



# Test Report Summary

## FCC CFR 47, Part 24

### Subpart E Broadband PCS

**Manufacturer:** ADC Telecommunications

**Name of Equipment:** InterReach® picoBTS 1900 MHz

**Model Number(s):** IRB-IBTS-D20N00

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

**Test Report Number:** MN090327\_PCS

**Test Date(s):** 25 November, 2008 (ETL)  
23 March, 2009 (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 24.

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 24 and the EUT fulfills the requirements of the Federal Communications Commission's CFR 47 Part 24.

Date: 27 March, 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:** MN090327\_PCS **Date of Issue:** 27 March, 2009

**Model Number(s):** IRB-IBTS-D20N00

**Product Name:** InterReach® picoBTS 1900 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:** 3163122MIN-001  
**Reference(s)**

**Total pages including Appendices:** 40



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## 2.0 REVISION DESCRIPTION

Rev	Total Pages	Date	Description
A	40	27 March, 2009	Original Release

## 3.0 DOCUMENTATION

### 3.1 Test Regulations

- 24.232 Power and antenna height limits
- 24.235 Frequency stability
- 24.238 Emission limits for Broadband PCS equipment

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**

Temperature: 25° C  
Relative Humidity: 48%  
Atmospheric Pressure: 98.2 kPa

##### **ETL**

15-35° C  
30-60%  
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 – PCS - 1930 to 1990 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-D20N00	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.

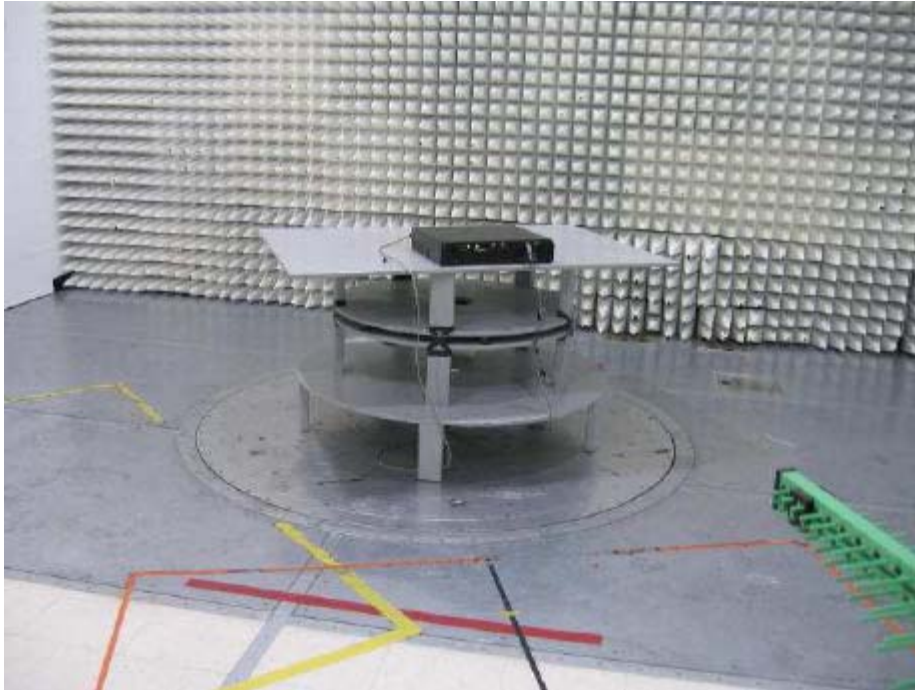
## 4.0 TEST SET-UP DRAWINGS AND PHOTOS

[Table of Contents: Section 1.0](#)

### 4.1 Test Set-up Photo, Radiated Emissions



## 4.2 Test Set-up Photo, Radiated Emissions





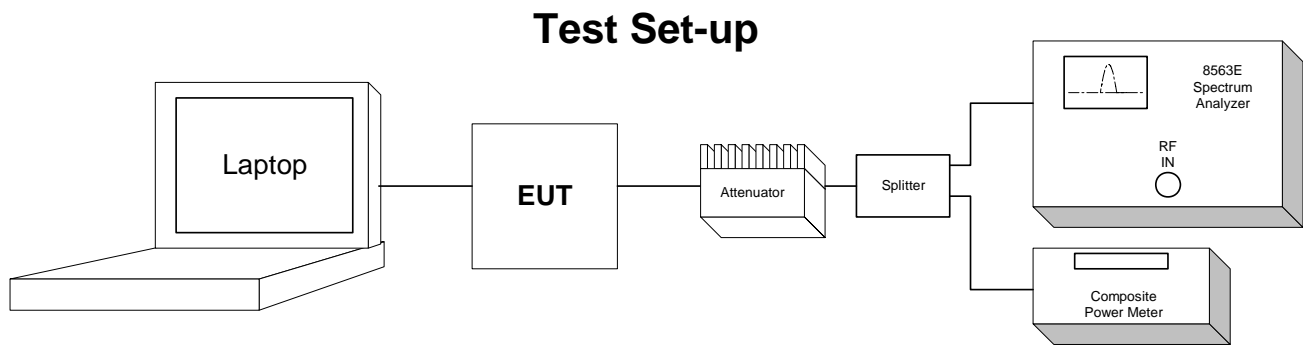
### 4.3 Test Set-up Drawings

## Conducted and Radiated Emission Limits Test

### Conducted Output Power Test

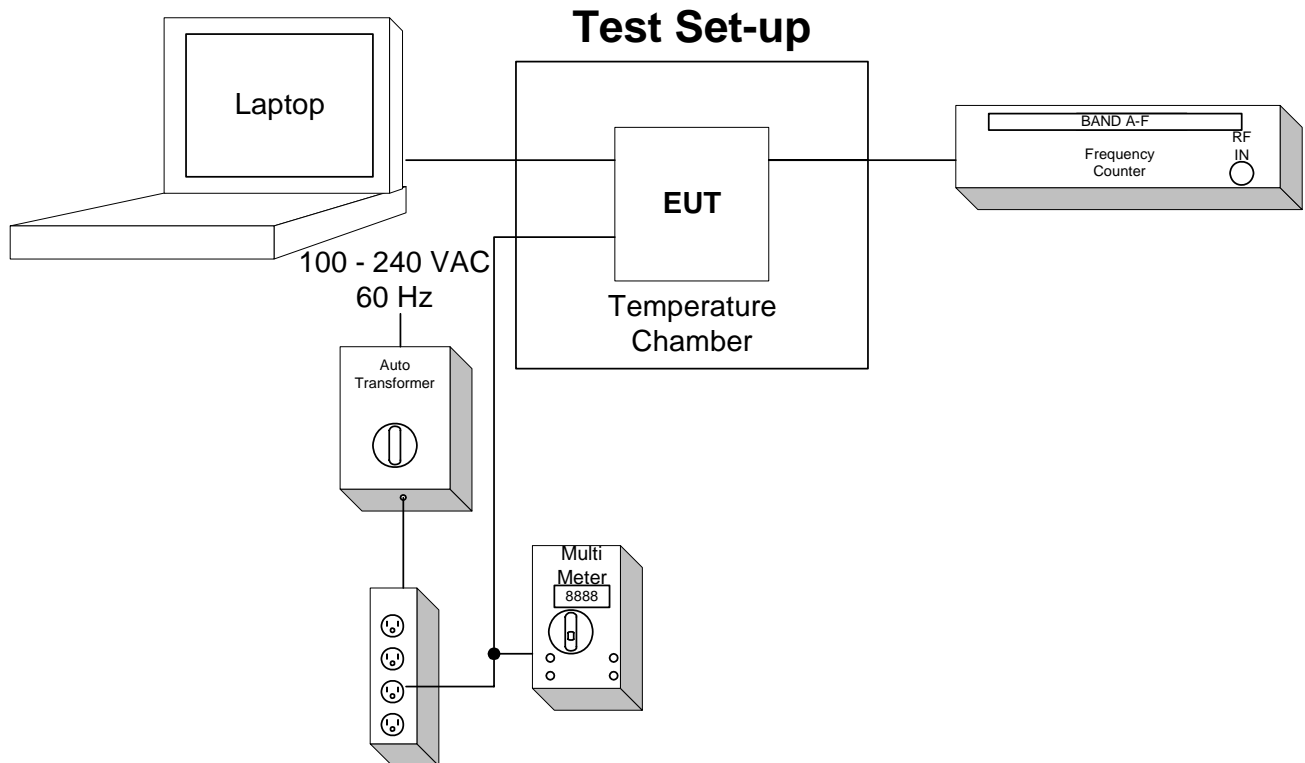
### Inter-Modulation Test

### Occupied Bandwidth Modulation Test



# Frequency Tolerance Test

EUT is specified for outdoor use with temperature range of  $-5^{\circ}$  to  $+45^{\circ}$  C, and was tested with its range.



## 5.0 TEST RESULTS

### 5.1.1 24.232 Power and Antenna Height Limits

#### Test Summary:

- The requirements are:  **MET**  NOT MET
- Minimum margin of compliance is 31.8 dB at 1960 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

#### Test Limit:

100 Watts or 50 dBm Limit

#### Test Data:

[Conducted Output Power; Section 7.2](#)

[Table of Contents; Section 1.0](#)

**Test Engineer:** Mark F. Miska

**Date:** 23 March, 2009

## 5.1.2 24.235 Frequency Stability

### Test Summary:

- The requirements are:  **MET**  NOT MET
- The fundamental emission stays within the limit.
- Frequency measured over a temperature range of –5 to 45° 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:

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

### Test Data:

[Frequency Stability; Section 7.3](#)

[Table of Contents; Section 1.0](#)

**Test Engineer:** Mark F. Miska

**Date:** 23 March, 2009

### 5.1.3 24.238 Emission Limitations for Broadband PCS Equipment

#### 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

#### Test Limit:

Out of band emissions:

Attenuated below the transmitting power (P) by a factor of at least  $43 + 10\log(P)$  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:** 23 March, 2009

**Date:** 23 March, 2009

**Date:** 23 March, 2009

[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	8593E	MC54602	9-17-09	<input checked="" type="checkbox"/>
2	Power Meter	HP	EPM-441A	MC27670	12-22-09	<input checked="" type="checkbox"/>
3	Multimeter	Fluke	79111	MC34730	6-24-10	<input checked="" type="checkbox"/>
4	Frequency Counter	HP	5347A	MC27569	5-7-09	<input checked="" type="checkbox"/>
5	Temperature Chamber	Thermotron	SM-32C	MC18966	4-8-09	<input checked="" type="checkbox"/>
6	Signal Generator	Agilent	E4436B	MC50601	8-27-09	<input checked="" type="checkbox"/>
7	Signal Generator	Agilent	E4432B	MC27657	7-4-09	<input type="checkbox"/>
8	Attenuator	Huber Suhner	6810.17.A	N/A	CNR	<input type="checkbox"/>
9	Variable Auto Transformer	Staco	1520CT	MC44655	CNR	<input checked="" type="checkbox"/>
10	Digital Barometer	Fisher Scientific	02-403	MC50719	10-28-09	<input checked="" type="checkbox"/>
11	Data Acquisition Unit	Fluke	Hydra	MC27549	12-3-09	<input type="checkbox"/>
12	Attenuator	Aeroflex	49-30-33	N/A	CNR	<input type="checkbox"/>
13	Attenuator	Aeroflex	86-30-12	N/A	CNR	<input checked="" type="checkbox"/>
14	LNA	Lucix Corp	C020200L 1603	N/A	CNR	<input type="checkbox"/>
15	Power Sensor	HP	8481A	MC27570	9-17-09	<input checked="" type="checkbox"/>

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

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[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 10<sup>th</sup> 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.

1900 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.

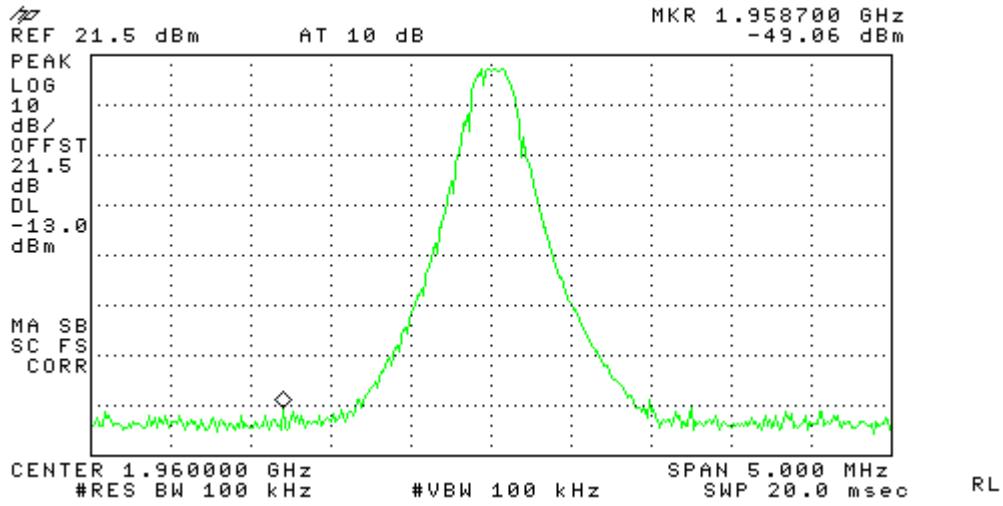
This is a constant gain device, so the setup controls the output. There is an overdrive and overpower limit control that prevents excess power.

Results:

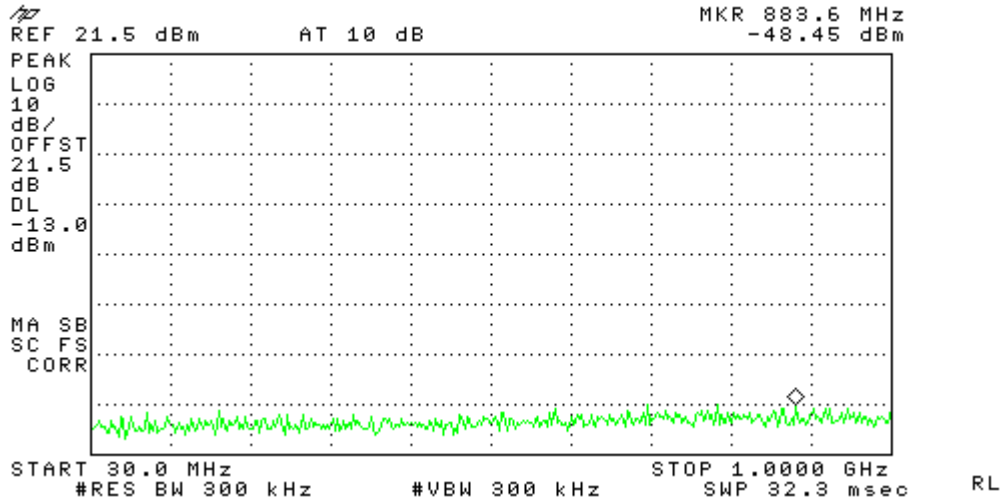
Pass (See plots)



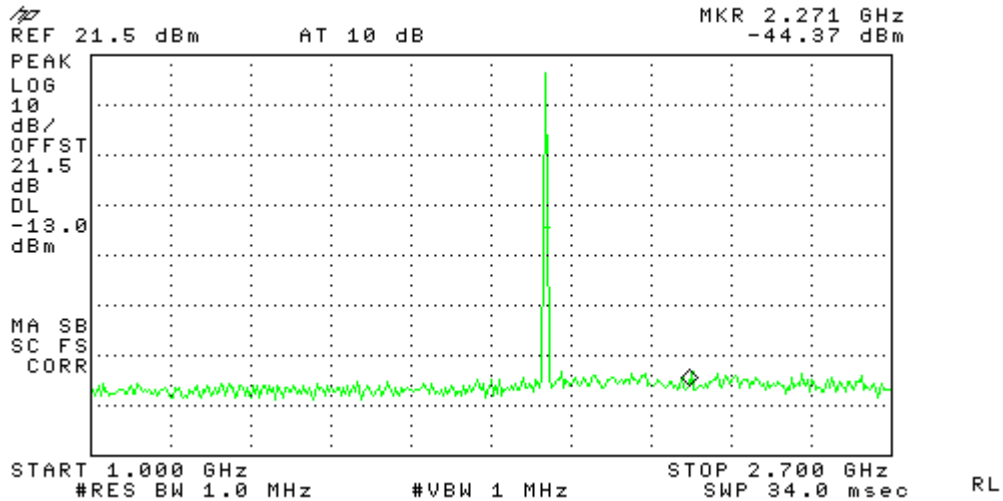
Conducted Emissions GSM PCS  
 Center: 1960 MHz Span: 5 MHz RBW/VBW: 100 kHz

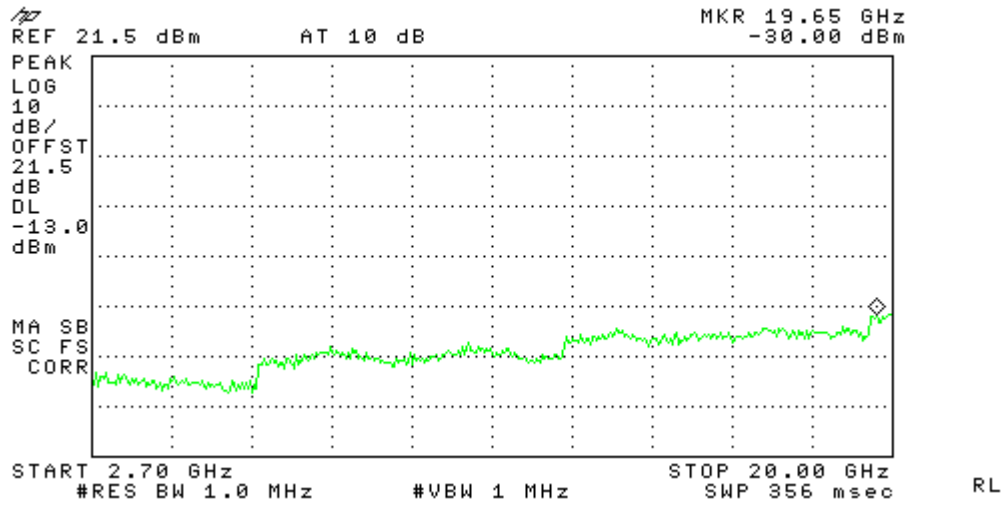


Conducted Emissions GSM PCS  
 Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz

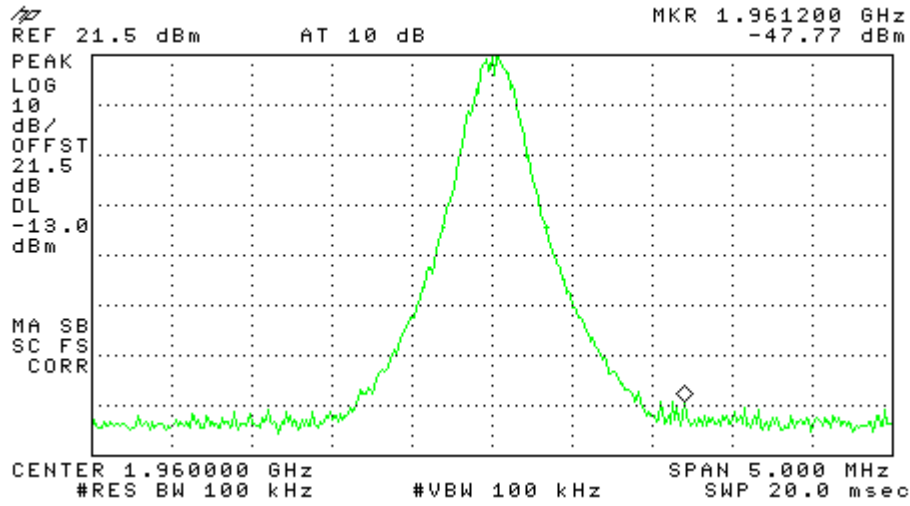


Conducted Emissions GSM PCS  
 Span: 1 GHz to 20 GHz RBW/VBW: 1 MHz



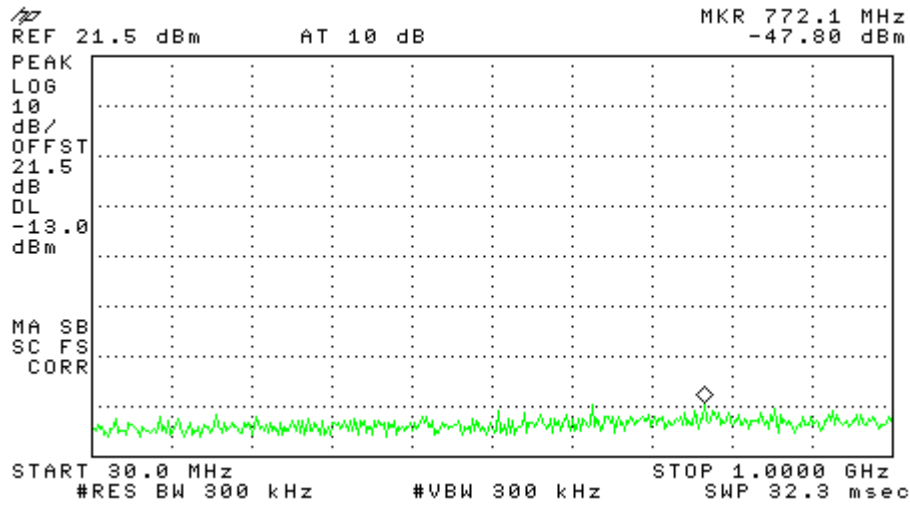


Conducted Emissions      EDGE PCS  
 Center: 1960 MHz      Span: 5 MHz      RBW/VBW: 100 kHz



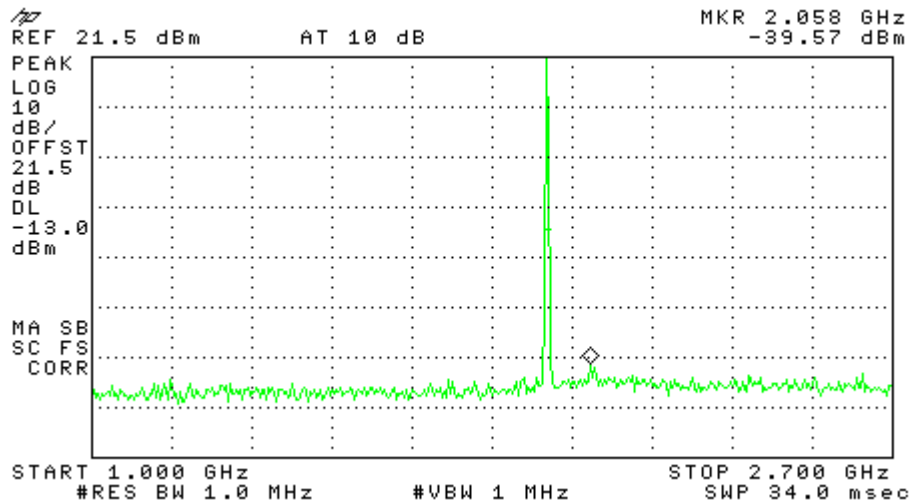
RL

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



RL

Conducted Emissions      EDGE PCS  
 Span: 1 GHz to 20 GHz      RBW/VBW: 1 MHz

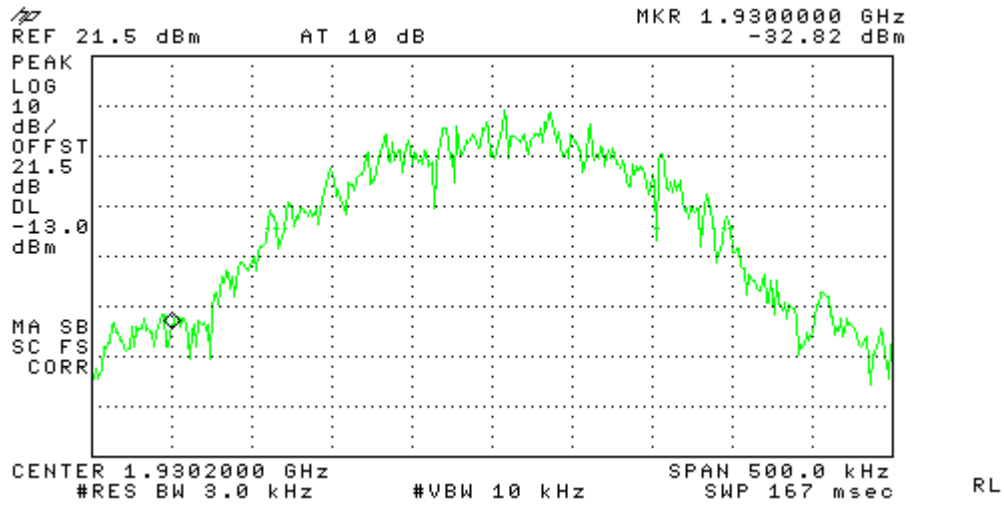


RL



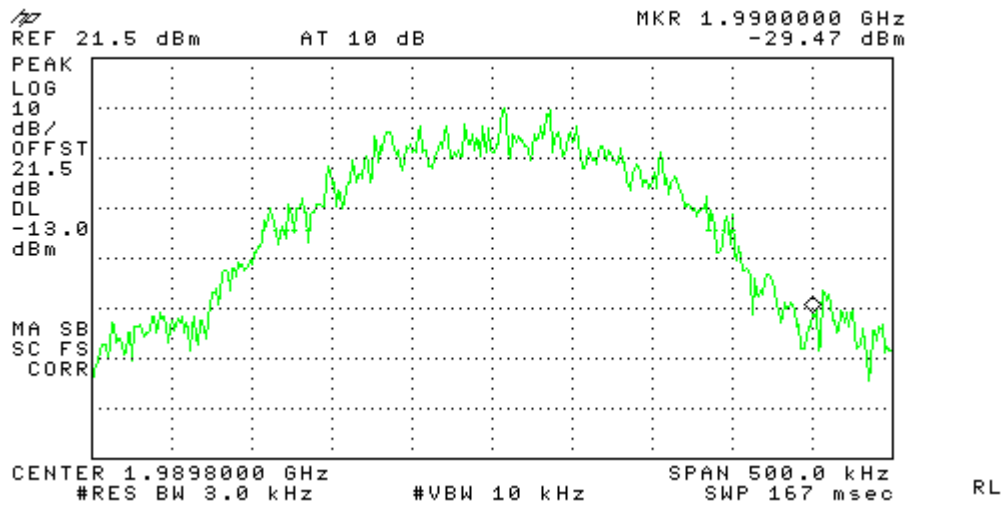
Band\_Edge  
Center: 1930.2 MHz Span: 500 kHz

GSM  
RBW: 3 kHz VBW: 10 kHz

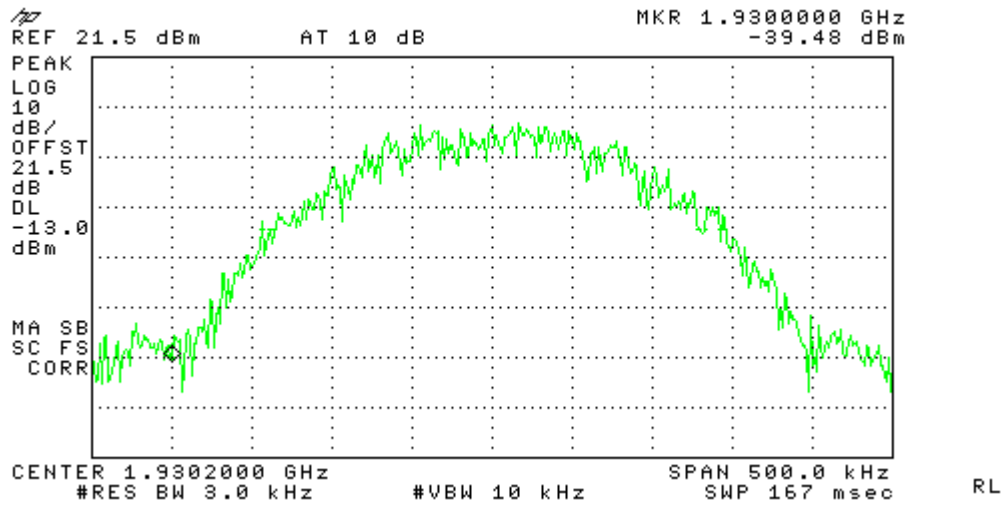


Band\_Edge  
Center: 1989.8 MHz Span: 500 kHz

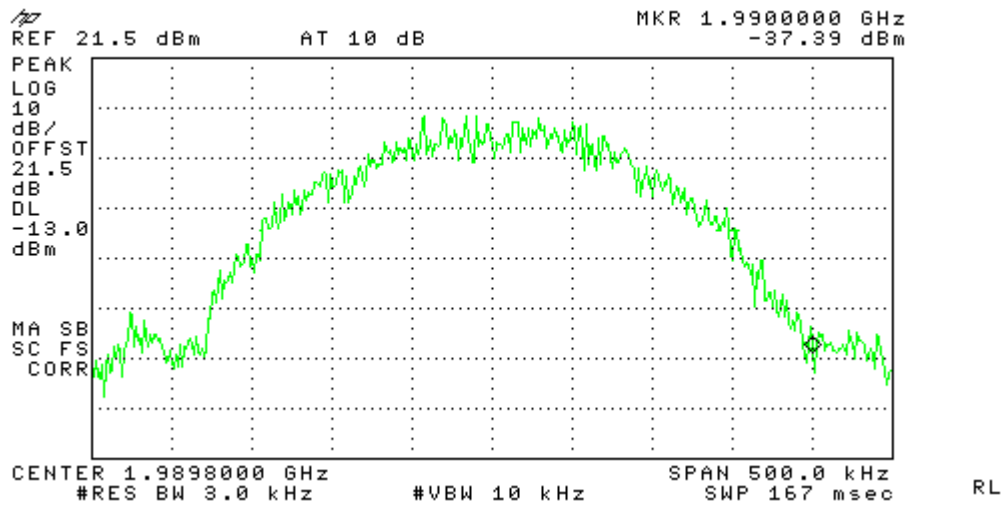
GSM  
RBW: 3 kHz VBW: 10 kHz



Band\_Edge                      EDGE  
Center: 1930.2 MHz Span: 500 kHz                      RBW: 3 kHz    VBW: 10 kHz



Band\_Edge                      EDGE  
Center: 1989.8 MHz Span: 500 kHz                      RBW: 3 kHz    VBW: 10 kHz



## 7.2 Conducted Output Power Test

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[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.

<u>GSM</u>	<u>0.066 Watts</u>
Carrier Frequency	Carrier Output
1930.2 MHz	17.85 dBm
1960.0 MHz	18.20 dBm
1989.8 MHz	17.70 dBm

<u>EDGE</u>	<u>0.063 Watts</u>
Carrier Frequency	Carrier Output
1930.2 MHz	17.80 dBm
1960.0 MHz	18.05 dBm
1989.8 MHz	18.00 dBm

### 7.3 Frequency Stability Test

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[Back to Frequency Stability: Section 5.1.2](#)

picoBTS				
Input Voltage	Input Voltage	Carrier Frequency	Measured Frequency	Meets Requirements?
100 VAC		1930.200 MHz	1930.200 MHz	Yes
170 VAC		1930.200 MHz	1930.200 MHz	Yes
240 VAC		1930.200 MHz	1930.200 MHz	Yes
100 VAC		1960.000 MHz	1960.000 MHz	Yes
170 VAC		1960.000 MHz	1960.000 MHz	Yes
240 VAC		1960.000 MHz	1960.000 MHz	Yes
100 VAC		1989.800 MHz	1989.800 MHz	Yes
170 VAC		1989.800 MHz	1989.800 MHz	Yes
240 VAC		1989.800 MHz	1989.800 MHz	Yes
Temperature		Carrier Frequency	Measured Frequency	Meets Requirements?
-5 Deg. C		1930.200 MHz	1930.200 MHz	Yes
0 Deg. C		1930.200 MHz	1930.200 MHz	Yes
10 Deg. C		1930.200 MHz	1930.200 MHz	Yes
20 Deg. C		1930.200 MHz	1930.200 MHz	Yes
30 Deg. C		1930.200 MHz	1930.200 MHz	Yes
40 Deg. C		1930.200 MHz	1930.200 MHz	Yes
45 Deg. C		1930.200 MHz	1930.200 MHz	Yes
-5 Deg. C		1960.000 MHz	1960.000 MHz	Yes
0 Deg. C		1960.000 MHz	1960.000 MHz	Yes
10 Deg. C		1960.000 MHz	1960.000 MHz	Yes
20 Deg. C		1960.000 MHz	1960.000 MHz	Yes
30 Deg. C		1960.000 MHz	1960.000 MHz	Yes
40 Deg. C		1960.000 MHz	1960.000 MHz	Yes
45 Deg. C		1960.000 MHz	1960.000 MHz	Yes
-5 Deg. C		1989.800 MHz	1989.800 MHz	Yes
0 Deg. C		1989.800 MHz	1989.800 MHz	Yes
10 Deg. C		1989.800 MHz	1989.800 MHz	Yes
20 Deg. C		1989.800 MHz	1989.800 MHz	Yes
30 Deg. C		1989.800 MHz	1989.800 MHz	Yes
40 Deg. C		1989.800 MHz	1989.800 MHz	Yes
45 Deg. C		1989.800 MHz	1989.800 MHz	Yes



## 7.4 Intermodulation Test

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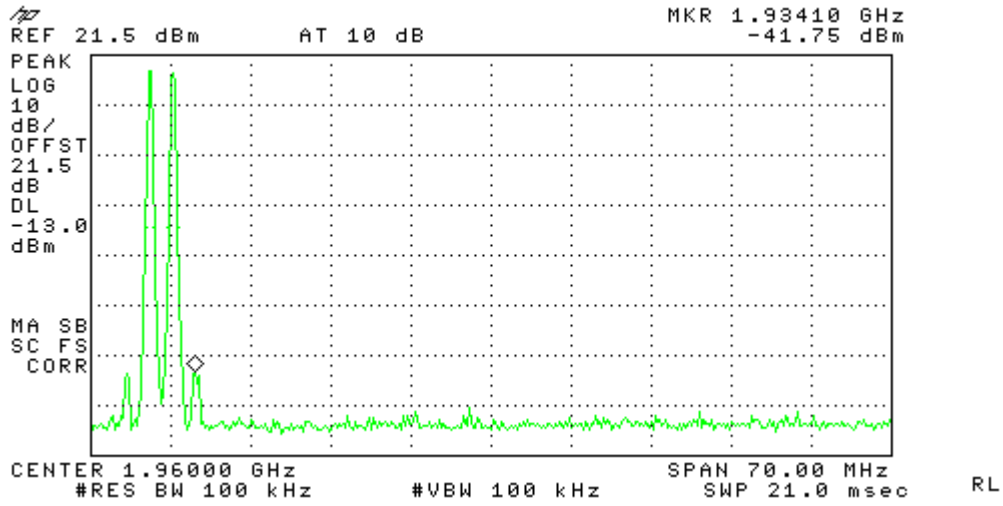
[Back to Emission Limits: Section 5.1.3](#)

The inter-modulation products test was performed for the EUT. Three tests were performed 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 (~20 GHz). The following plots show the results.

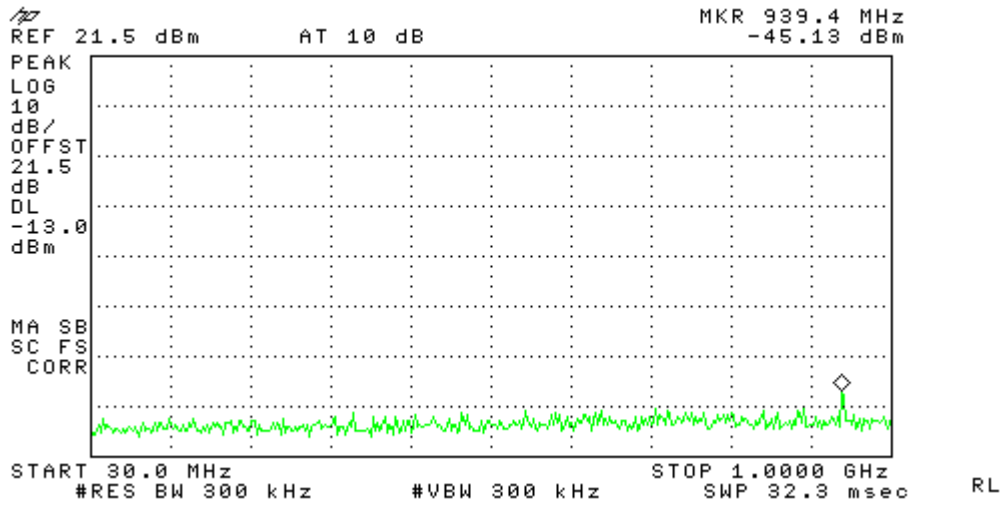
Results:

(See Plots)

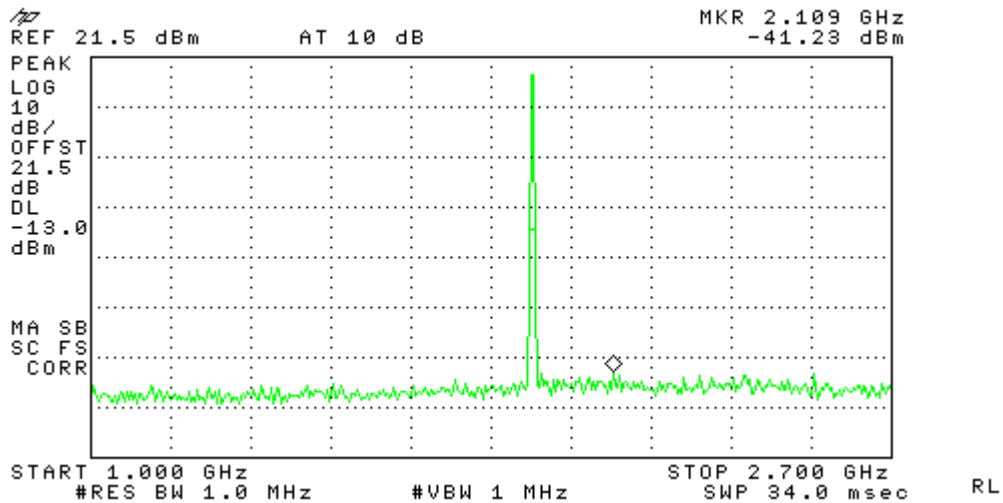
Intermodulation GSM\_Low PCS  
Center: 1960 MHz Span: 70 MHz RBW/VBW: 100 kHz

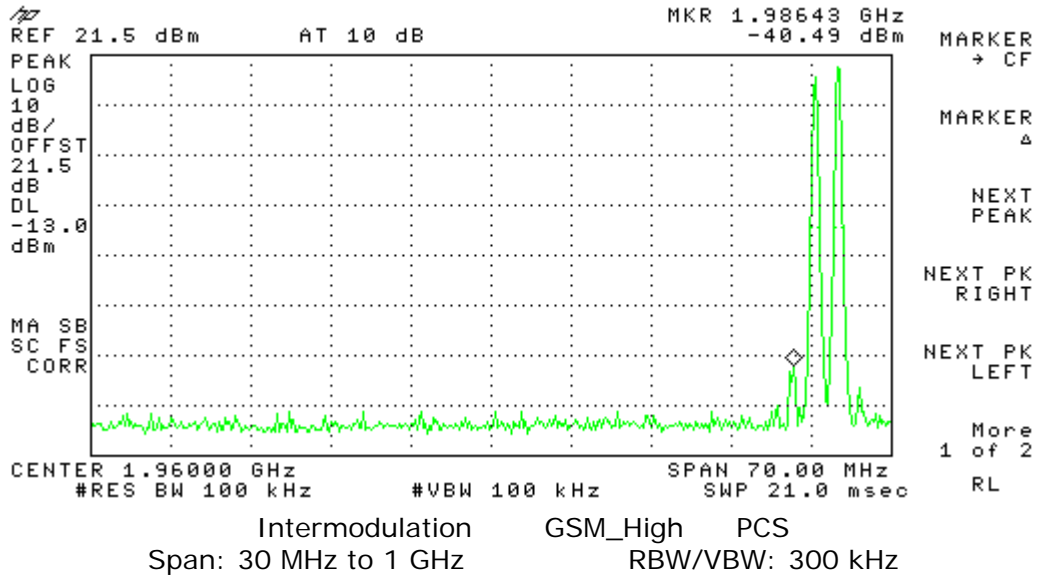
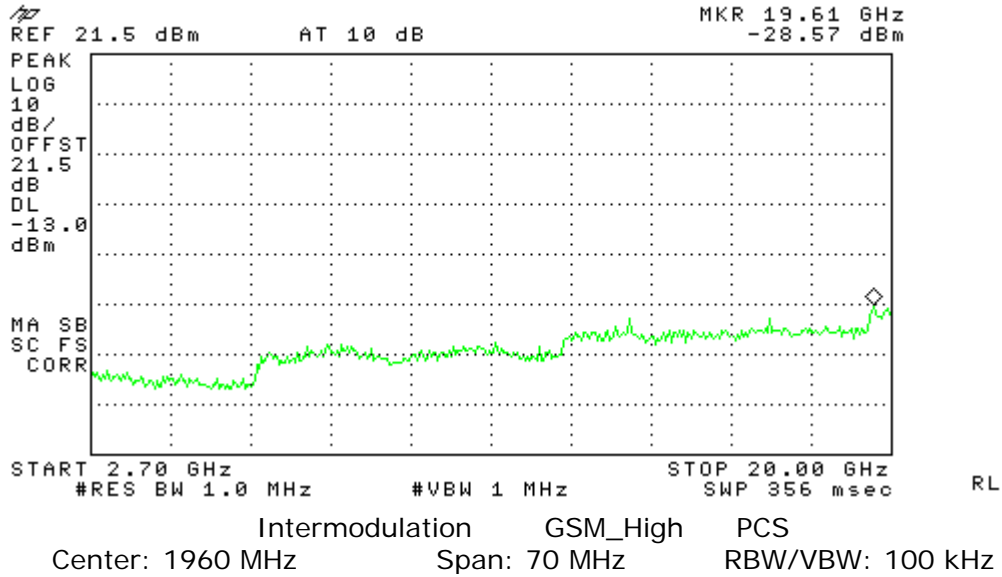


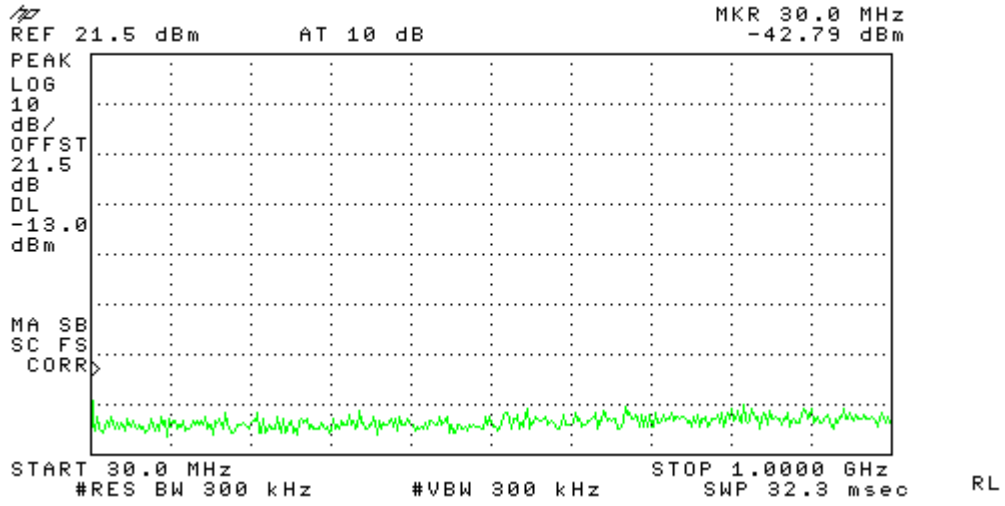
Intermodulation GSM\_Low PCS  
Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz



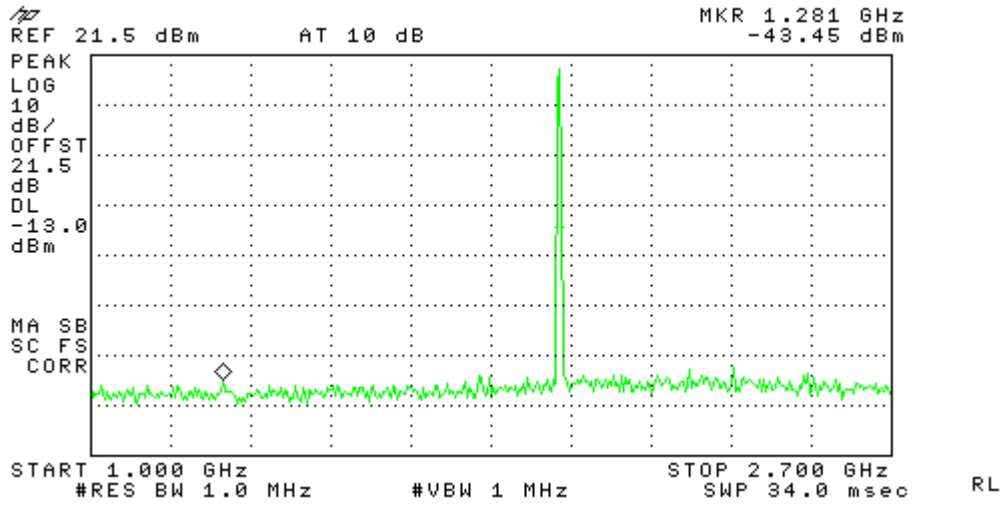
Intermodulation GSM\_Low PCS  
Span: 1 GHz to 20 GHz RBW/VBW: 1 MHz

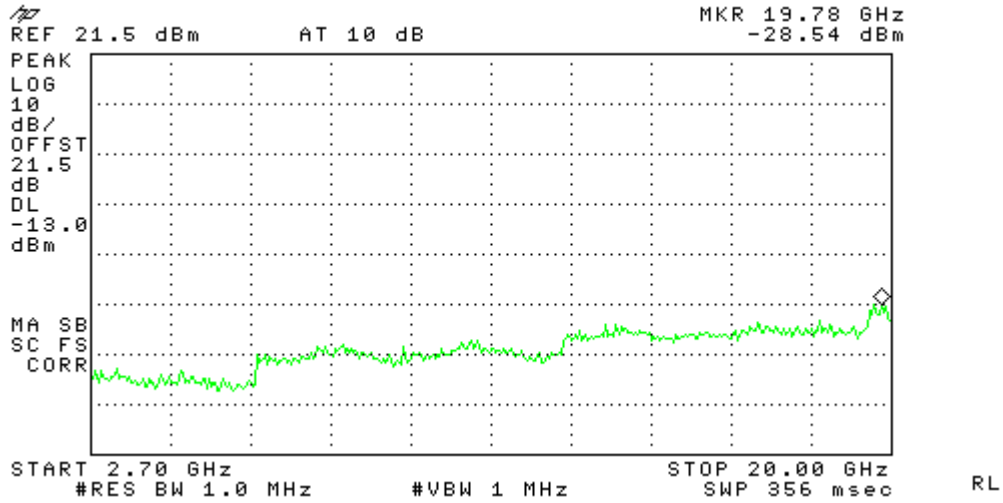




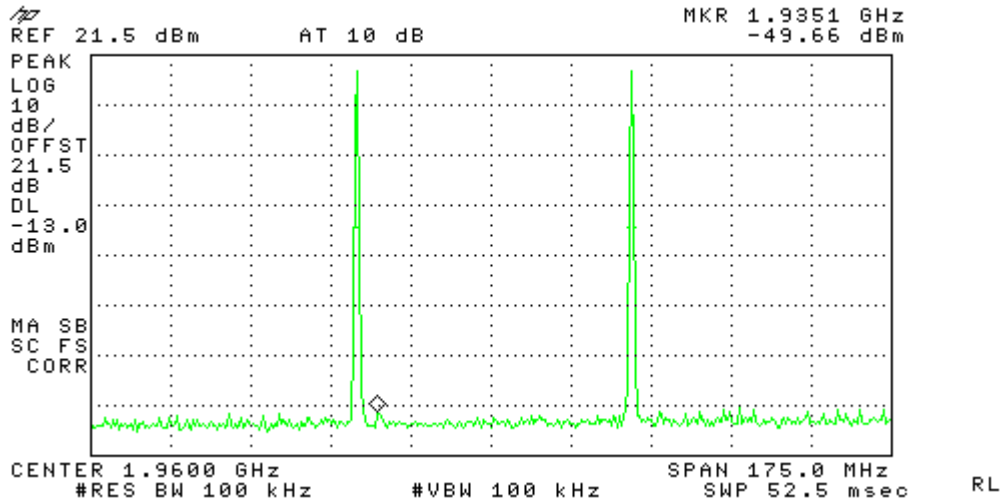


Intermodulation GSM\_High PCS  
 Span: 1 GHz to 20 GHz RBW/VBW: 1 MHz





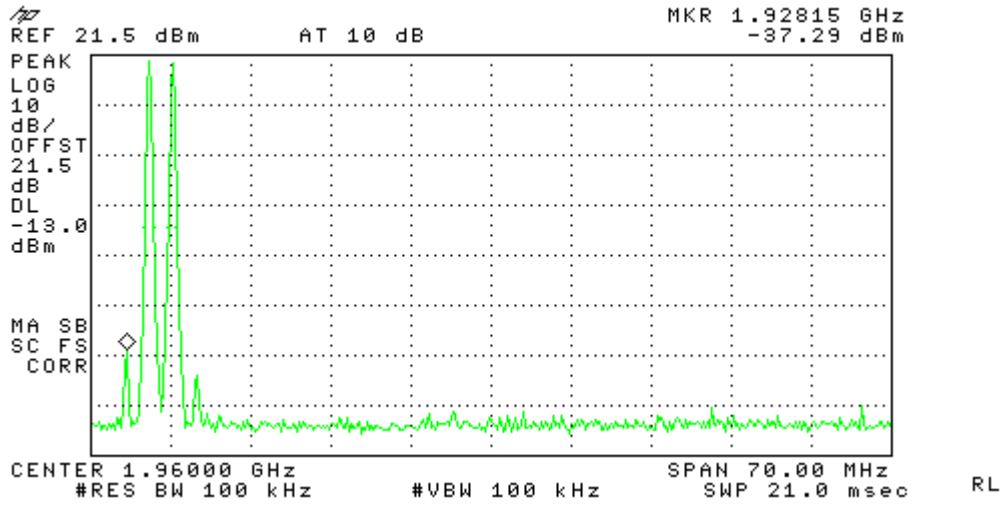
Intermodulation      GSM\_Apart      PCS  
 Center: 1960 MHz      Span: 175 MHz      RBW/VBW: 100 kHz



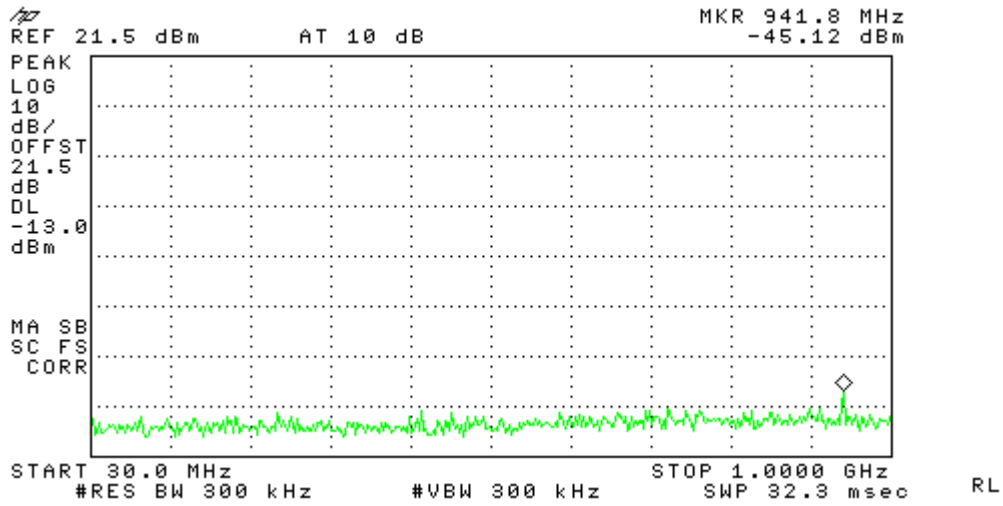
Intermodulation      GSM\_Apart      PCS  
 Span: 30 MHz to 1 GHz      RBW/VBW: 300 kHz



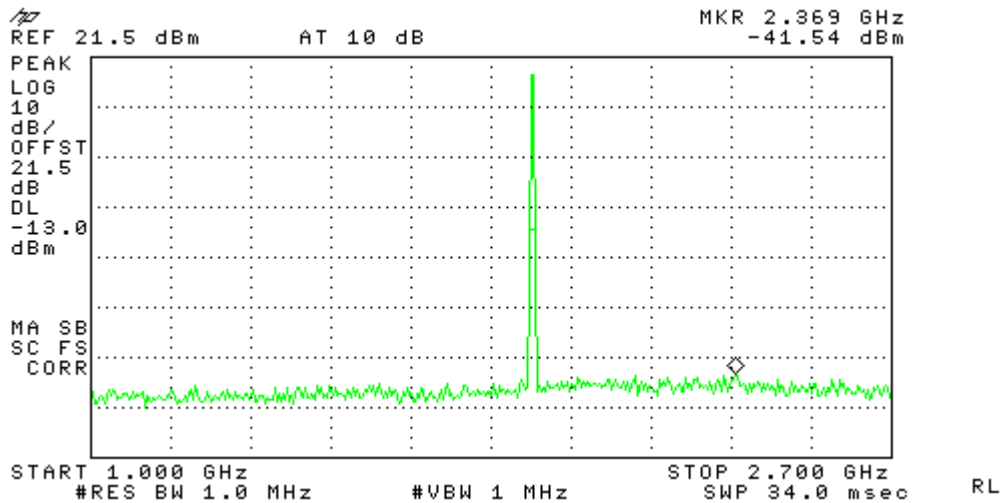
Intermodulation EDGE\_Low PCS  
 Center: 1960 MHz Span: 70 MHz RBW/VBW: 100 kHz

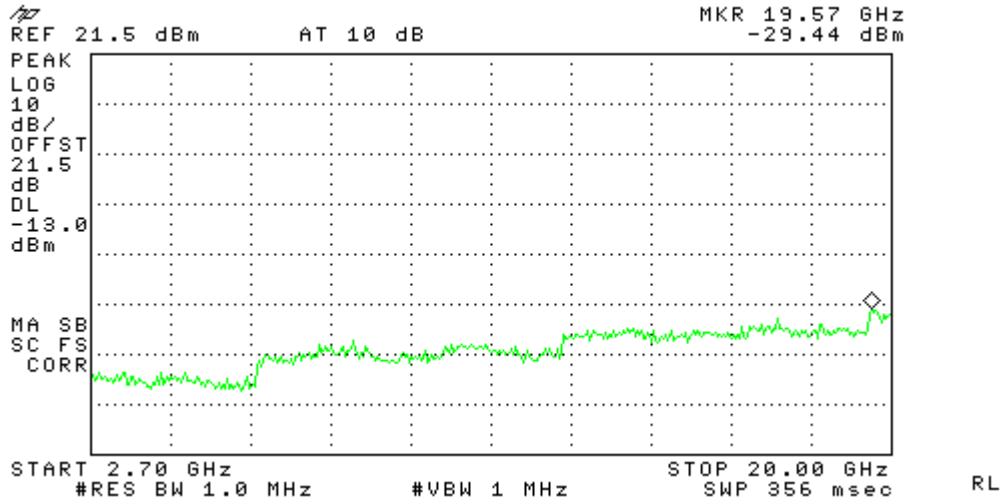


Intermodulation EDGE\_Low PCS  
 Span: 30 MHz to 1 GHz RBW/VBW: 300 kHz

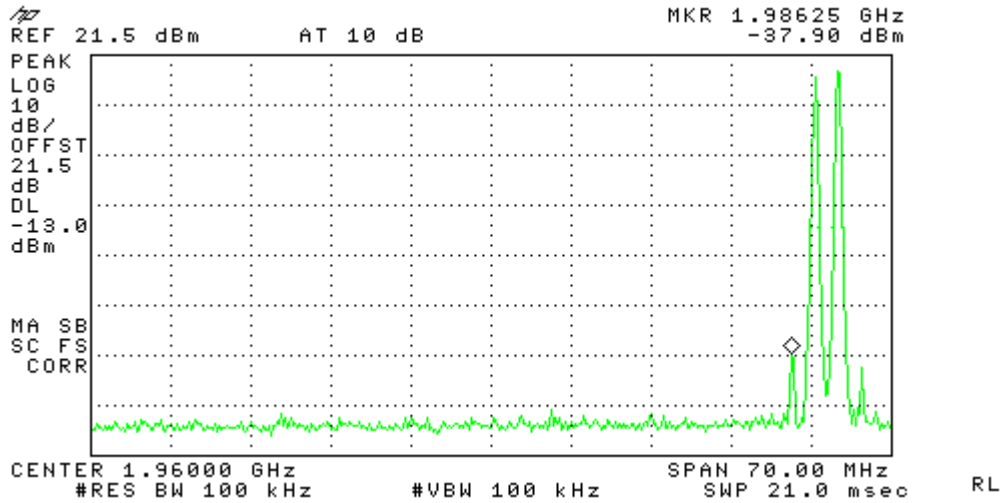


Intermodulation EDGE\_Low PCS  
 Span: 1 GHz to 20 GHz RBW/VBW: 1 MHz



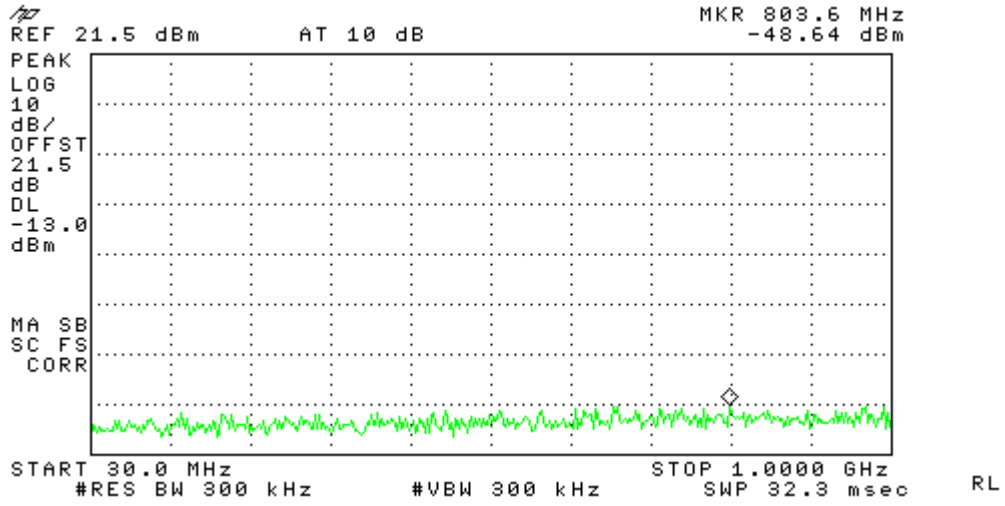


Intermodulation      EDGE\_High      PCS  
 Center: 1960 MHz      Span: 70 MHz      RBW/VBW: 100 kHz

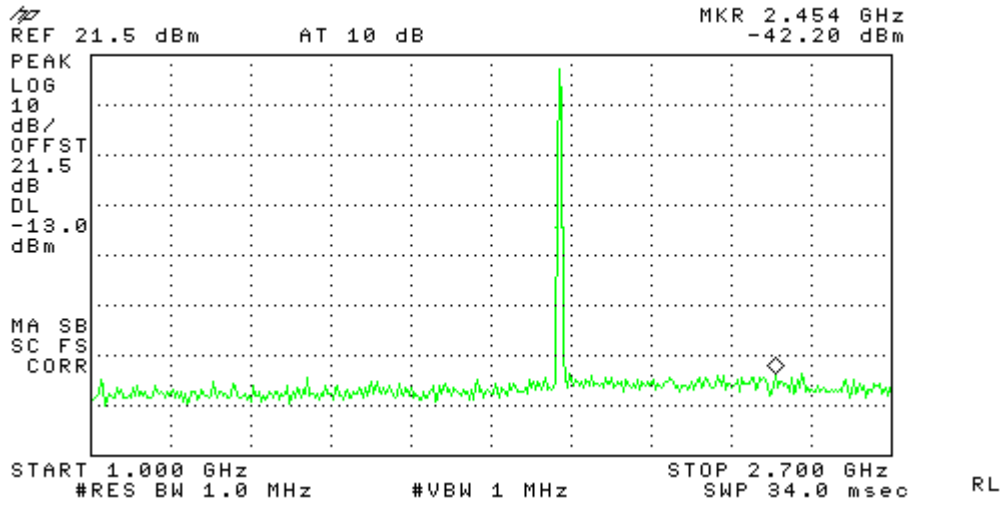


Intermodulation      EDGE\_High      PCS  
 Span: 30 MHz to 1 GHz      RBW/VBW: 300 kHz





Intermodulation EDGE\_High PCS  
 Span: 1 GHz to 20 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.

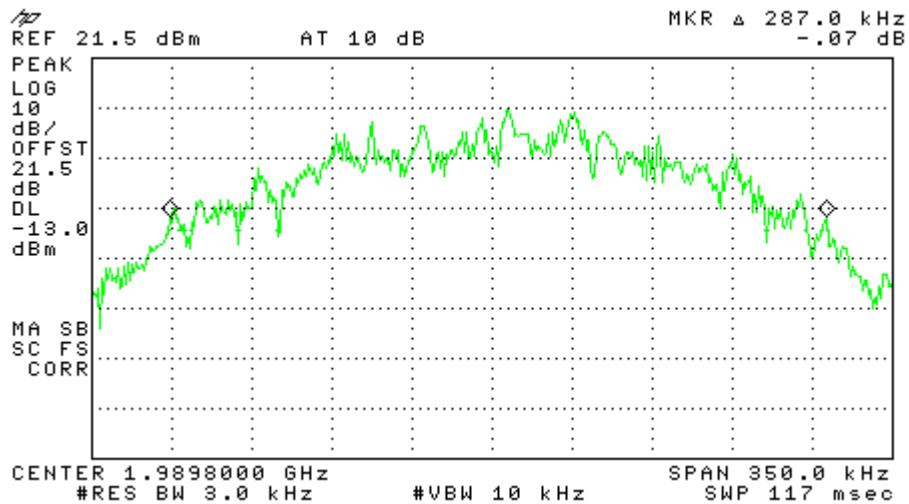
The resolution bandwidth is reduced to 1% of the estimated emission bandwidth and the video bandwidth is set to 3 times the resolution bandwidth. The markers are moved to the -20 dB points (from the previously established center frequency level) on either side of center frequency.

### **Results:**

Pass (see plots)

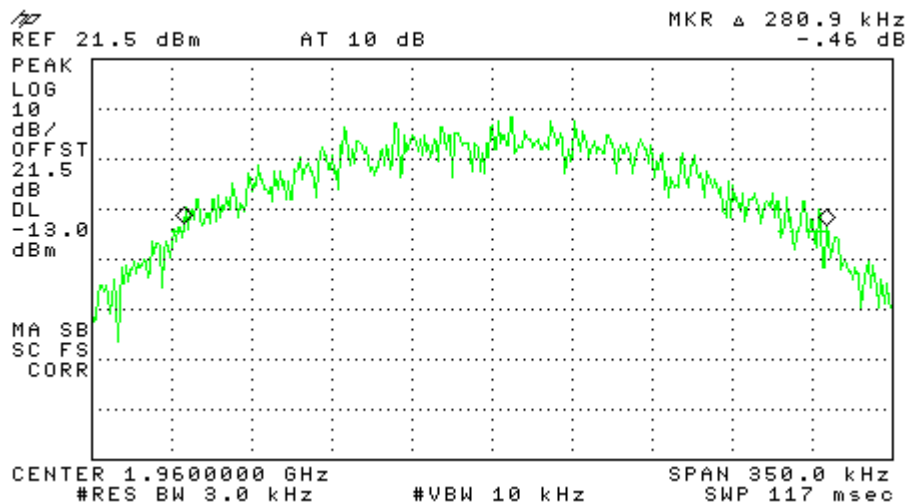
Occupied Bandwidth  
Span: 350 kHz

GSM\_Signal\_Out  
RBW: 3 kHz VBW: 10 kHz



Occupied Bandwidth  
Span: 350 kHz

EDGE\_Signal\_Out  
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 - 26° 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)	FINAL (dB) (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 placed directly on the turntable/ground plane. Interface cables 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.

## Radiated Emissions Test Data

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Document Name: *3163122MIN-001\_Radiated\_Emissions\_Test\_Report\_Part\_24*

**Test Engineer:** Norman Shpilsher

**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