Engineer: Mark F. Miska
Date: 1 December, 2008
Date: 1 December, 2008
Date: 1 December, 2008

Table of Contents; Section 1.0

6.0 TEST EQUIPMENT

Table of Contents; Section 1.0

Number	Description	Manufacturer	Model	ADC Serial Number	Cal Due	Used
1	Spectrum Analyzer	HP	8563E	MC27690	6-5-09	☒
2	Power Meter	HP	EPM-441A	MC27670	12-22-09	☒
3	Multimeter	Fluke	79III	MC34730	6-24-10	☒
4	Frequency Counter	HP	5347A	MC27548	1-16-09	☒
5	Temperature Chamber	Thermotron	SM-32C	MC18966	4-8-09	☒
6	Signal Generator	Agilent	E4437B	967974	1-15-10	☒
7	Signal Generator	Agilent	E4438C	1013210	2-9-09	☒
8	Attenuator	Huber Suhner	6810.17.A	N/A	CNR	☐
9	Variable Auto Transformer	Staco	1520CT	MC44655	CNR	☒
10	Digital Barometer	Fisher Scientific	02-403	MC50719	10-28-09	☒
11	Data Acquisition Unit	Fluke	Hydra	MC27549	12-3-09	☐
12	Attenuator	Aeroflex	49-30-33	N/A	CNR	☐
13	Attenuator	Aeroflex	86-30-12	N/A	CNR	☒
14	LNA	Lucix Corp	C020200L 1603	N/A	CNR	☐
15	Power Sensor	HP	8481A	MC27570	9-17-09	☒

Equipment with a Calibration Not Required (CNR) listing is verified and compensated for with NIST traceable calibrated equipment.

7.0 APPENDIX A

Conducted Emissions Test Data

Table of Contents; Section 1.0

Test Engineer: Mark F. Miska

7.1 Conducted Emission Limits Test

Table of Contents; Section 1.0
Back to Emission Limits; Section 5.1.3

The out of band emissions were measured directly from the EUT antenna output with a spectrum analyzer from 30 MHz to the 10th harmonic of the highest carrier frequency. Test signals used are GSM and EDGE. The different signals were input one at a time to the EUT. In all cases, the out of band emissions were less than –13 dBm from the equation

$$(19\text{dBm} - [43 + 10\log(0.08\text{W})])$$

Band edge compliance is also demonstrated using a GSM and EDGE signal at the upper and lower limits of the band.

IPACCESS nanoBTS output sets the signal power level.

Industry practice has generally set the output signal power level.

800 MHz picoBTS:
Range: 100 - 240 VAC
Tested @: 120 VAC
Tested @: 2.2 A

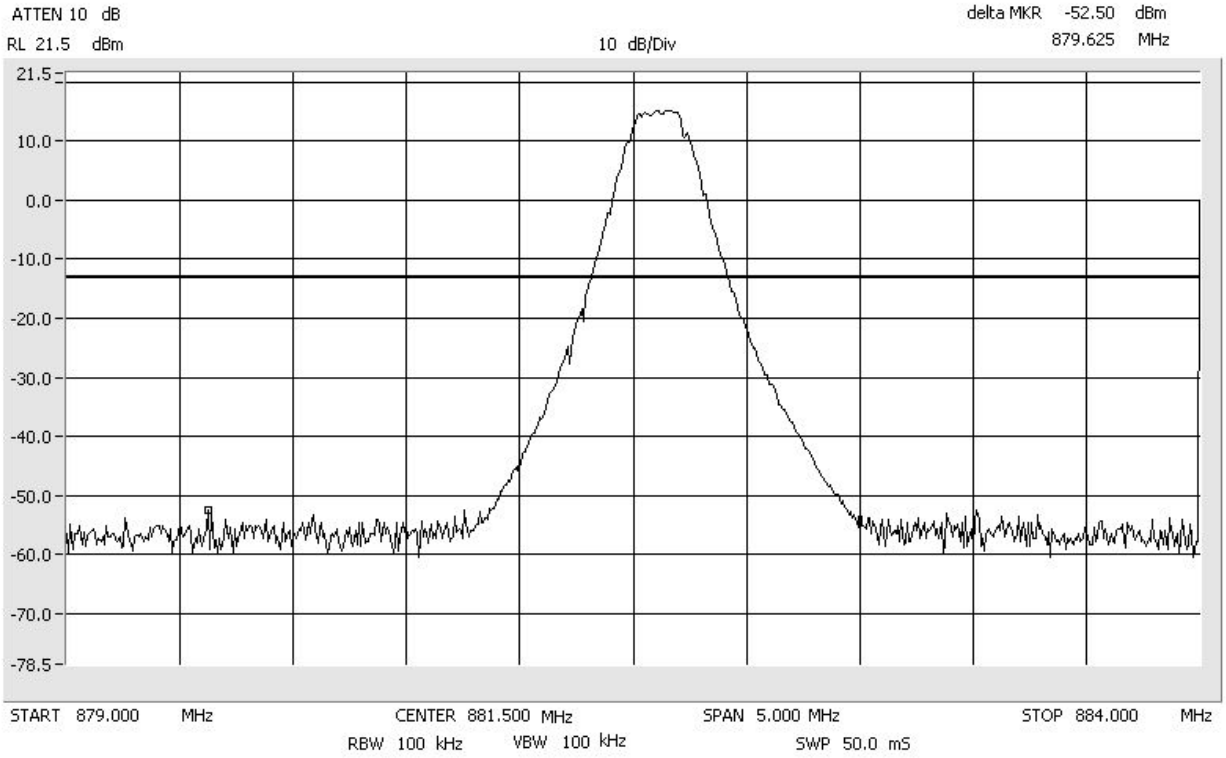
Application details for 2.1033(c)(10) and 2.1033(c)(13) are covered in Theory of Operation.

The spurious limitation is completed with the duplexer. The ALC also suppresses in-band spurious by preventing PA overdrive, while the duplexer suppresses out-of-band spurious. Internal to the electronics, the use of SAW filters provides for higher Q roll-off at band edges.

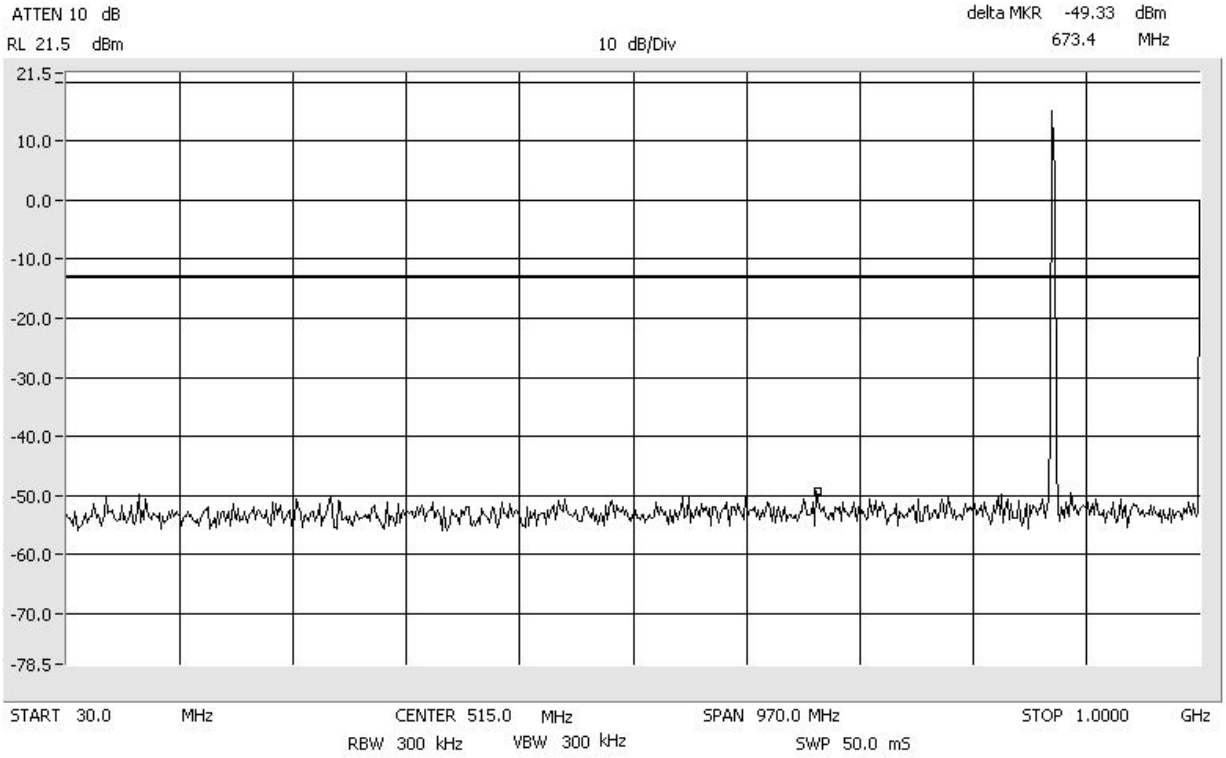
This is a constant gain device, so the setup controls the output. There is an overdrive and overpower limit control that prevents excess power.

Results:
Pass (See plots)

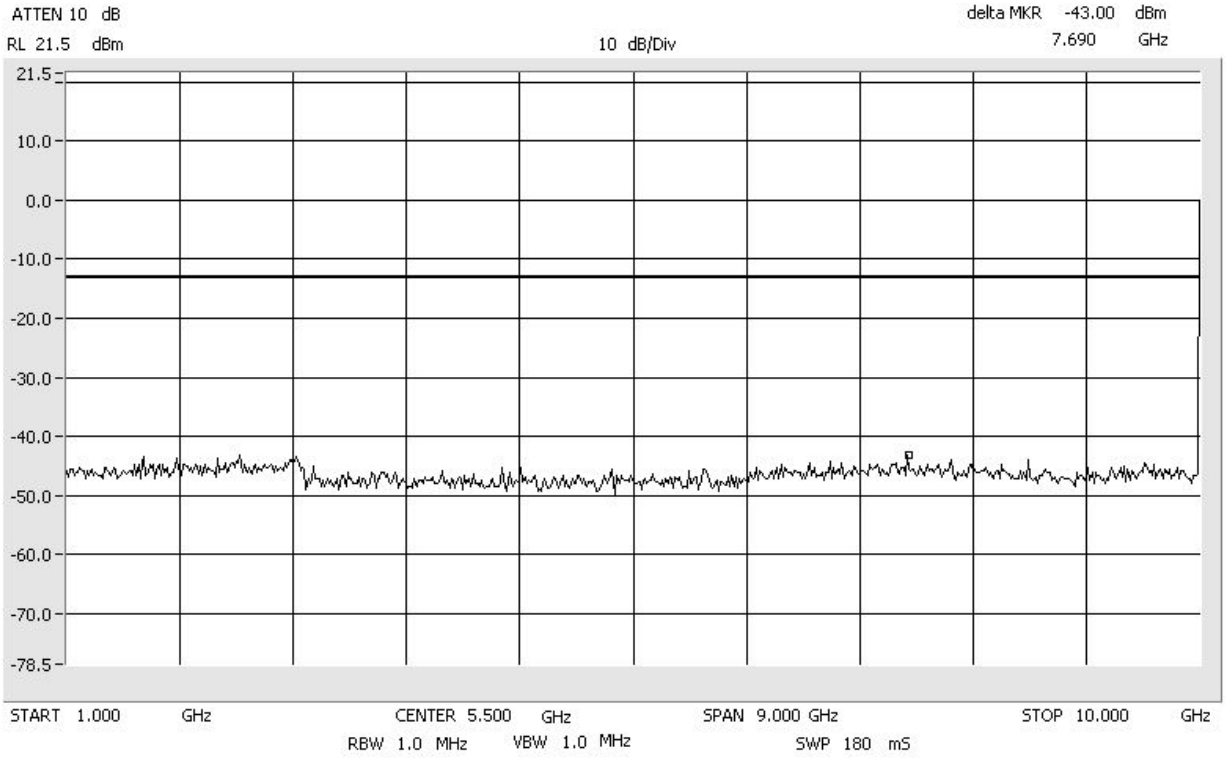
Conducted Emissions GSM CELLULAR
Center: 881.5 MHz Span: 5 MHz RBW/VBW: 100 kHz



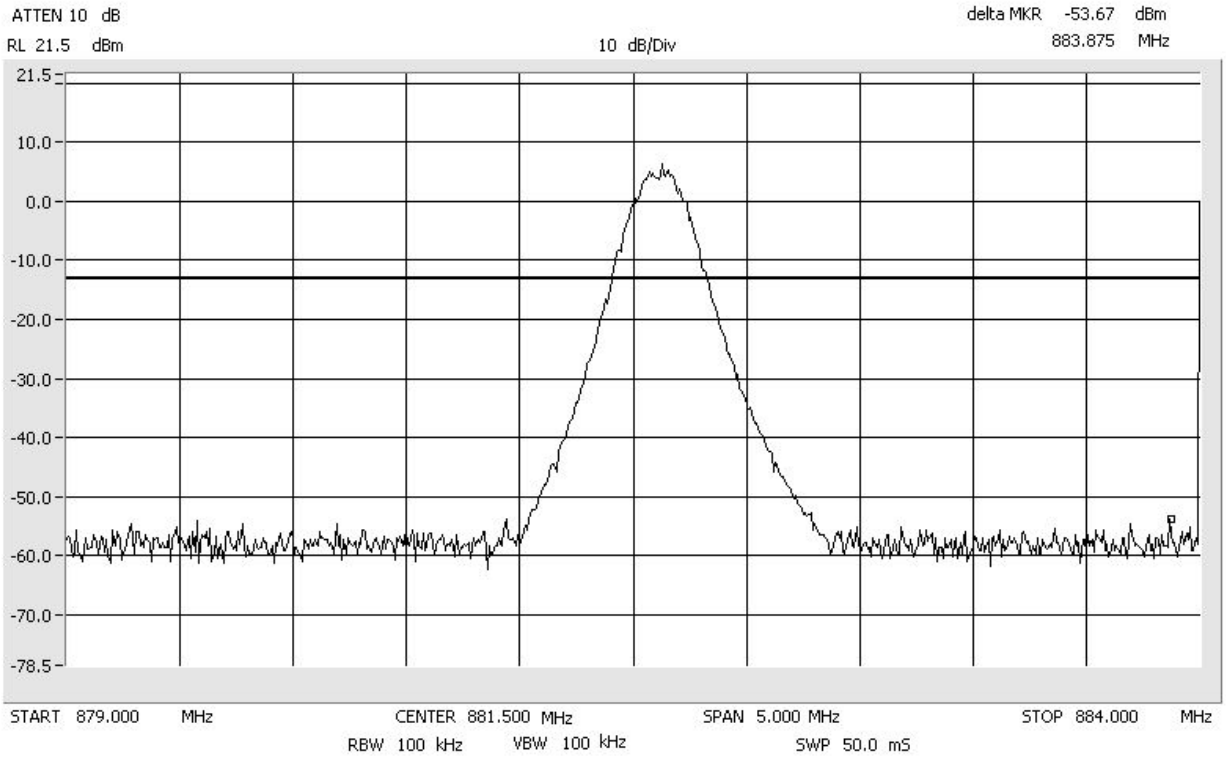
Conducted Emissions GSM CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



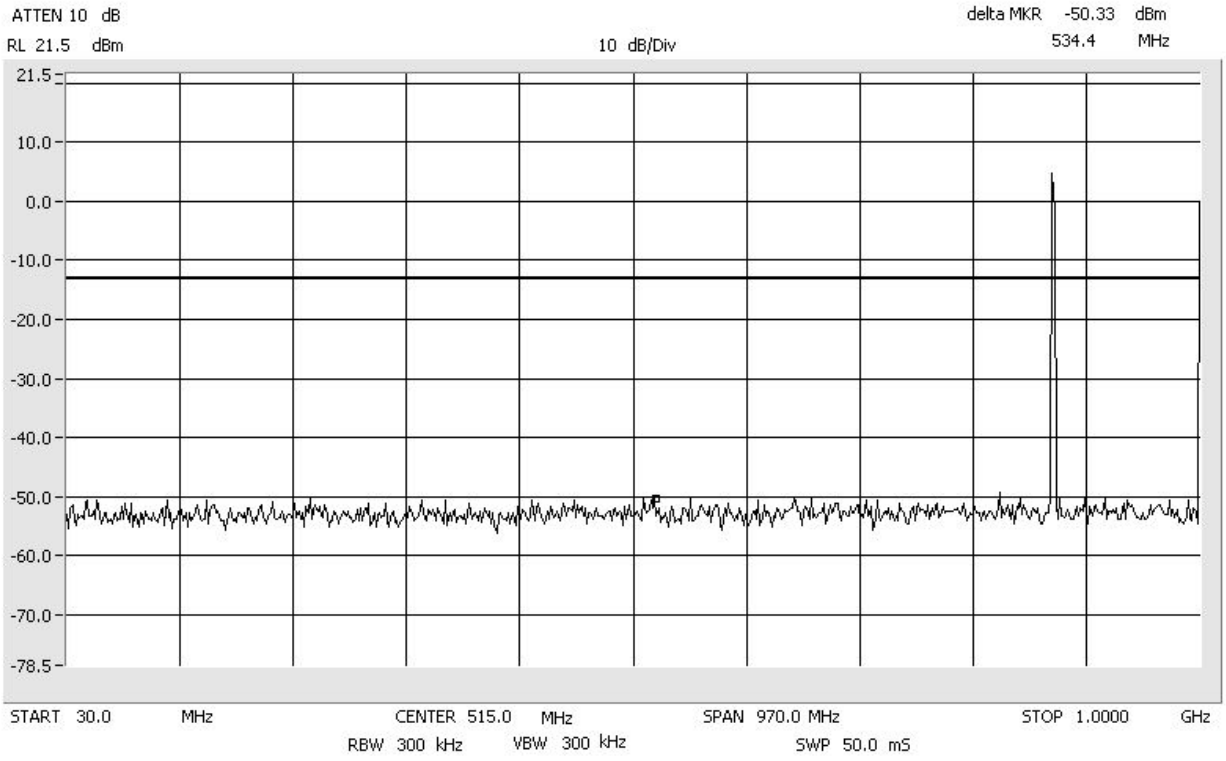
Conducted Emissions GSM CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



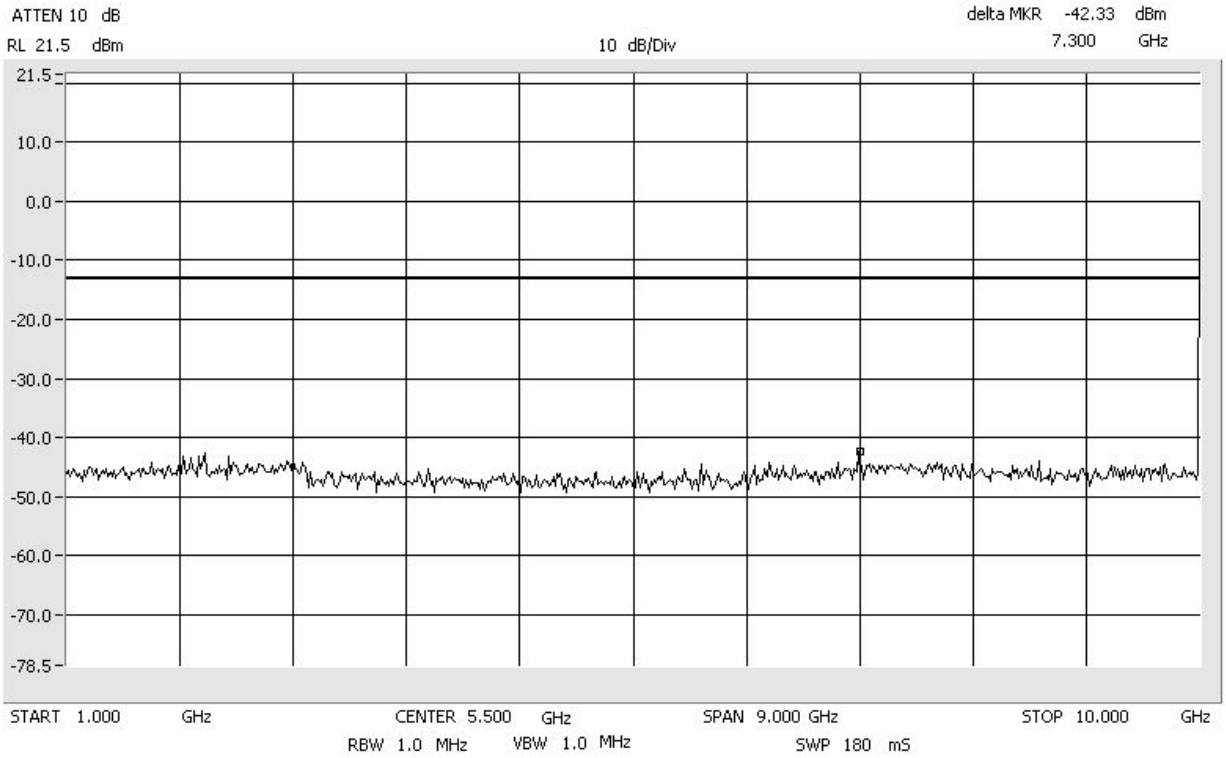
Conducted Emissions EDGE CELLULAR
Center: 881.5 MHz Span: 5 MHz RBW/VBW: 100 kHz



Conducted Emissions EDGE CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz

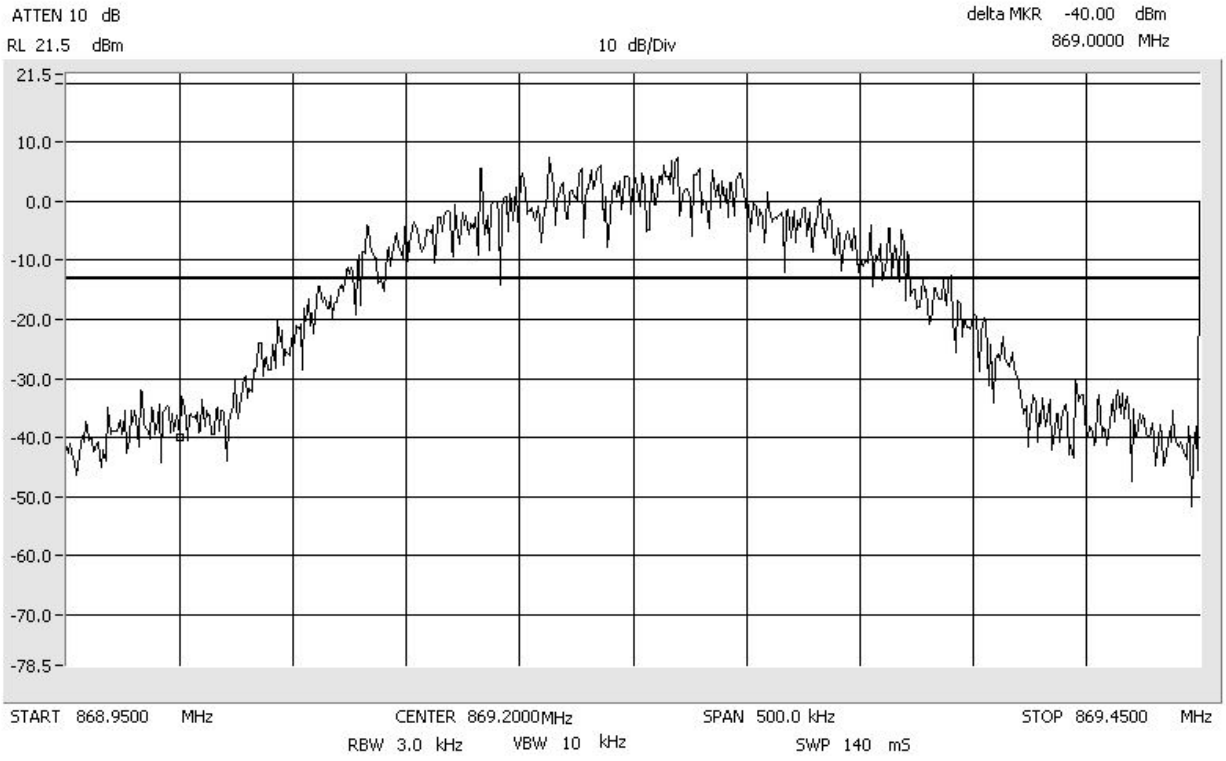


Conducted Emissions EDGE CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



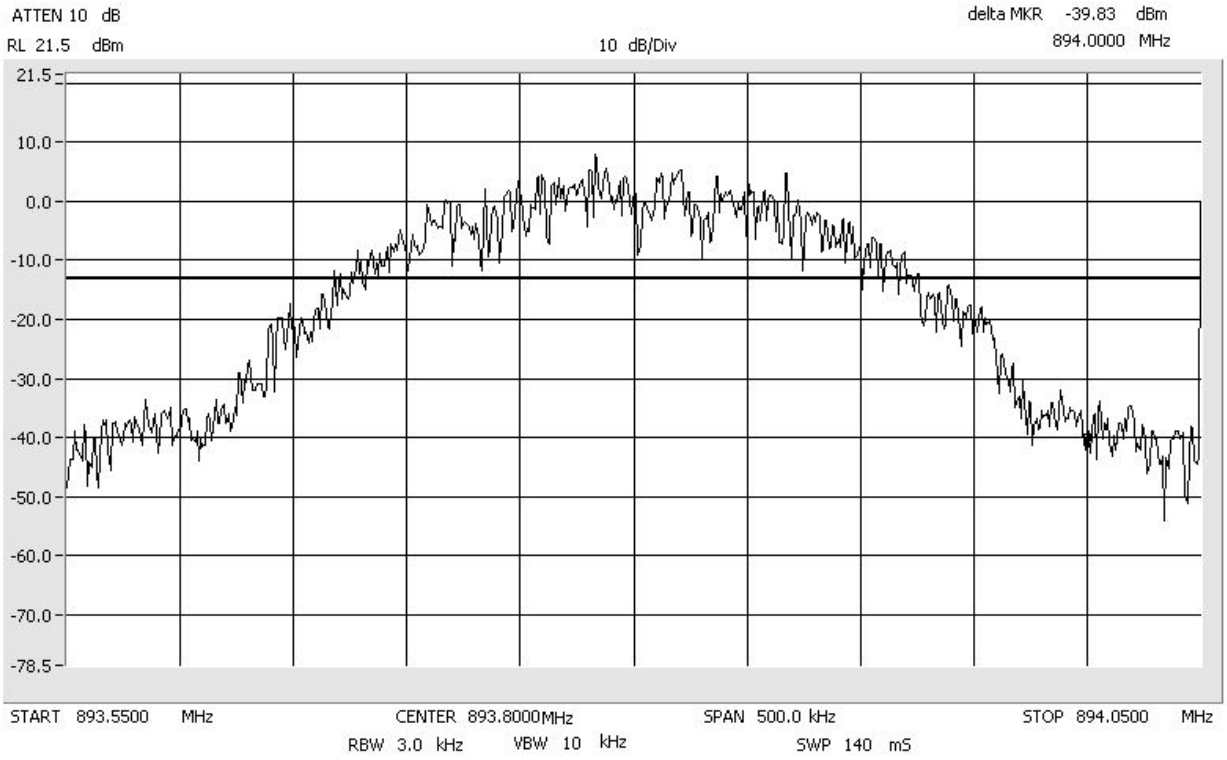
Band_Edge GSM

Center: 869.2 MHz Span: 500 kHz RBW: 3 kHz VBW: 10 kHz



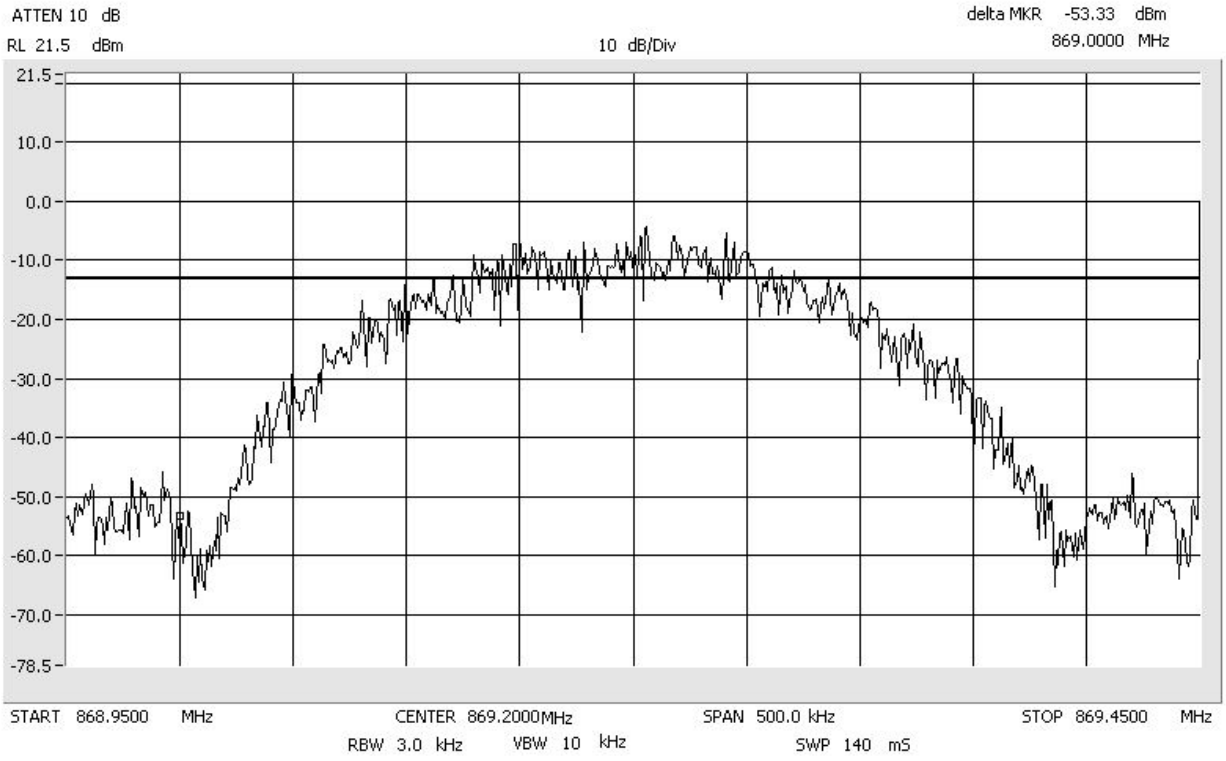
Band_Edge GSM

Center: 893.8 MHz Span: 500 kHz RBW: 3 kHz VBW: 10 kHz



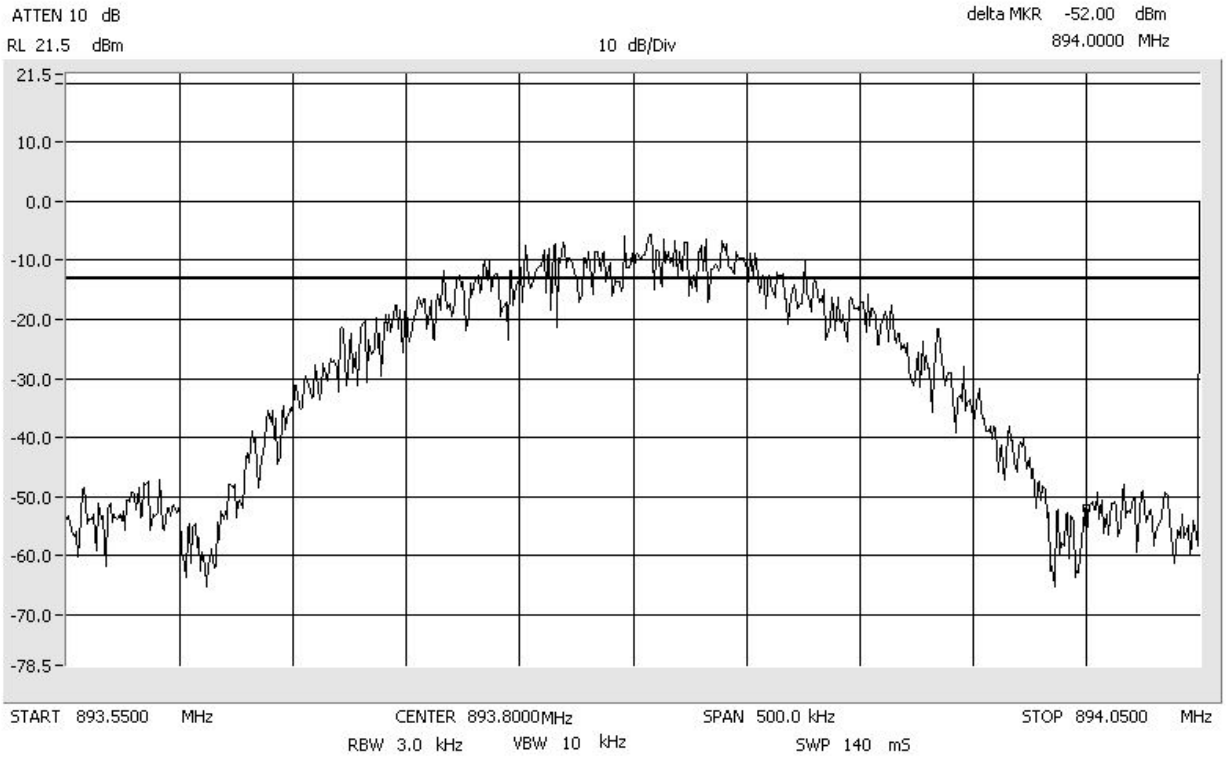
Band_Edge EDGE

Center: 869.2 MHz Span: 500 kHz RBW: 3 kHz VBW: 10 kHz



Band_Edge EDGE

Center: 893.8 MHz Span: 500 kHz RBW: 3 kHz VBW: 10 kHz



7.2 Conducted Output Power Test

Table of Contents; Section 1.0
Back to Conducted Output Power; Section 5.1.1

*Note: The EUT is a fixed repeater and not a base station.
This measurement was made as a direct conducted emission measurement. The output from the EUT antenna connector was connected to the power meter. The carrier output, below, was conducted using a single GSM and EDGE signal. The power meter level was offset to compensate for attenuators and cable loss between the EUT and the power meter.

A signal was used at the low, mid and high parts of the selected band. The power meter level was offset by 21.5 dB to compensate for cable loss and attenuator between the EUT and the power meter.

GSM	0.061 Watts
Carrier Frequency	Carrier Output
869.2 MHz	17.50 dBm
881.5 MHz	17.85 dBm
893.8 MHz	17.25 dBm

EDGE	0.060 Watts
Carrier Frequency	Carrier Output
869.2 MHz	17.50 dBm
881.5 MHz	17.80 dBm
893.8 MHz	17.30 dBm

7.3 Frequency Stability Test

Table of Contents; Section 1.0
Back to Frequency Stability; Section 5.1.1

picoBTS				
Input Voltage	**Input Voltage**	**Carrier Frequency**	**Measured Frequency**	**Meets Requirements?**
100 VAC		869.200 MHz	869.200 MHz	Yes
170 VAC		869.200 MHz	869.200 MHz	Yes
240 VAC		869.200 MHz	869.200 MHz	Yes
100 VAC		881.500 MHz	881.500 MHz	Yes
170 VAC		881.500 MHz	881.500 MHz	Yes
240 VAC		881.500 MHz	881.500 MHz	Yes
100 VAC		893.800 MHz	893.800 MHz	Yes
170 VAC		893.800 MHz	893.800 MHz	Yes
240 VAC		893.800 MHz	893.800 MHz	Yes
Temperature		**Carrier Frequency**	**Measured Frequency**	**Meets Requirements?**
-5 Deg. C		869.200 MHz	869.200 MHz	Yes
0 Deg. C		869.200 MHz	869.200 MHz	Yes
10 Deg. C		869.200 MHz	869.200 MHz	Yes
20 Deg. C		869.200 MHz	869.200 MHz	Yes
30 Deg. C		869.200 MHz	869.200 MHz	Yes
40 Deg. C		869.200 MHz	869.200 MHz	Yes
45 Deg. C		869.200 MHz	869.200 MHz	Yes
-5 Deg. C		881.500 MHz	881.500 MHz	Yes
0 Deg. C		881.500 MHz	881.500 MHz	Yes
10 Deg. C		881.500 MHz	881.500 MHz	Yes
20 Deg. C		881.500 MHz	881.500 MHz	Yes
30 Deg. C		881.500 MHz	881.500 MHz	Yes
40 Deg. C		881.500 MHz	881.500 MHz	Yes
45 Deg. C		881.500 MHz	881.500 MHz	Yes
-5 Deg. C		893.800 MHz	893.800 MHz	Yes
0 Deg. C		893.800 MHz	893.800 MHz	Yes
10 Deg. C		893.800 MHz	893.800 MHz	Yes
20 Deg. C		893.800 MHz	893.800 MHz	Yes
30 Deg. C		893.800 MHz	893.800 MHz	Yes
40 Deg. C		893.800 MHz	893.800 MHz	Yes
45 Deg. C		893.800 MHz	893.800 MHz	Yes

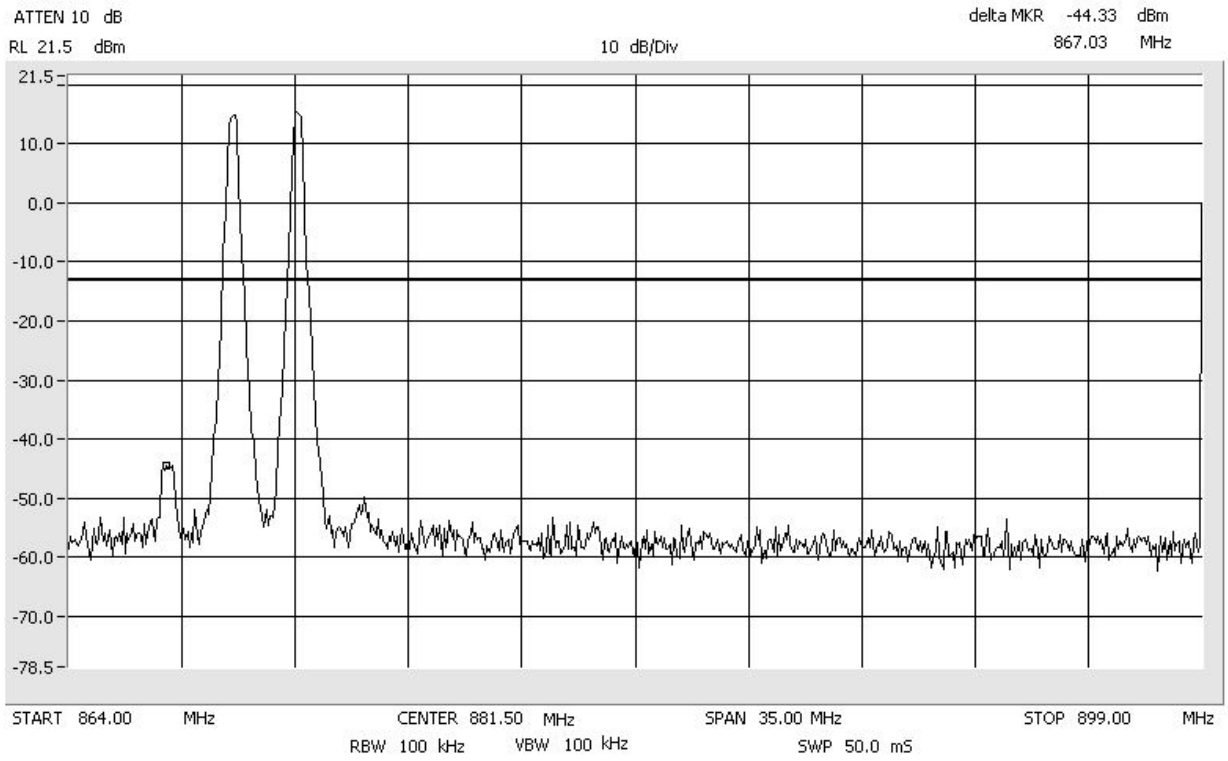
7.4 Intermodulation Test

Table of Contents; Section 1.0
Back to Emission Limits; Section 5.1.3

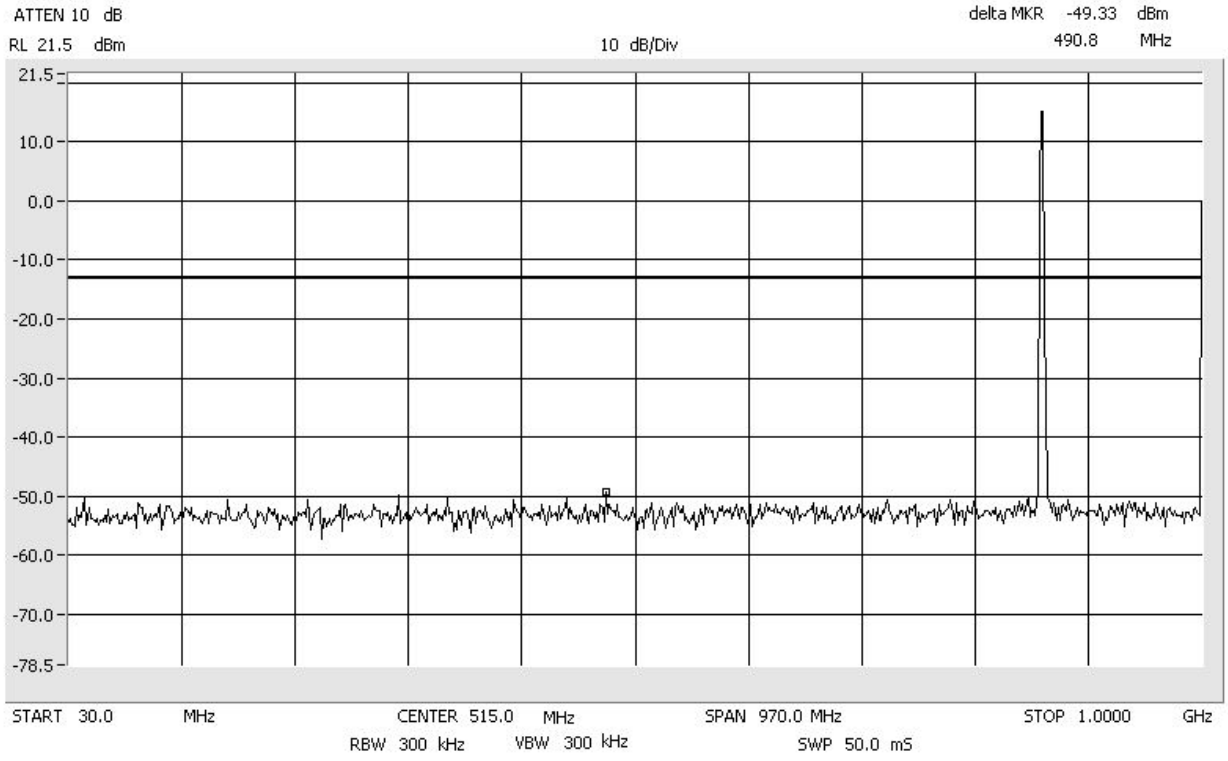
The inter-modulation products test was performed for the EUT. Three tests were preformed with the modulation type. Test 1 was with 2 signals input to the EUT at lower end channels. Test 2 was with 2 signals input to the EUT at upper end channels. Test 3 was with 2 signals input to the EUT at upper and lower end channels. The modulation types tested were GSM and EDGE An investigation was made from 30 MHz to the 10th Harmonic of the highest fundamental frequency (~10 GHz). The following plots show the results.

Results:
(See Plots)

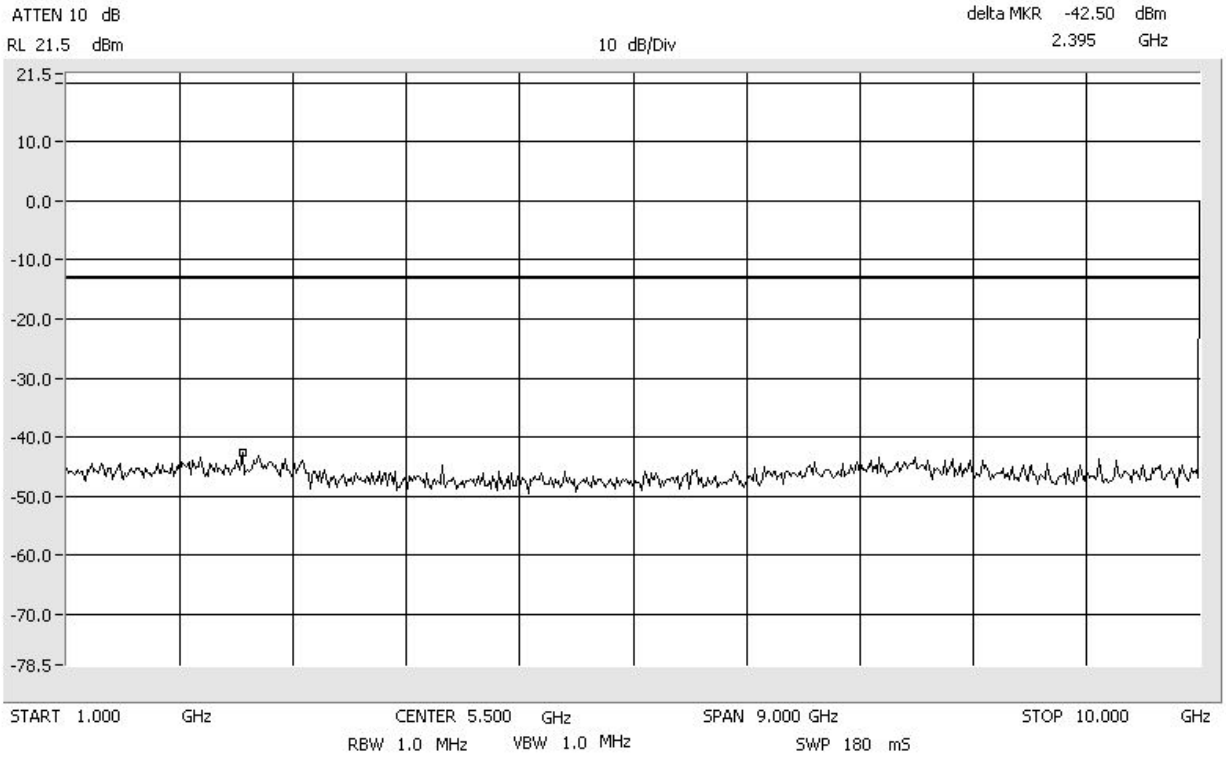
Intermodulation GSM_Low CELLULAR
Center: 881.5 MHz Span: 35 MHz RBW/VBW: 100 kHz



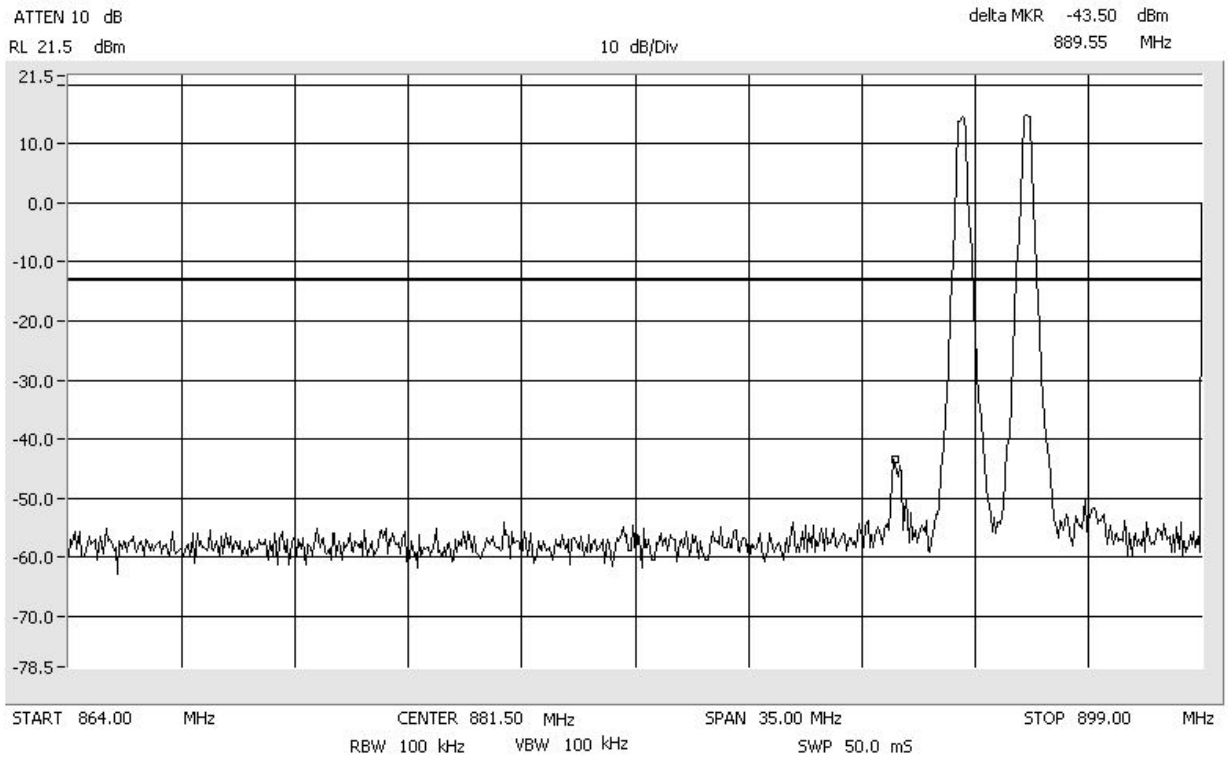
Intermodulation GSM_Low CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



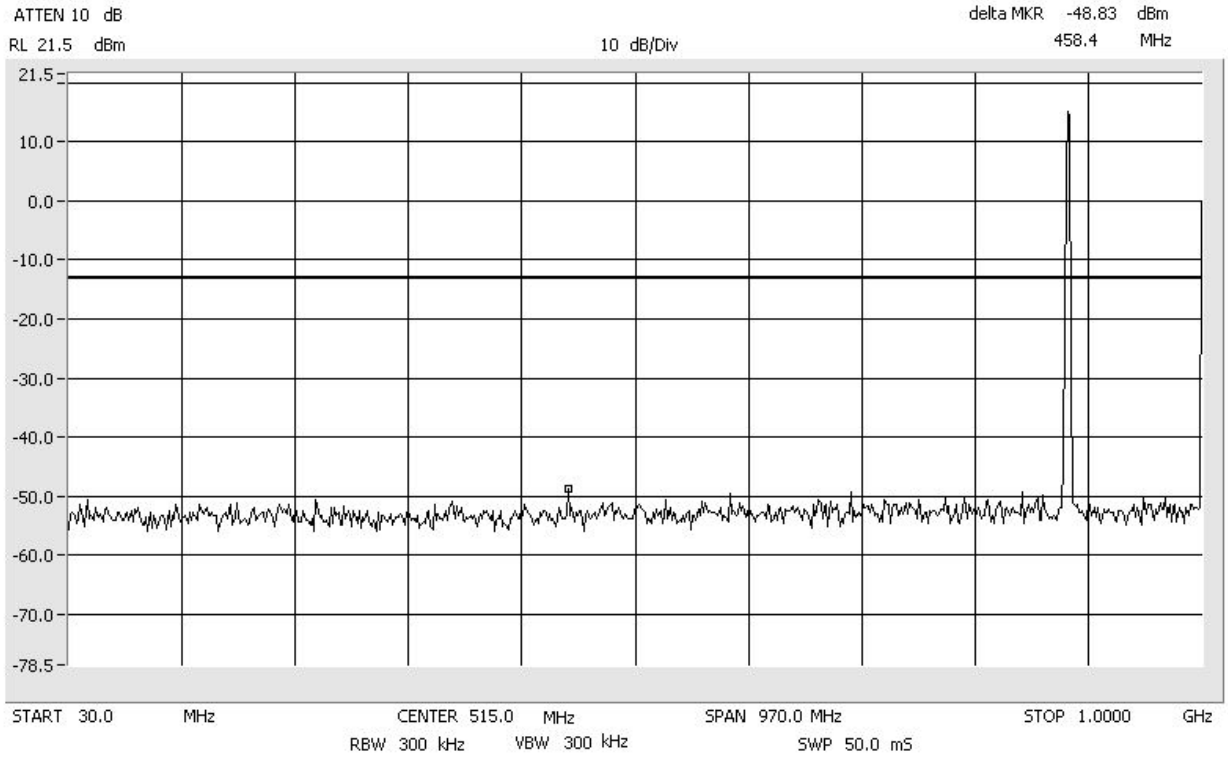
Intermodulation GSM_Low CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



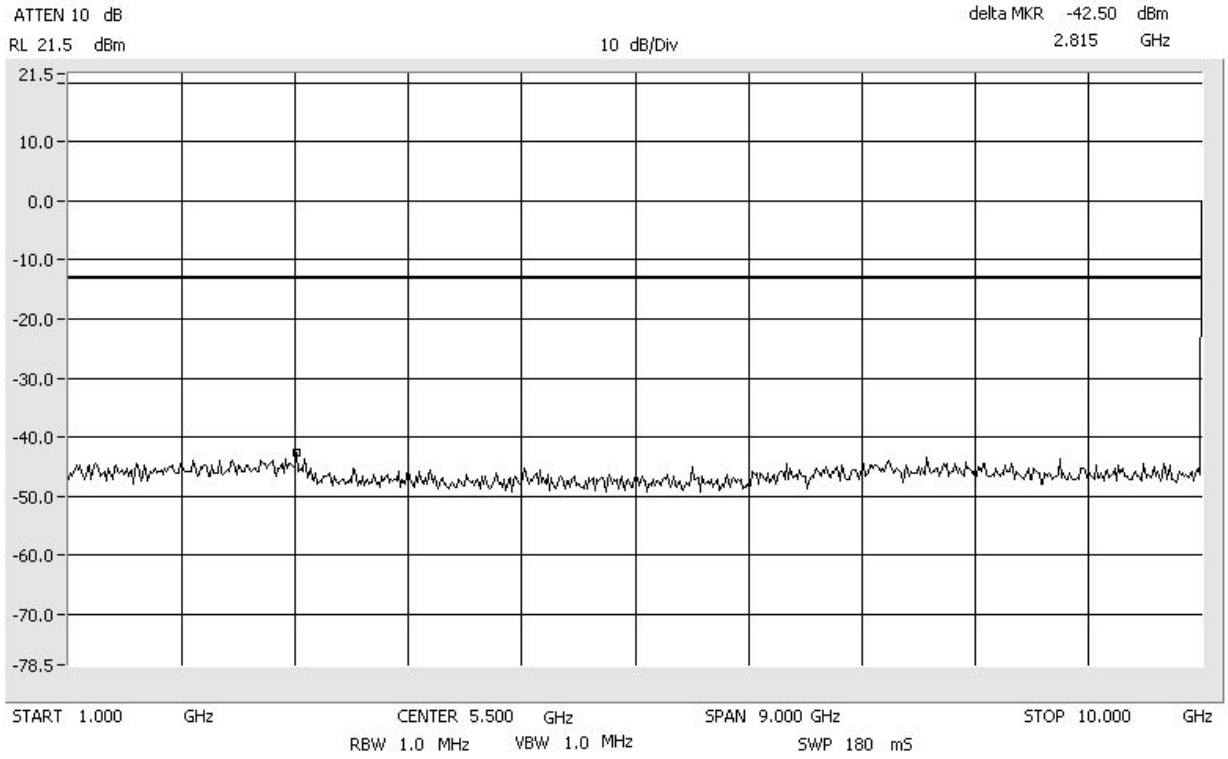
Intermodulation GSM_High CELLULAR
Center: 881.5 MHz Span: 35 MHz RBW/VBW: 100 kHz



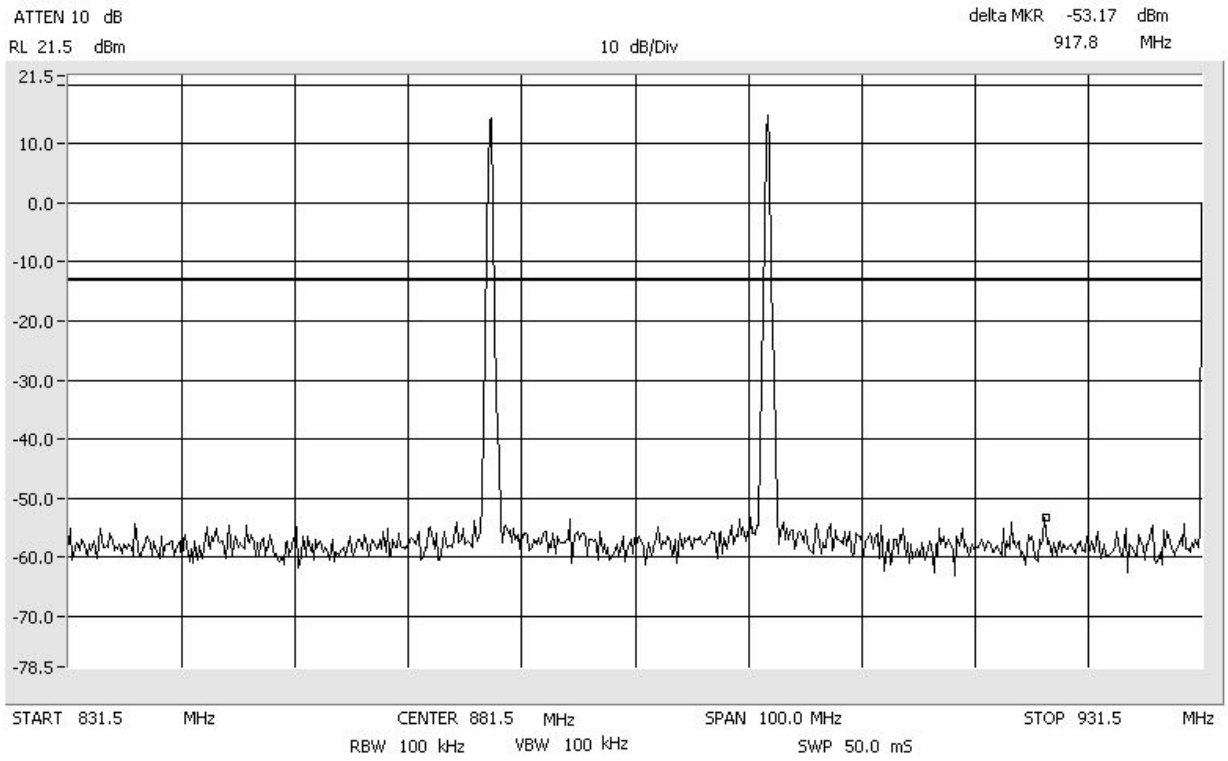
Intermodulation GSM_High CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



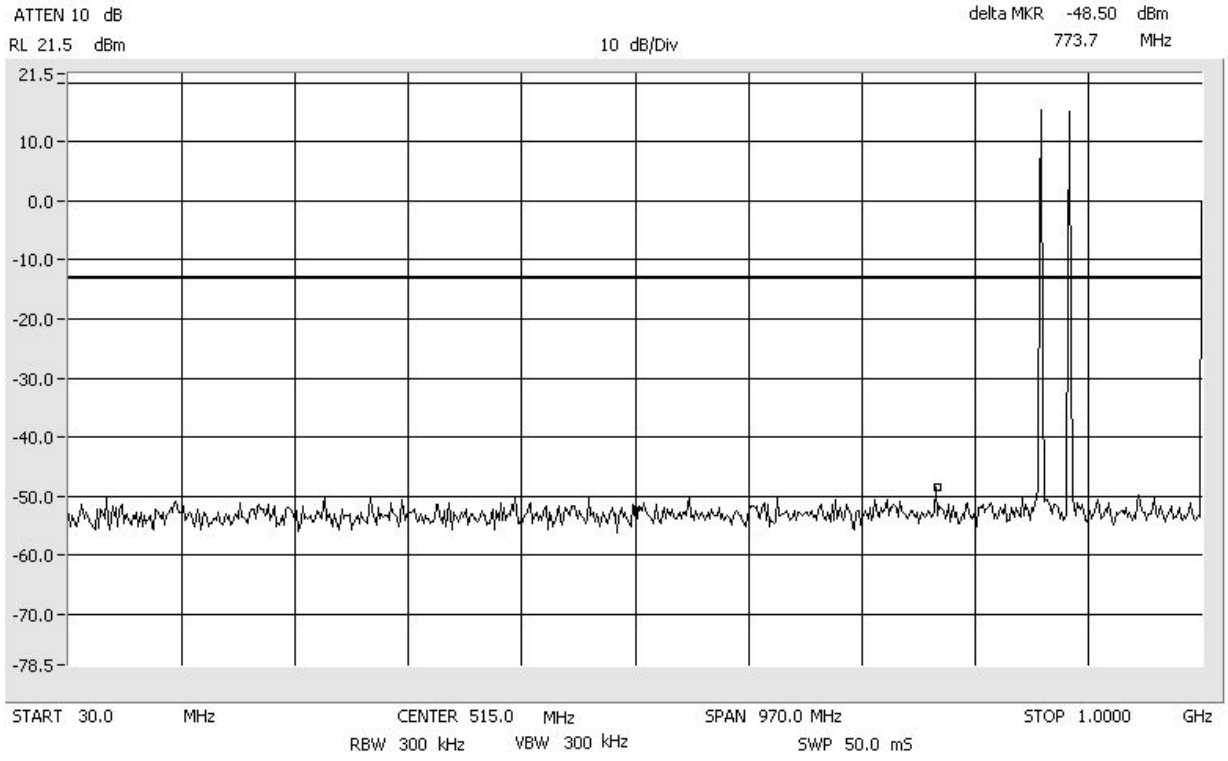
Intermodulation GSM_High CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



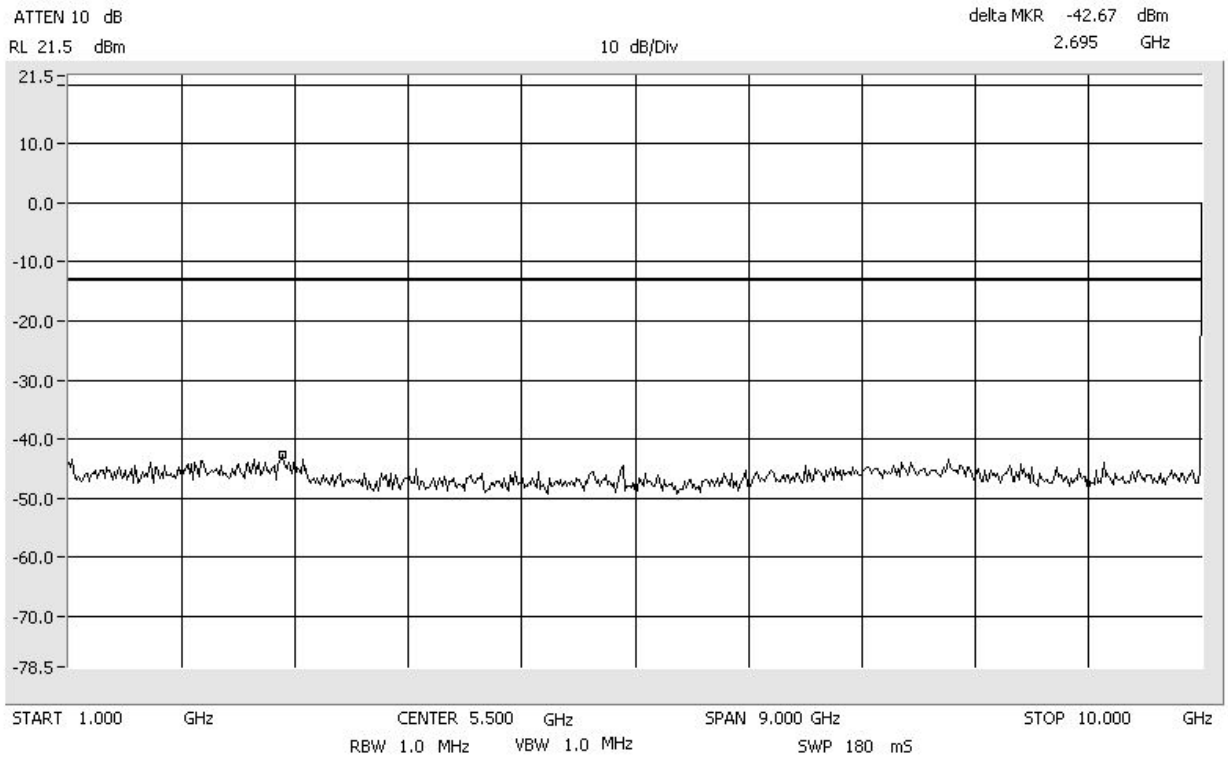
Intermodulation GSM_Apart CELLULAR
Center: 881.5 MHz Span: 100 MHz RBW/VBW: 100 kHz



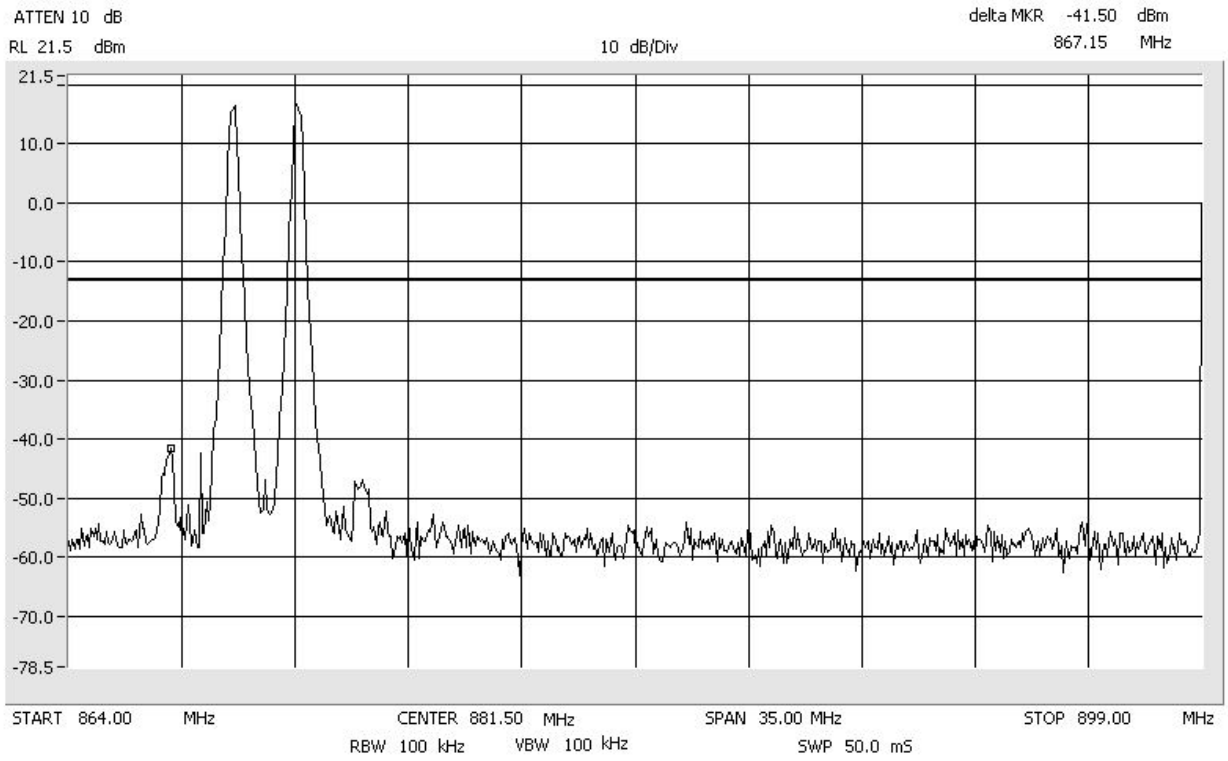
Intermodulation GSM_Apart CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



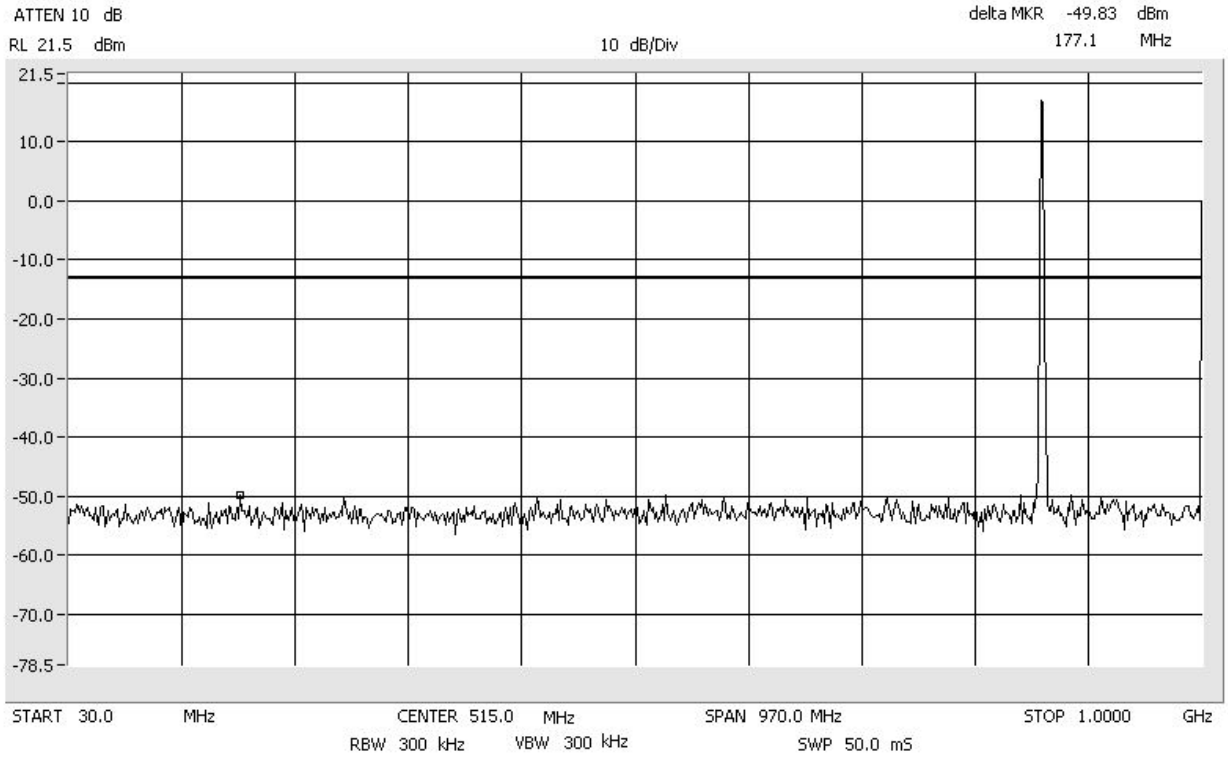
Intermodulation GSM_Apart CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



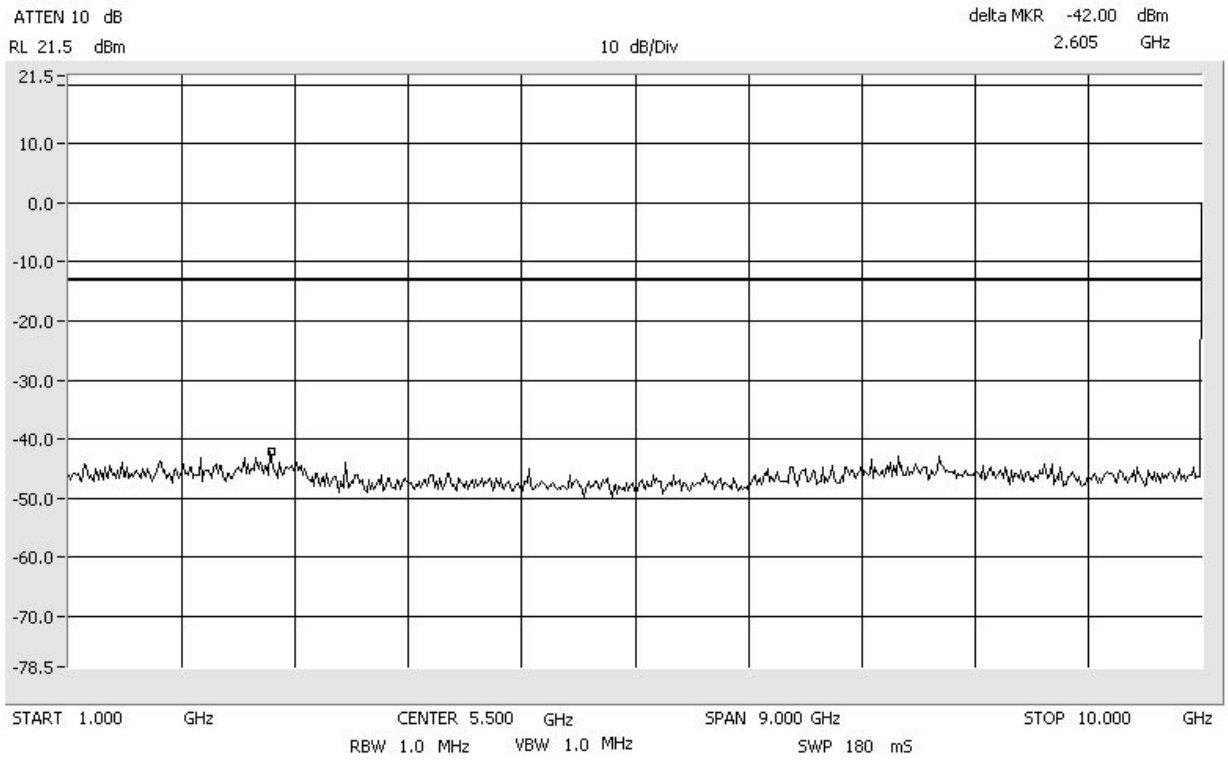
Intermodulation EDGE_Low CELLULAR
Center: 881.5 MHz Span: 35 MHz RBW/VBW: 100 kHz



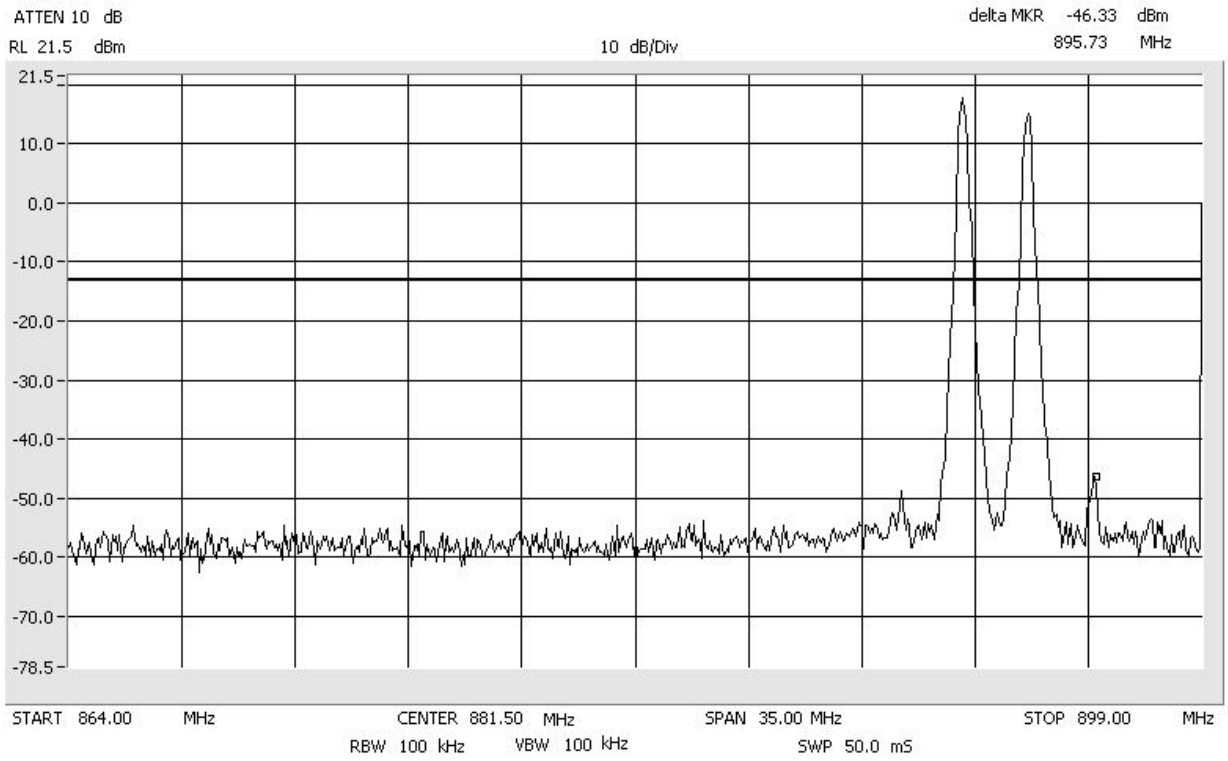
Intermodulation EDGE_Low CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



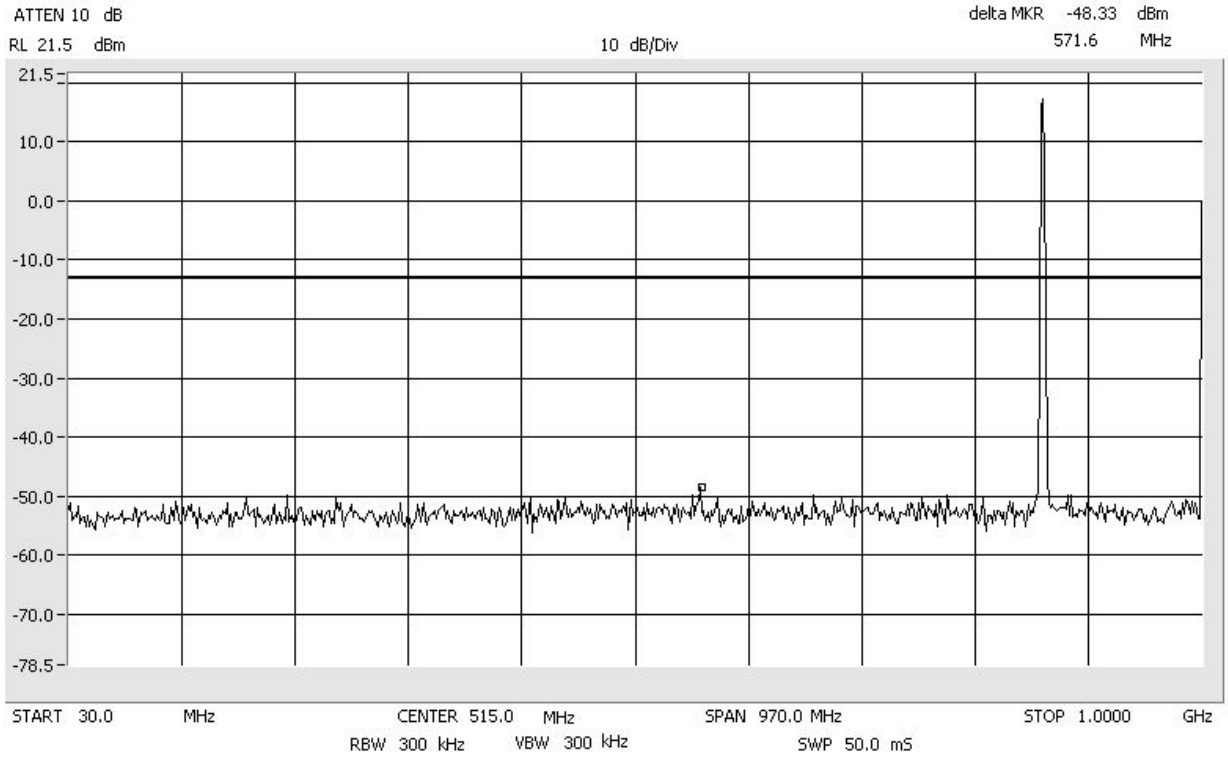
Intermodulation EDGE_Low CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



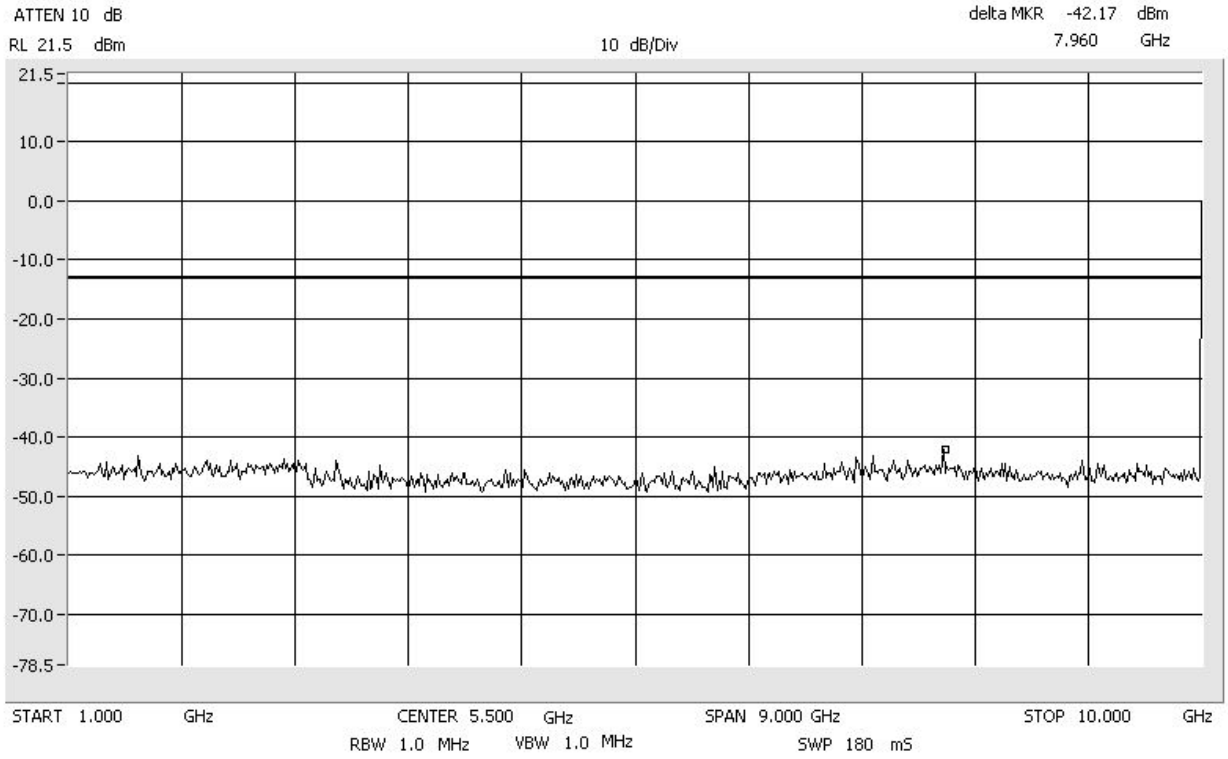
Intermodulation EDGE_High CELLULAR
Center: 881.5 MHz Span: 35 MHz RBW/VBW: 100 kHz



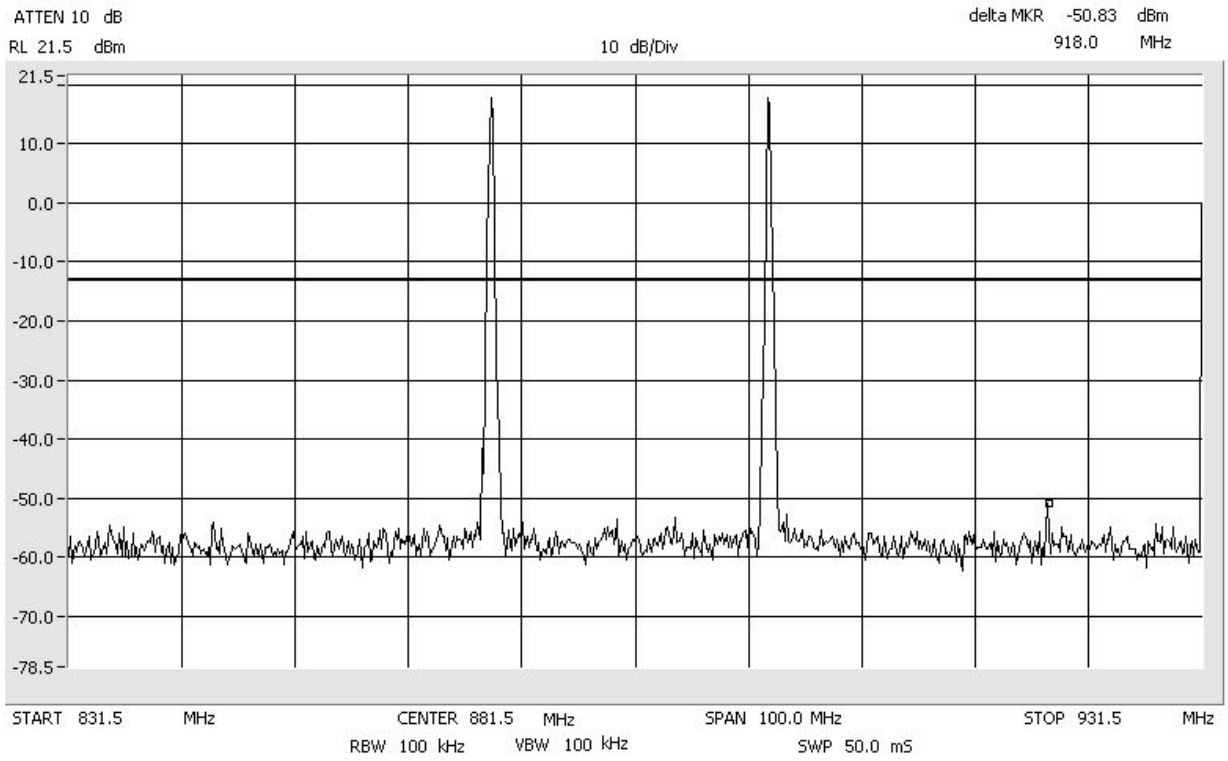
Intermodulation EDGE_High CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



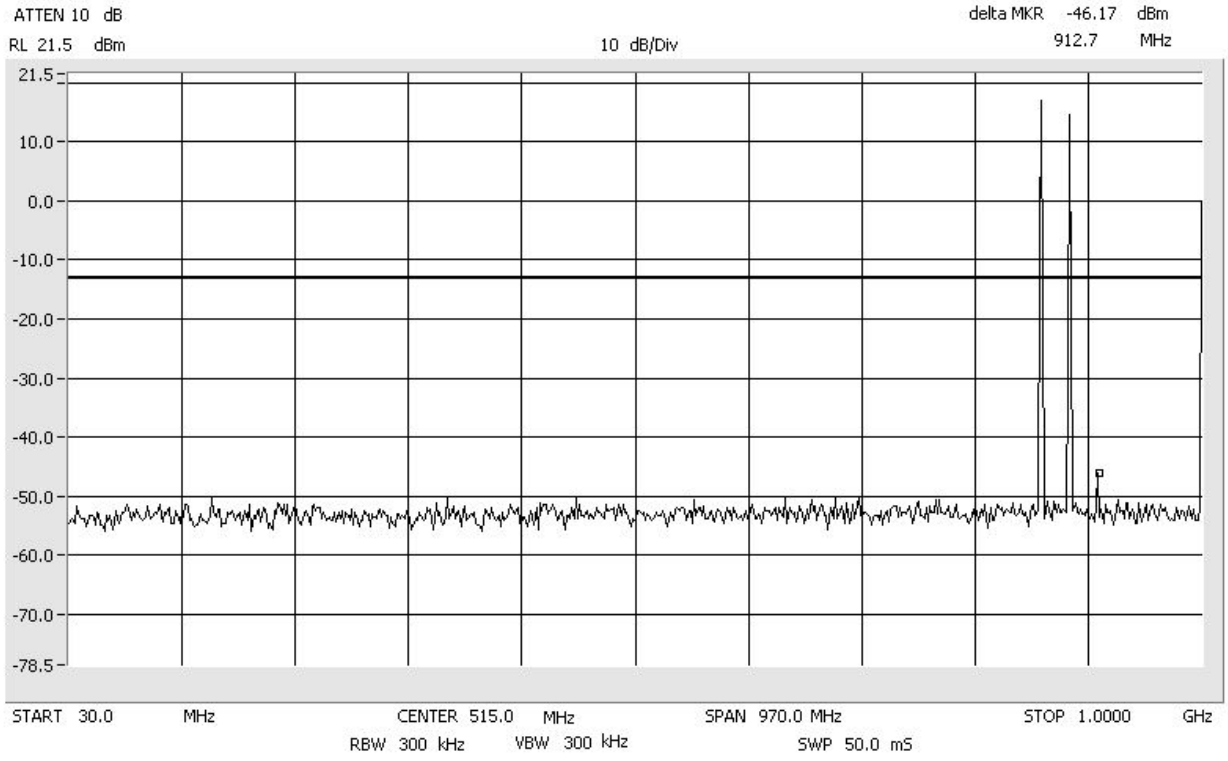
Intermodulation EDGE_High CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



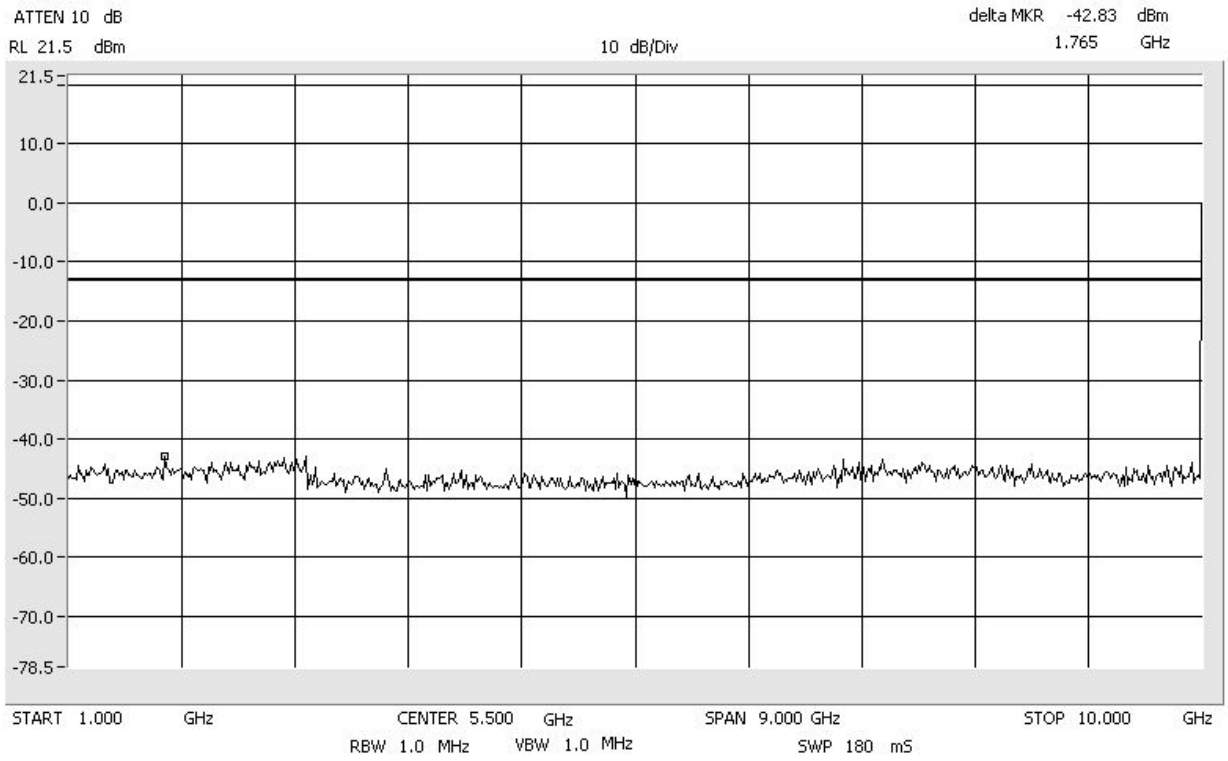
Intermodulation EDGE_Apart CELLULAR
Center: 881.5 MHz Span: 100 MHz RBW/VBW: 100 kHz



Intermodulation EDGE_Apart CELLULAR
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



Intermodulation EDGE_Apart CELLULAR
Span: 1 GHz to 10 GHz RBW/VBW: 1 MHz



7.5 Occupied Bandwidth Modulation Test

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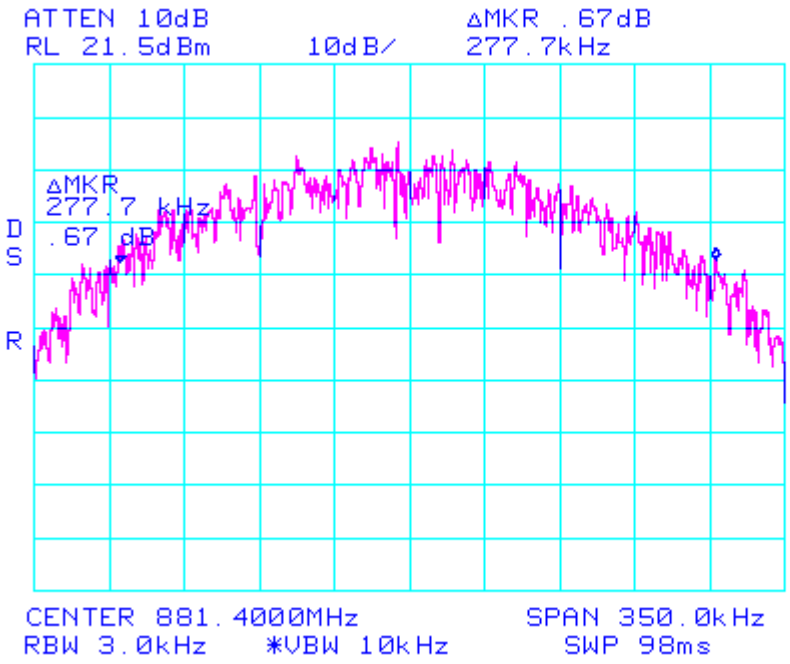
An output Occupied Bandwidth test was done with modulation types: GSM and EDGE. The purpose was to determine the amount of occupied bandwidth for the different types of modulation schemes produced by the EUT. The following plots show output signals.

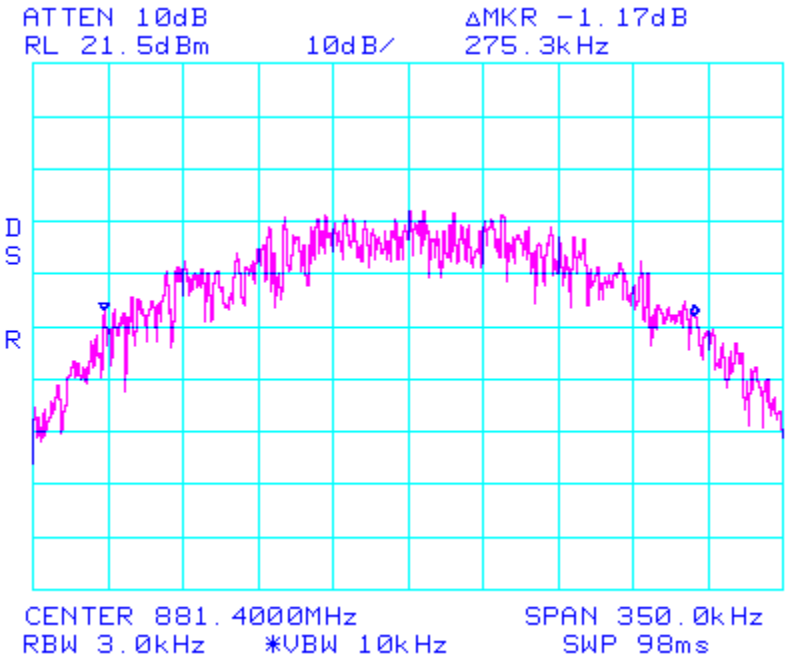
The resolution bandwidth is reduced to 1% of the estimated emission bandwidth and the video bandwidth is set to 3 times the resolution bandwidth. The markers are moved to the -20 dB points (from the previously established center frequency level) on either side of center frequency.

Results:
Pass (see plots)

Occupied Bandwidth GSM_Signal_Out
Span: 350 kHz RBW: 3 kHz VBW: 10 kHz



Occupied Bandwidth EDGE_Signal_Out
Span: 350 kHz RBW: 3 kHz VBW: 10 kHz



8.0 APPENDIX B

Measurement Protocol

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Measurement Protocol

Environmental conditions of the lab, (ADC)
Temperature: 21 - 26º C
Relative Humidity: 21 - 24 %
Atmospheric Pressure: 97.8 - 100.0 kPa

Test Methodology:
Emission testing is performed according to the procedures in ANSI C63.4-2003.

Measurement Uncertainty
The test system for conducted emissions is defined as the signal generator(s), the power meter, the spectrum analyzer and the coaxial cable. The equipment comprising the test systems is calibrated prior to testing the EUT.

Justification
The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left un-terminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

Radiated Emissions
The final level, in dBuV/m, equals the reading from the spectrum analyzer (Level dBuV), adding the antenna correction factor and cable loss factor (Factor dB) to it, and subtracting the preamp gain (and duty cycle correction factor, if applicable). This result then has the limit subtracted from it to provide the Delta, which gives the tabular data as shown in the data sheets in Appendix B.

Example:

FREQ (MHz)	LEVEL (dBuV)	CABLE/ANT/PREAMP (dB) (dB/m) (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m) (deg)	DELTA1
60.80	42.5Qp +	1.2 + 10.9 - 25.5	= 29.1	V 1.0 0.0	-10.9

Substitution Method
A cabinet (or enclosure) radiated emission scan was also made, at Intertek, with the EUT's antenna replaced with a termination to demonstrate case radiation compliance to the –13 dBm requirement. Radiated emissions from the EUT are measured in the frequency range of 30 to 20,000 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is place directly on the turntable/ground plane. Interface cable that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. The field strength levels were measured per ANSI C63.4. The EUT is then replaced with a tuned dipole antenna (below 1GHz) or horn antenna (above 1 GHz). The substitute antenna was placed in the same polarization as the test antenna. A signal generator was used to generate a signal level that matched the highest level measured from the EUT. The signal generator level minus the cable loss from the signal generator to the substitute antenna plus the substitute antenna gain equals the spurious power level.

Test Equipment
All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated according to internal procedure.

9.0 APPENDIX C

Radiated Emissions Test Data

Table of Contents; Section 1.0

Document Name: *3163123MIN-001_Radiated_Emissions_Test_Report_Part_22*

Test Engineer: Uri Spector **Date:** 21 November, 2008

Test Procedure:
Test measurements were made in accordance with ANSI C63.4-2003, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

Test Site Location:
The test site is a 3 meter Semi-Anechoic Chamber, constructed by Panashield™ Inc. and located inside the building at 7250 Hudson Blvd. Suite 100, Oakdale, MN 55128.

Test Site Description:
The 3 meter Semi-Anechoic Chamber is constructed of Panabolt™ modular RF shielding and self-supported with structural steel designed for the local seismic zone rating. The chamber has the nominal size of 20' wide x 29' long x 18' high. All walls and ceiling of the chamber are treated with FFG-1000 Ferrite Grid absorber which was developed specifically to meet international requirements for EMC anechoic chambers for emissions and immunity measurements. To meet high frequency testing white HY-35 hybrid absorber is mounted on the ferrites in specular regions of the chamber.

The chamber has a 2 meter diameter ANSI test volume area and meets the requirements of ANSI C63.4 (1992), EN55022, and FCC Part 15 standards for testing at a 3 meter path length.

FCC Registration Number: 90706
IC Registration Number: 4359