FCC PART 90

TEST AND MEASUREMENT REPORT

For

ADC Telecommunications Inc.

1187 Park Place,

Shakopee, MN 55379, USA

FCC ID: NOO-S2795-012

Report Type: Original Report	**Product Type:** Remote Access Unit for InterReach Fusion System

Test Engineer: Wei Sun

Report Number: R1207096-90

Report Date: 2012-08-08

Victor Zhang

Reviewed By: EMC/RF Lead

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1207096-90	Original Report	2012-08-08

1. General Information

1.1 Product Description for Equipment under Test (EUT)

The ADC Telecommunications Inc. product, model: Inter Reach Fusion, FCC ID: NOO-S2795-012 or the "EUT" as referred to in this report, is a RAU for *Indoor Booster; which* is an Indoor Wireless Repeater System that consists Five modular components, the Spectrum Host Unit, Spectrum DART Remote Unit, Spectrum IF Expansion Unit, Spectrum Remote Access Unit (EUT)(Model Number:SPT-S1-8019-22) and Support Spectrum Remote Access Unit (Model Number: SPT-M1-8519-1). The downlink frequency band is: SMR Band: 851-869 MHz.

1.2 Mechanical Description

The EUT dimension is approximately 29.21cm (L) x 22.86cm (W) x 8.9cm (H) and weighs approximately 3.4 kg.

The test data gathered are from production sample. Serial number: R1207096-1, assigned by BACL.

1.3 Objective

This type approval report is prepared on behalf of ADC Telecommunications Inc. in accordance with Part 90, of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated spurious emissions.

1.4 Related Submittal(s)/Grant(s)

NA.

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 90 – PRIVATE LAND MOBILE RADIO SERVICES

Applicable Standards: TIA/EIA 603-C

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from ±2.0 dB for Conducted Emissions tests and ±4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

N/A

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Spectrum Host Unit

Manufacturer	Description	Model	Serial Number
ADC Telecommunications Inc.	Spectrum-Prism,800 SMR, Classic RF DART	FWU-40000HUDART	-
ADC Telecommunications Inc.	Spectrum-Prism,850 CELL, Classic RF DART	FWU-20000HUDART	-
ADC Telecommunications Inc.	Spectrum-Prism,1900 PCS, Single RF SuperDART	FWU-86000HUDART	-
ADC Telecommunications Inc.	Spectrum-Prism,2100 AWS, Single RF SuperDART	FWU-A6000HUDART	-

Spectrum DART Remote Unit

Manufacturer	Description	Model	Serial Number
ADC Telecommunications Inc.	Spectrum,800 SMR, Path-2 IF DART	SPT-000800SMRIFD	-
ADC Telecommunications Inc.	Spectrum,850 CELL, Path-2 IF DART	SPT-0000850P2IFD	-
ADC Telecommunications Inc.	Spectrum,1900 PCS, Path-2 IF DART	SPT-0001900P2IFD	-
ADC Telecommunications Inc.	Spectrum,2100 AWS, Path-1 IF DART	SPT-2100AWSP1IFD	-
ADC Telecommunications Inc.	Spectrum IF Expansion Unit	SPT-00000IFEU-1	-
ADC Telecommunications Inc.	850p1-1900p1 main RAU	SPT-M1-8519-1	-
Unipower Corporation	Power Supply	TPCPR1U3C-Z	24090T0019

2.5 Internal Configuration

Manufacturers	Descriptions	Models	Serial Numbers
TE Connectivity	Main PCB Board	MR225WQC	R1217M016NC
TE Connectivity	1900 PCS Band module Main PCB Board	MR225WPP	R1220M0387NC
TE Connectivity	800 SMR Band module Main PCB Board	MR2260D5	R12121M02055NC

2.6 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
Power Cable x4	2.0	Power Supply	Expansion Unit
CATV Cable x2	15.0	850p1-1900p1 main RAU	Expansion Unit
CATV Cable x2	15.0	850p1-1900p1 main RAU	EUT
Fiber Optic Cable x4	2.0	DRU	Expansion Host
Serial Cable	1.0	DRU	Expansion Host
QMA Cable x8	1.0	DRU	Expansion Host
Power Cable x4	2.0	Power Supply	Expansion Unit

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§2.1046, §90.635	RF Output Power	Compliant
§2.1047	Modulation Characteristics	NA
§2.1049	Occupied Bandwidth	Compliant
§2.1051 §90.669, §90.691	Emission Mask	Compliant
§2.1053, §90.669	Spurious Emissions at Antenna Terminals	Compliant
§2.1055,§90.669	Frequency Stability	Compliant
§2.1053, §90.669	Field Strength of Spurious Radiation	Compliant

N/A: Not applicable to repeater.

4 FCC §2.1091 - RF Exposure Information

4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	842/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1	30

f = frequency in MHz
** = Plane-wave equivalent power density*

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the anten

Maximum peak output power at antenna input terminal (dBm):	26.28
Maximum peak output power at antenna input terminal (mW):	424.62
Prediction distance (cm):	20
Prediction frequency (MHz):	851.1
Maximum Antenna Gain, typical (dBi):	3.0
Maximum Antenna Gain (numeric):	2.0
Power density of prediction frequency at 20 cm (mW/cm^2):	0.169
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.567

Results

The device complies with the MPE requirements by providing a safe separation distance of at least 20 cm between the antenna with maximum 3 dBi gain, including any radiating structure, and any persons when normally operated.

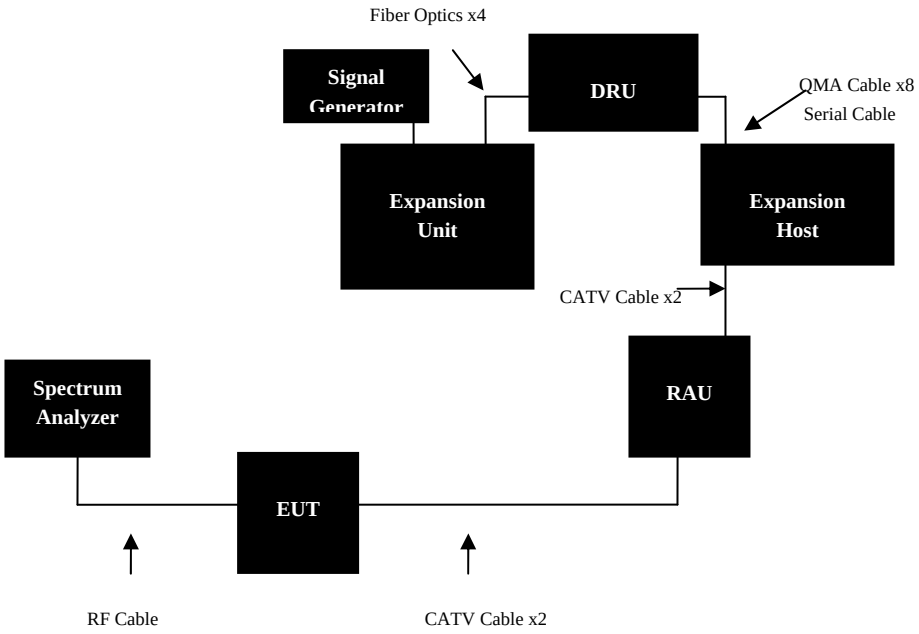
5 FCC §2.1046 & §90.635 – RF Output Power

5.1 Applicable Standard

FCC §2.1046 and §90.635.

5.2 Test Procedure and Test Setup Block Diagram

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.



5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09	2 years
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03	1 year

***Statement of Traceability**: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

5.4 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	60 %
ATM Pressure:	101.8 kPa

The testing was performed by Wei Sun on 2012-07-31 on the RF Site.

5.5 Test Results

Mode		Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
iDEN	800 MHz Downlink	Low	851.1	-24	18.06
		Middle	860	-25	18.07
		High	868.9	-24	17.91

Mode		Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
APCO25 C4FM	800 MHz Downlink	Low	851.1	-16	26.28
		Middle	860	-15	26.09
		High	868.9	-16	26.11

6 FCC §2.1049 – Occupied Bandwidth

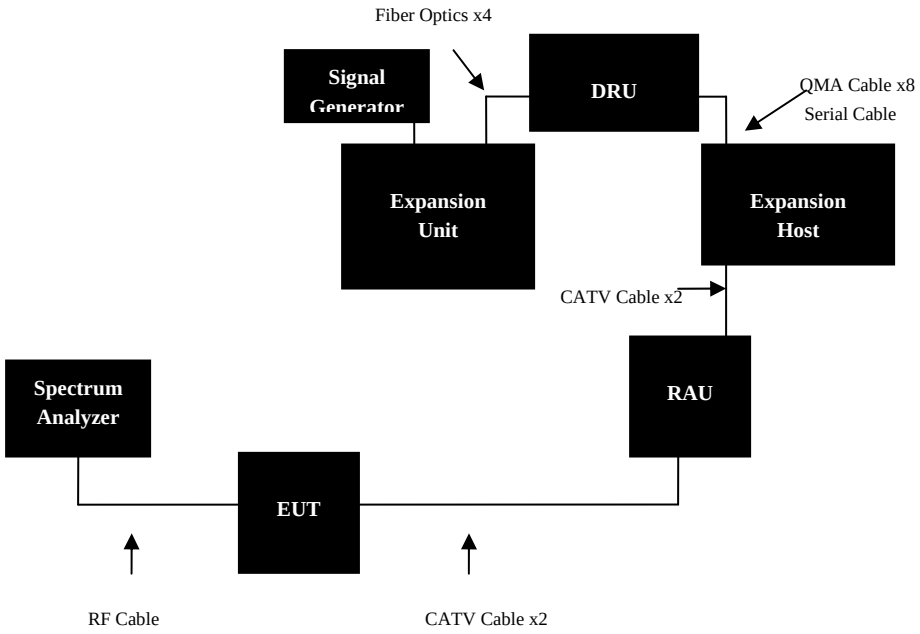
6.1 Applicable Standard

FCC §2.1049

6.2 Test Procedure and Setup Block Diagram

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 1% of the authorized bandwidth and the 26 dB & 99% bandwidth was recorded.



6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09	2 years

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

6.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	60 %
ATM Pressure:	101.6 kPa

The testing was performed by Wei Sun on 2012-07-31 on the RF Site.

6.5 Test Results

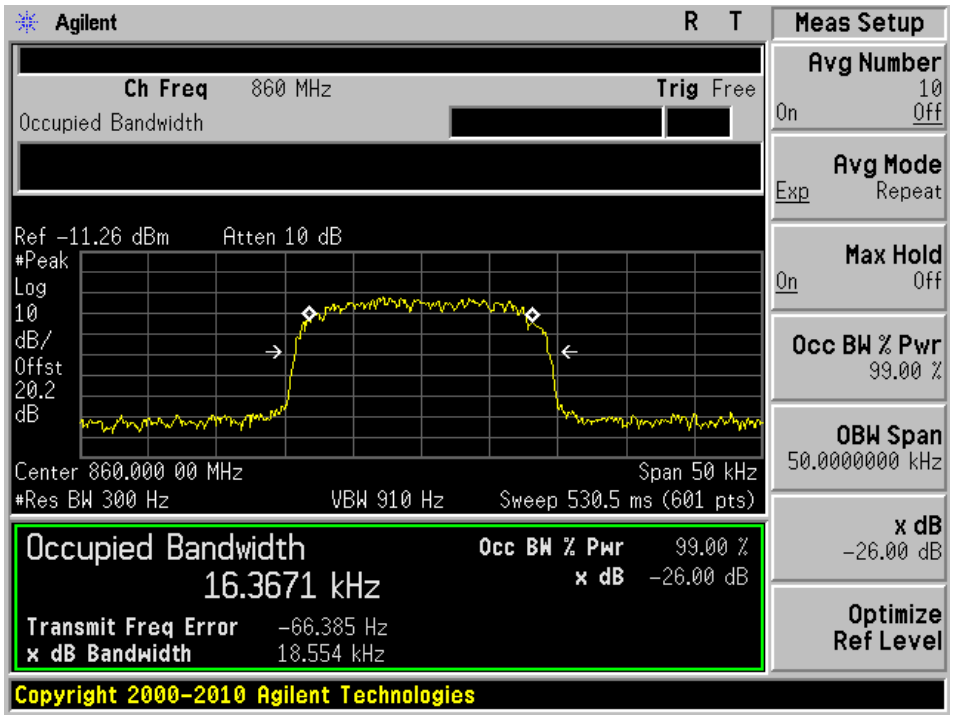
Please refer to the following table and plots.

Mode		Channel	Frequency (MHz)	Emission Band Width	
				Input (kHz)	Output (kHz)
iDEN	800 MHz Downlink	Middle	860	16.3671	16.3581

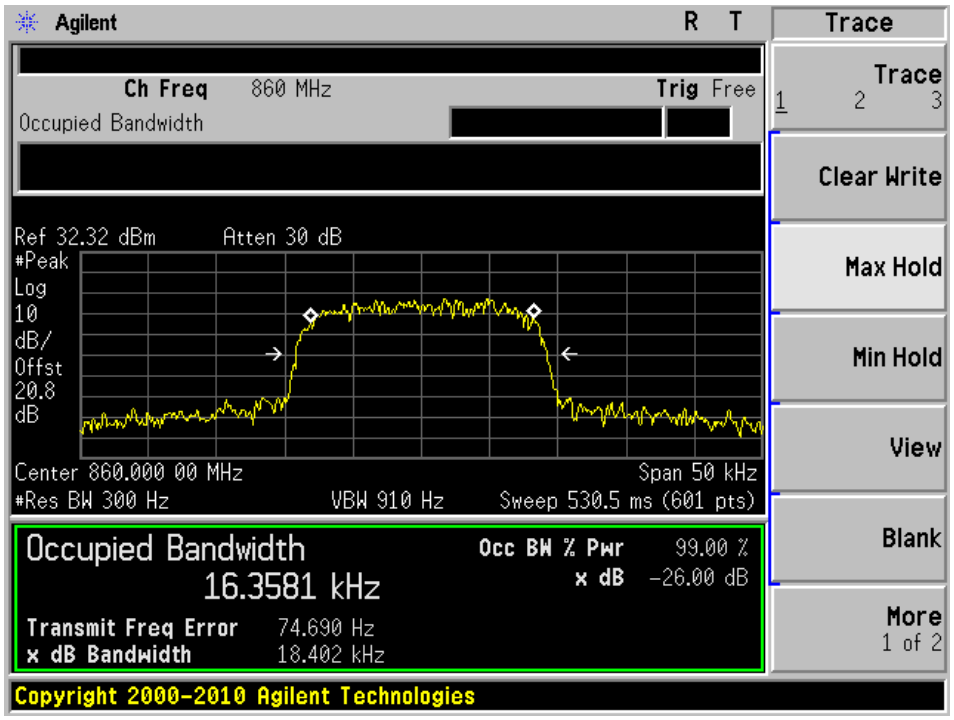
Mode		Channel	Frequency (MHz)	Emission Band Width	
				Input (kHz)	Output (kHz)
APCO25 C4FM	800 MHz Downlink	Middle	860	8.4372	8.3571

Occupied Bandwidth

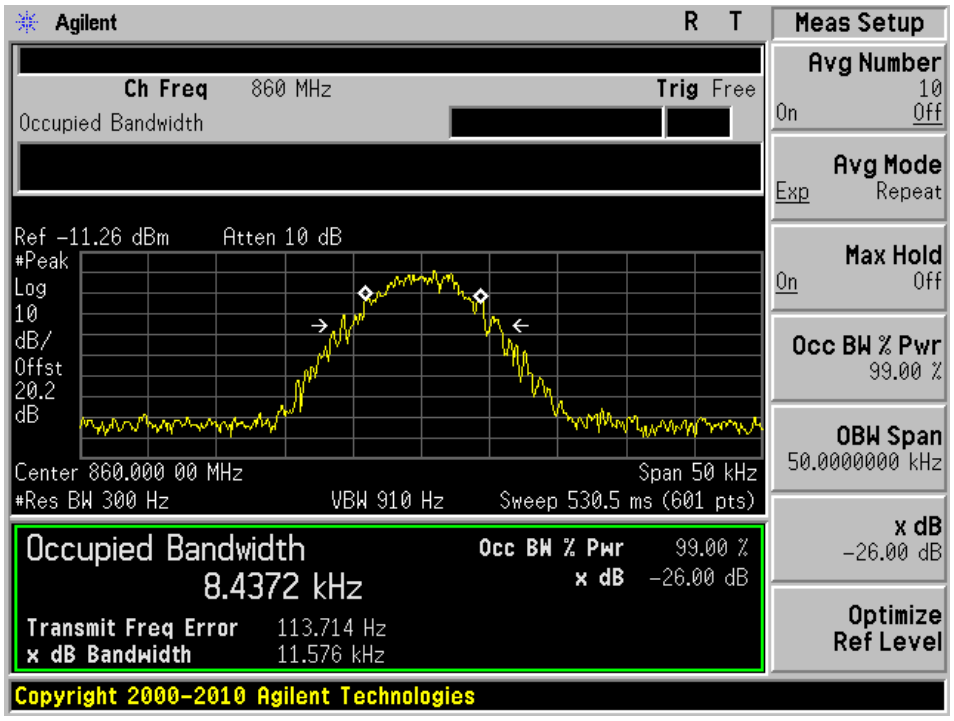
Input of 800 MHz Dowlink iDEN Modulation Middle Channel



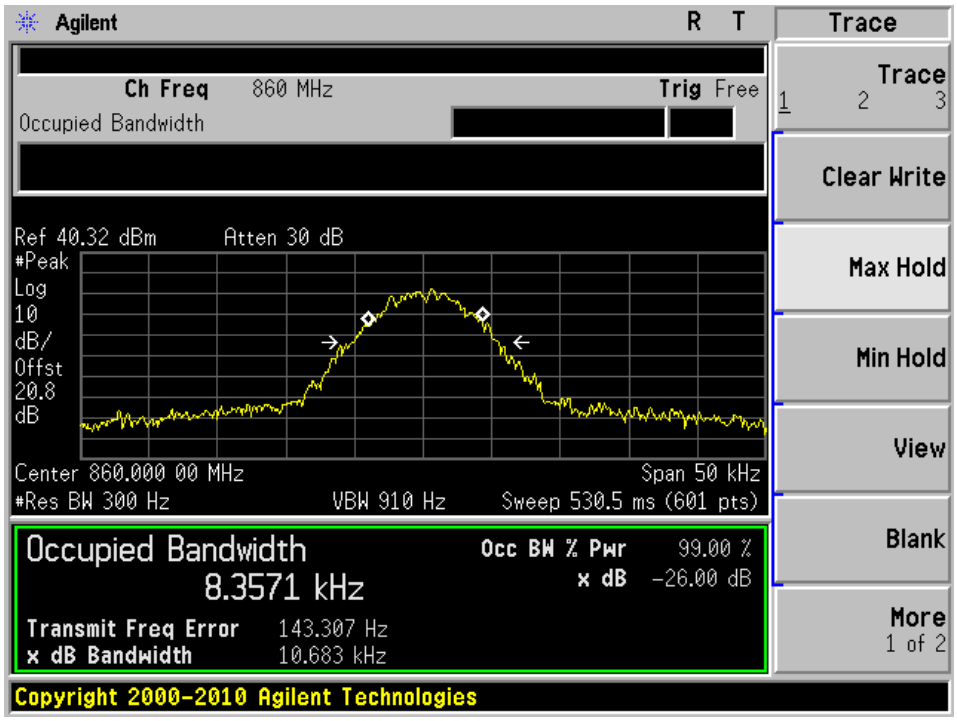
Output of 800 MHz Dowlink iDEN Modulation Middle Channel



Input of 800 MHz Dowlink APCO25 C4FM Modulation Middle Channel



Output of 800 MHz Dowlink APCO25 C4FM Modulation Middle Channel



7 FCC §2.1051, §90.669 & §90.691 – Emission Mask

7.1 Applicable Standard

§90.691 Emisison Masks Requirements for EA-based systems

a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

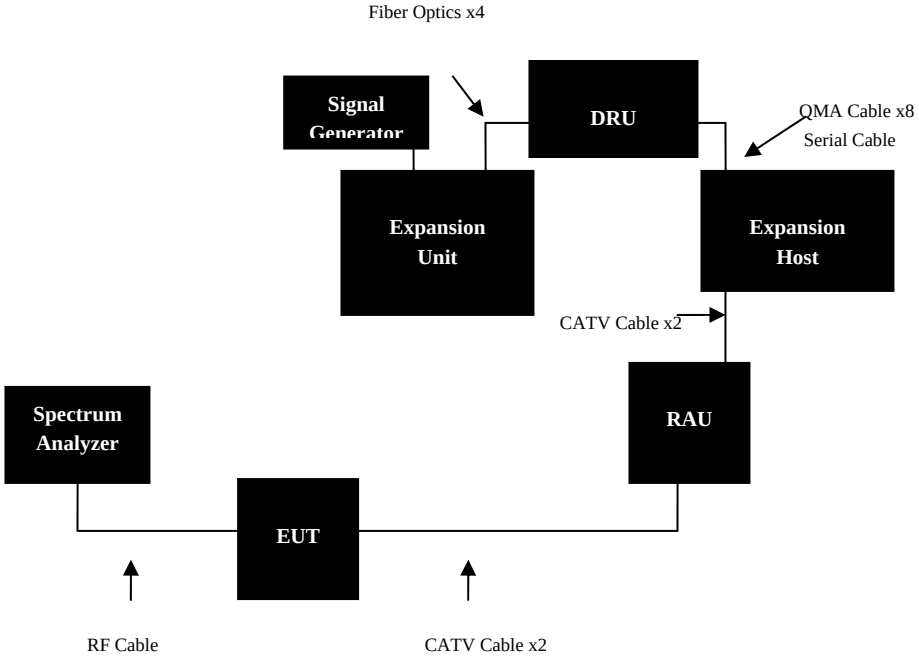
(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 $Log_{10}(f/6.1)$ decibels or 50 + 10 $Log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10$Log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

7.2 Test Procedure and Setup Block Diagram

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09	2 years

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

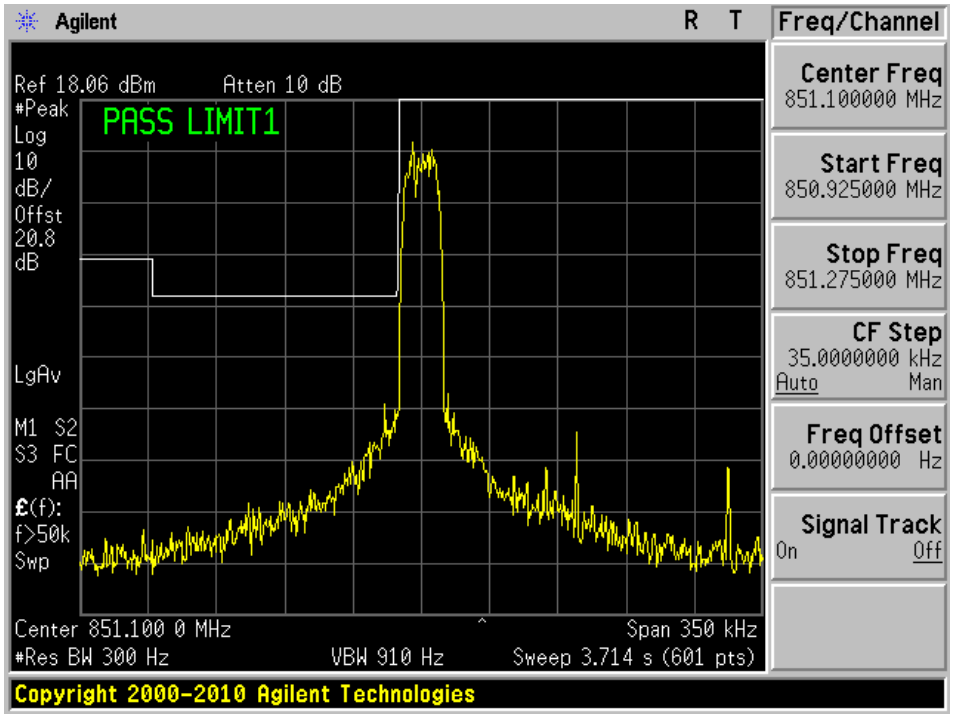
Temperature:	22 °C
Relative Humidity:	60 %
ATM Pressure:	101.6 kPa

The testing was performed by Wei Sun on 2012-07-31 on the RF Site.

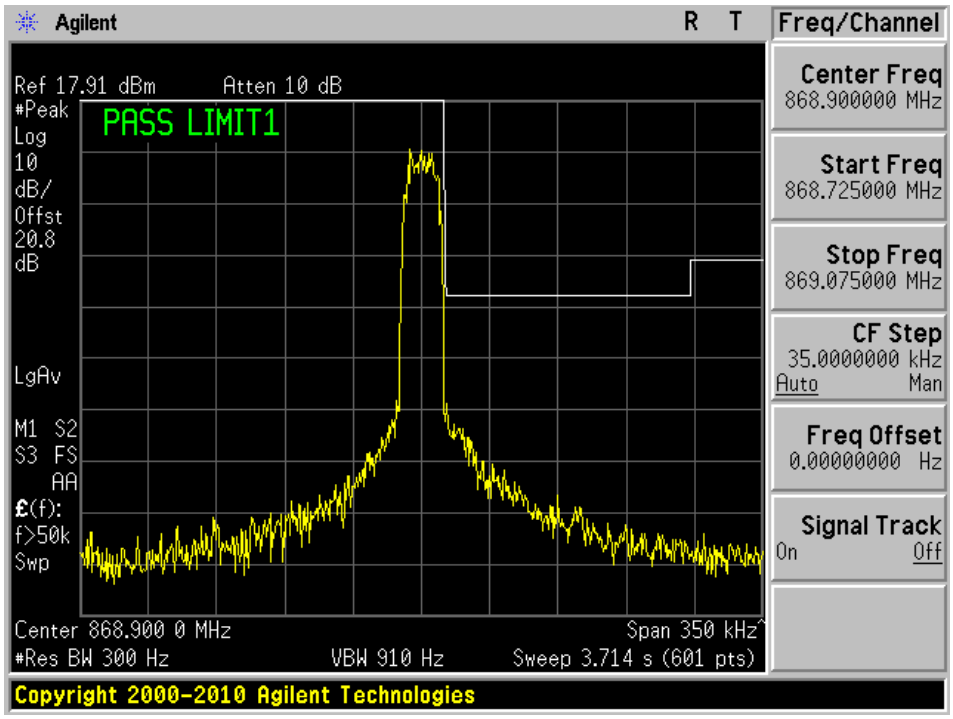
7.5 Test Results

Please refer to the following plots.

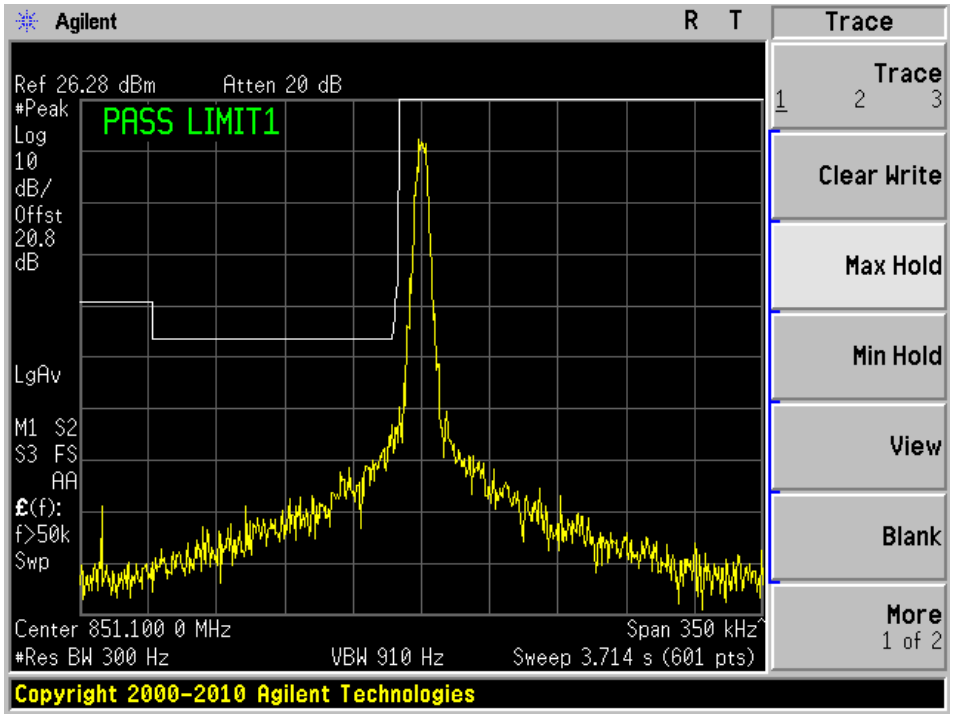
800 MHz Downlink iDEN Modulation Low Channel



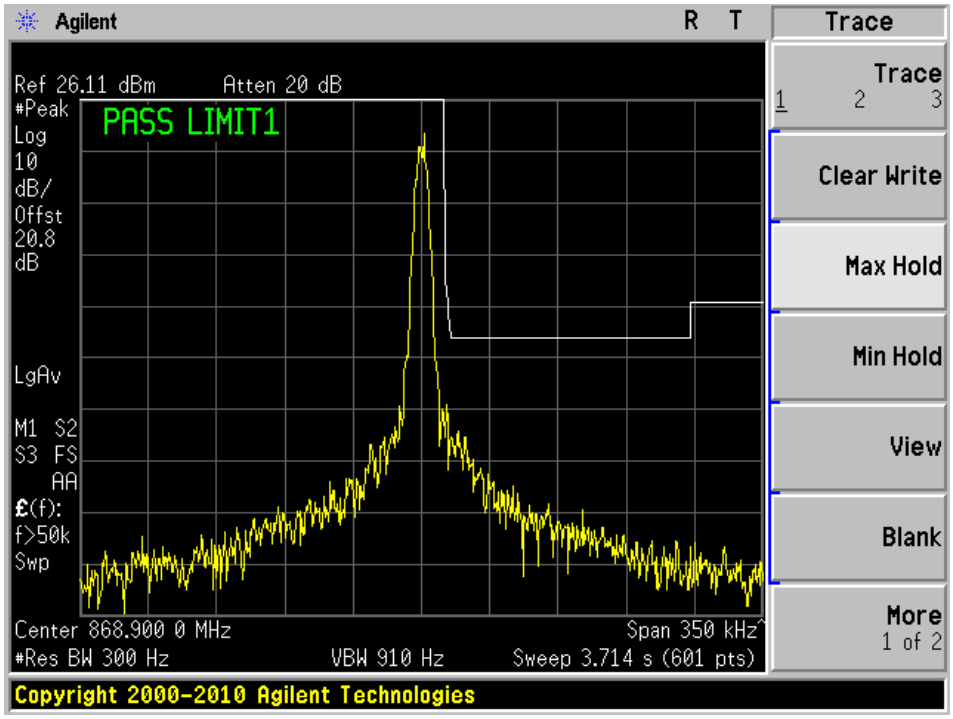
800 MHz Downlink iDEN Modulation High Channel



800 MHz Downlink APCO25 C4FM Modulation Low Channel



800 MHz Downlink APCO25 C4FM Modulation High Channel



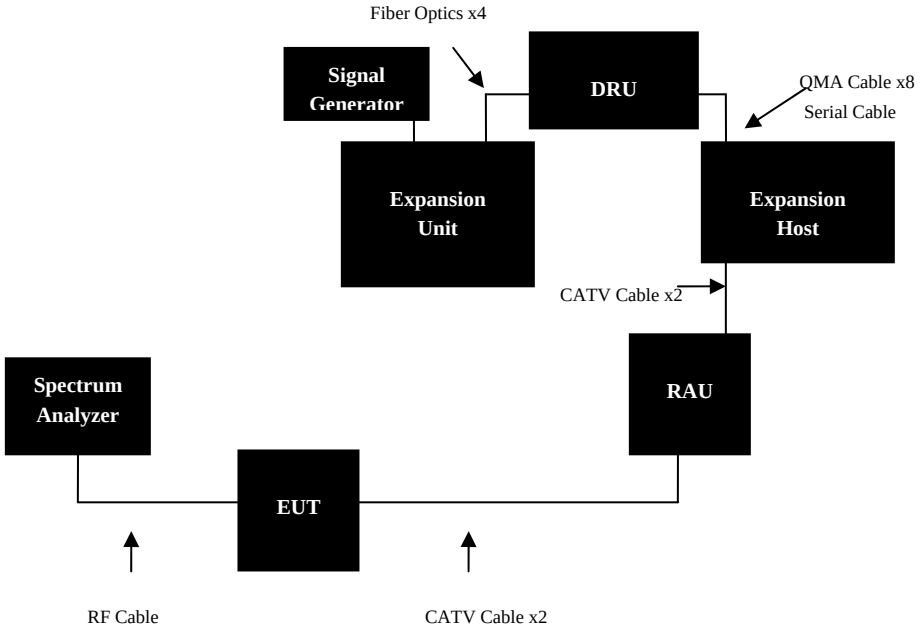
8 FCC §2.1053 & §90.669 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standard

The spectrum shall be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1053.

8.2 Test Procedure and Setup Block Diagram

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09	2 years

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

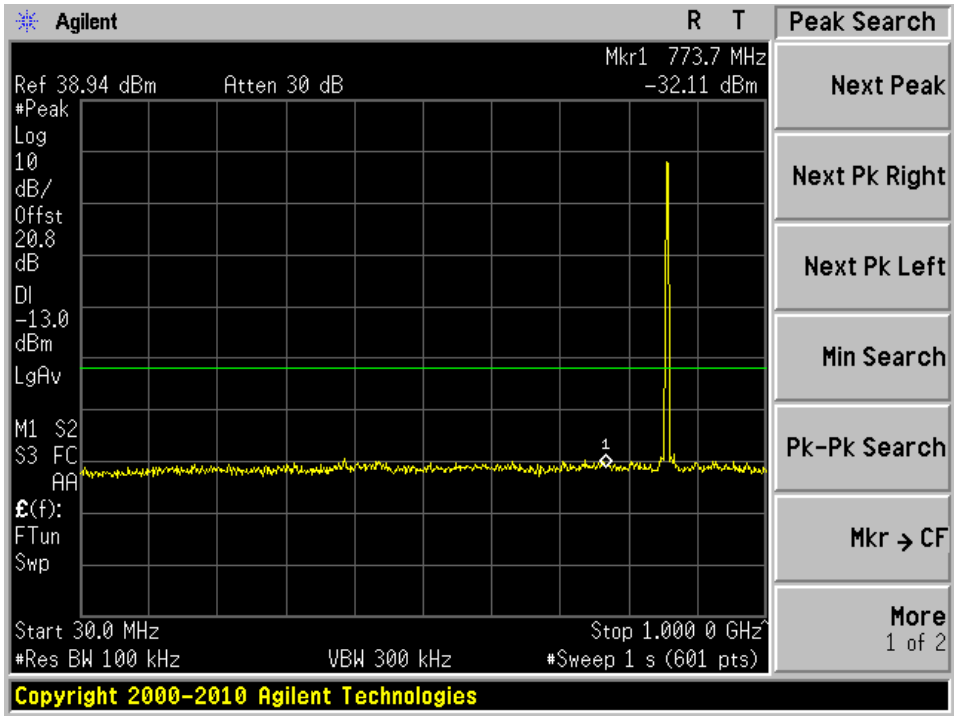
Temperature:	22 °C
Relative Humidity:	60 %
ATM Pressure:	101.6 kPa

The testing was performed by Wei Sun on 2012-07-31 on the RF Site.

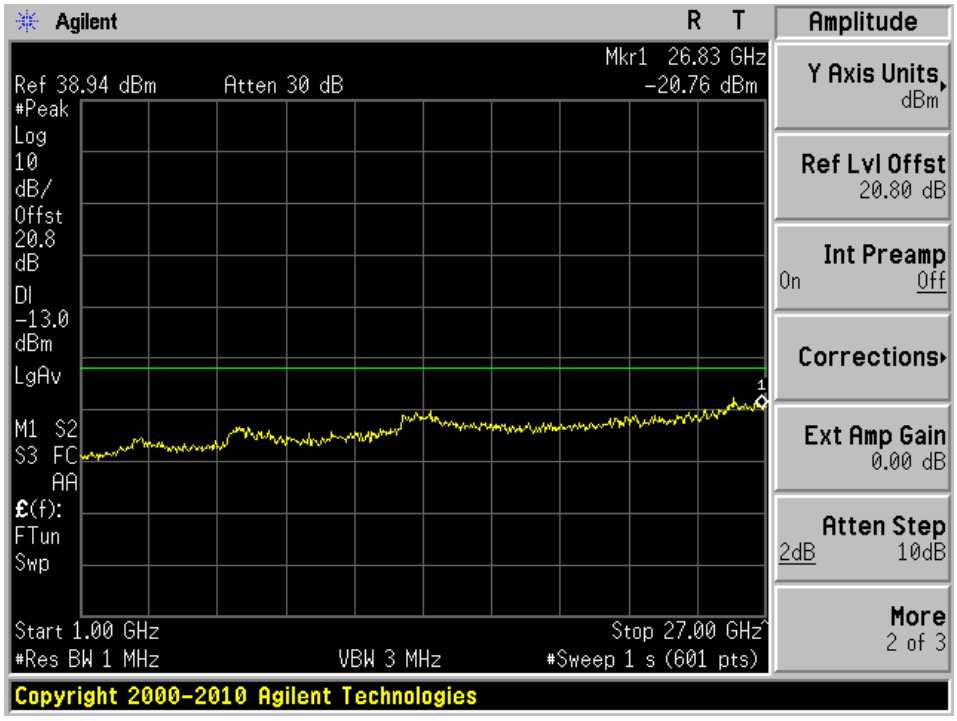
8.5 Test Results

Please refer to the following plots.

800 MHz Downlink Middle Channel, below 1GHz



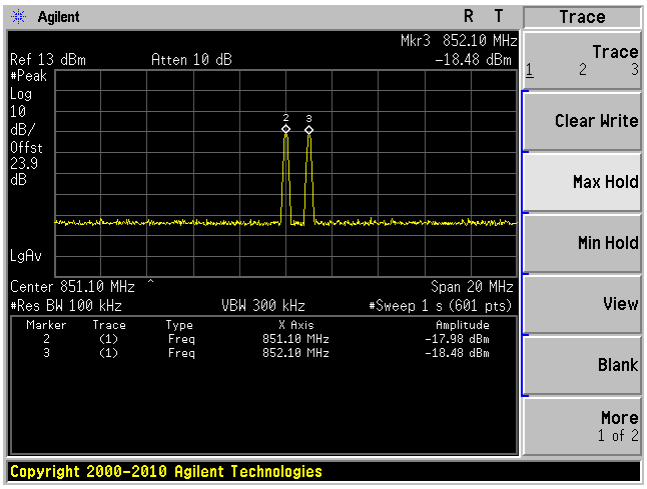
800 MHz Downlink Middle Channel, above 1 GHz



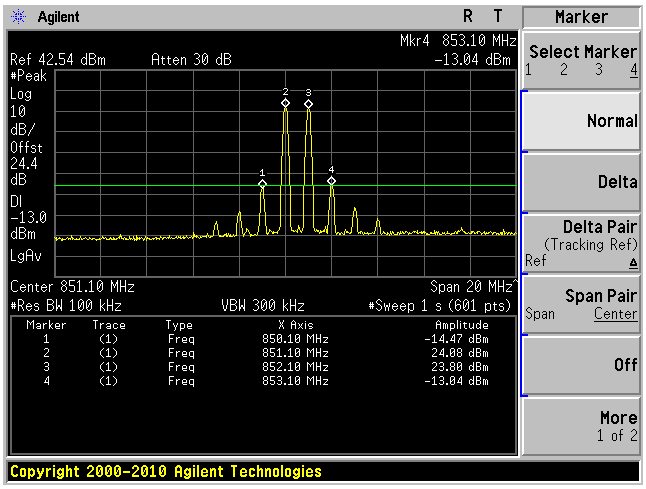
Intermodulation

800 MHz Downlink Low Channel

Input

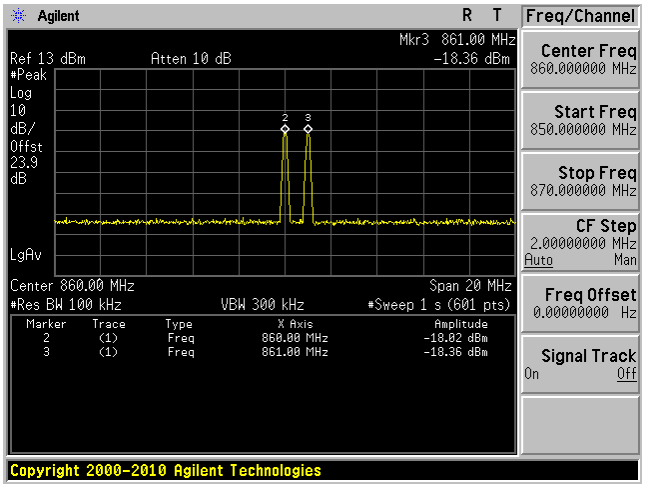


Output

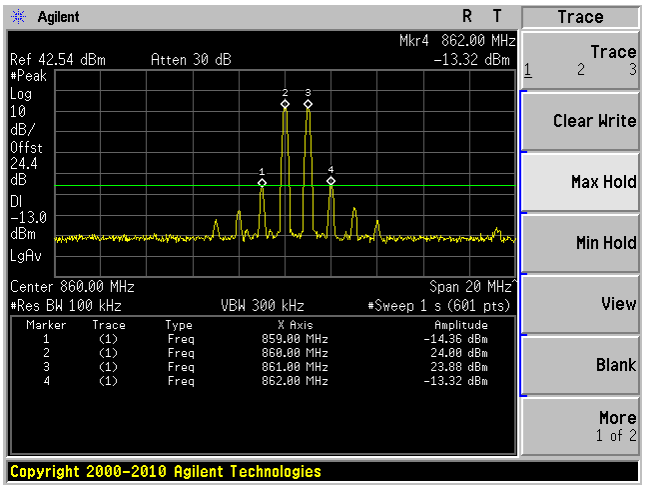


800 MHz Downlink Middle Channel

Input

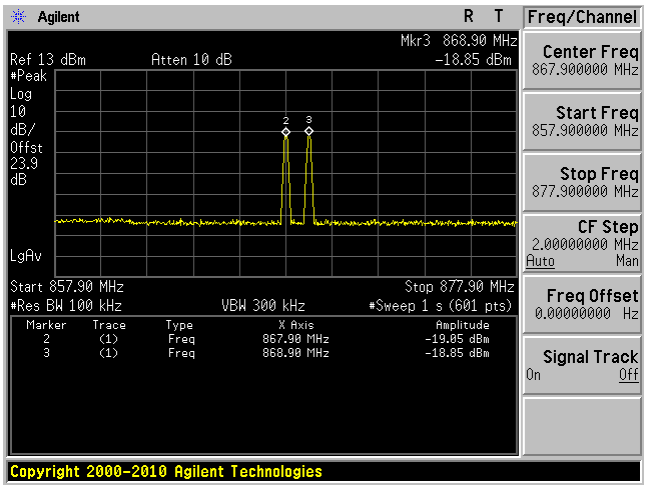


Output

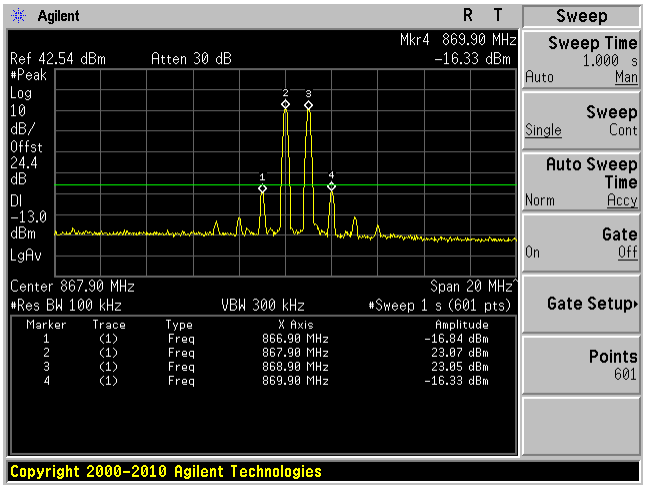


800 MHz Downlink High Channel

Input



Output



9 FCC §2.1055 & §90.669 - Frequency Stability

9.1 Applicable Standard

According to FCC §2.1055 the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

9.2 Test Procedure

The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.
b.) **Primary Supply Voltage:** The primary supply voltage is varied from battery end point to 115 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification **—** the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ± 0.000 25 %(± 2.5 ppm) of the center frequency.

CW was tested as worst case.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09	2 years
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03	1 year
Espec	Temp/Humidity Chamber	ESL-4CA	18010	2012-02-10	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	57 %
ATM Pressure:	101.4kPa

The testing was performed by Wei Sun on 2012-07-31 at RF Site.

9.5 Test Results

800 MHz Downlink, Middle Channel

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vac)	Temperature (^{o}C)				
Frequency vs. Temperature					
120	50	860	860	0	± 1.5
120	45	860	860	0	± 1.5
120	35	860	860	0	± 1.5
120	25	860	860	0	± 1.5
120	15	860	860	0	± 1.5
120	5	860	860	0	± 1.5
120	-5	860	860	0	± 1.5
120	-15	860	859.9999971	-0.00337	± 1.5
120	-25	860	860	0	± 1.5
Frequency vs. Voltage					
108	25	860	860	0	± 1.5
132	25	860	860	0	± 1.5

10 FCC §2.1053 & §90.669 – Field Strength of Spurious Radiation

10.1 Applicable Standard

Requirements: FCC §2.1053, and §90.669.

10.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 log (TX Power in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43 + 10 Log10 (power out in Watts)

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-02-28	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	-
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10	1 year
EMCO	Horn Antenna	3115	9511-4627	2011-10-03	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-03-08	1 year
A.R.A	Horn antenna	DRG-118/A	1132	2012-01-04	1 year
HP	Signal Generator	83650B	3614A00276	2012-07-13	2 years

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	40 %
ATM Pressure:	101.6 kPa

The testing was performed by Wei Sun on 2012-08-01 in 5 meters chamber 3.

10.5 Test Results

800 MHz Downlink, Middle Channel

Indicated		Turntable Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
59.1	76.13	59	155	V	59.1	-19.16	0	0.5	-19.66	-13	-6.66
59.1	64.11	111	305	H	59.1	-31.81	0	0.5	-32.31	-13	-19.31
6652	40.23	184	155	V	6652	-60.98	11.4	6.25	-55.83	-13	-42.83
6652	40.67	157	218	H	6652	-59.42	11.4	6.25	-54.27	-13	-41.27