FCC PART 90
IC RSS-119, ISSUE 11, JUNE 2011

TEST AND MEASUREMENT REPORT

For

Teltronic S.A.U.

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50016 Zaragoza, Spain

FCC ID: WT7PTRKTMDT400800
IC: 8624A-PTMDT800
Model: MDT-400 806-870 MHz

Report Type: C2PC Report	**Product Type:** Land-Mobile and Fixed Radio Transmitter and Receiver

Prepared By:	Lionel Lara
Report Number:	R1212141A-90119
Report Date:	2013-02-26
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1212141-90119	Original Report	2013-02-21
1	R1212141A-90119	Update cal. data	2013-02-26

1. General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Teltronic S.A.U.* and their product, FCC ID: WT7PTRKTMDT400800, IC: 8624A-PTMDT800, model: MDT-400 806-870 MHz, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a land-mobile and fixed radio transmitter and receiver with GPS receiver.

Specifications	
Frequency Band	20 kHz: 806-824 MHz/851-869 MHz 22 kHz: FCC 809-824 MHz/854-869 MHz IC: 806-824MHz/851-869 MHz
Modulation Type	π/4-DQPSK
Emission Designator	20K0D7W, 20K0D7E, 20K0D7D 20K0Q7W, 20K0Q7E, 20K0Q7D 22K0D7W, 22K0D7E, 22K0D7D 22K0Q7W, 22K0Q7E, 22K0Q7D
RF Output Power	20 kHz: 2 Watt 22 kHz: 3 Watt
Channel Spacing	25 kHz
Necessary /authorized Bandwidth	20 kHz, 22 kHz
Power Supply	10.8-15.6 DC volt supply input

RF Channel Spacing: 25 kHz (Spectrum Efficiency 6.25 kHz) Note: TDMA access scheme with 4 physical channels per carrier. The channel bandwidth is 25 kHz. As a result, the equipment meets the narrowbanding spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth. Modulation is π/4-DQPSK with 18 ksymbols/sec. This modulation is based on transmitting two bits per symbol, so the data rate for each physical channel is 9000 bits per second (higher than narrowbanding standard of 4800 bps per 6.25 kHz of channel bandwidth).

1.2 Mechanical Description

The EUT measures approximately 21cm (L) x 16cm (W) x 5cm (H) and weighs 1675.5 g.

The test data gathered are from production sample. Serial number: 000003031737480 and 000003031737490 *provided by Teltronic S.A.U.*

1.3 Objective

This type approval report is prepared on behalf of *Teltronic S.A.U.* in accordance with Part 90 and Rule & Order 12-114 of the Federal Communication Commissions rules and with Industry Canada RSS-119 Issue 11, Jun 2011.

This test and measurement report only pertains to the 22 kHz Occupied Bandwidth portion of the EUT.

This class II permissive change report is based on a new frequency range, a new bandwidth and a higher power.

The objective was to determine the RF output power, Occupied Bandwidth, Transmitter and Receiver Spurious Emissions, Emission Mask and Frequency Stability are in compliance with the FCC and IC rules.

1.4 Related Submittal(s)/Grant(s)

FCC ID: WT7PTRKTMDT400800 and IC: 8624A-PTMDT800, Report number: R1010251-90.

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 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

And IC RSS-119, Issue 11, June 2011- Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz with IC RSS-Gen, Issue 3, Dec 2010 – General Requirements and Information for the Certification of Radio Apparatus.

Applicable Standards:TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All emissions measurement was performed by Bay Area Compliance Laboratories 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 $\pm$2.0 dB for Conducted Emissions tests and $\pm$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 and Accreditation

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

The software used was TDriver.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Internal Configuration

Manufacturers	Descriptions	Models	Serial Numbers
Teltronic S.A.U.	Control Board	F054001	-
Teltronic S.A.U.	Radio Board	F054118	-
Teltronic S.A.U.	GPS Board	F054203	-

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Dell	Laptop	PP05L	7T390 A02

2.6 Local Support Equipment Power Supply and Line Filters

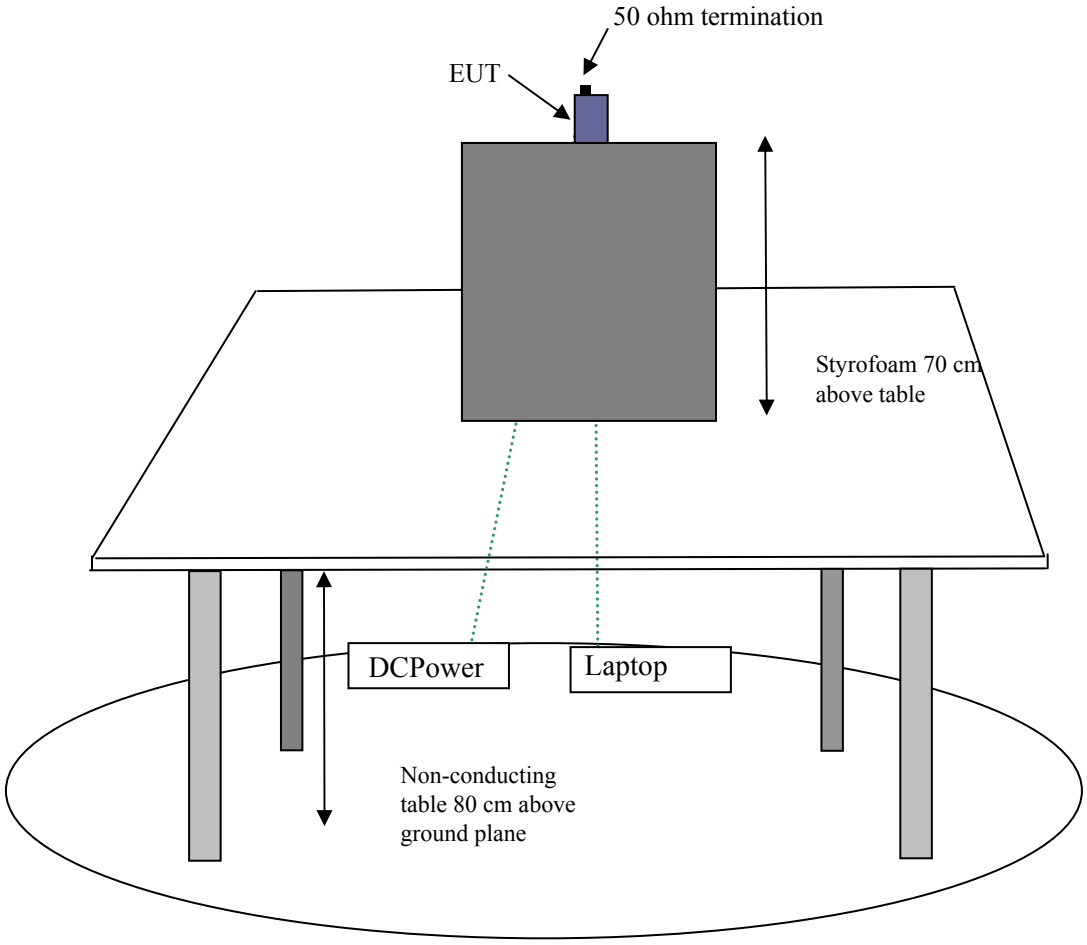
Manufacturer	Description	Model	Serial Number
BK Precision	DC Power Supply	1621A	D185052265
Minebea Matsushita Motor Corporation	DC Fan	3610KL- 0 4 W-B50	11742

2.7 External I/O Cabling List and Details

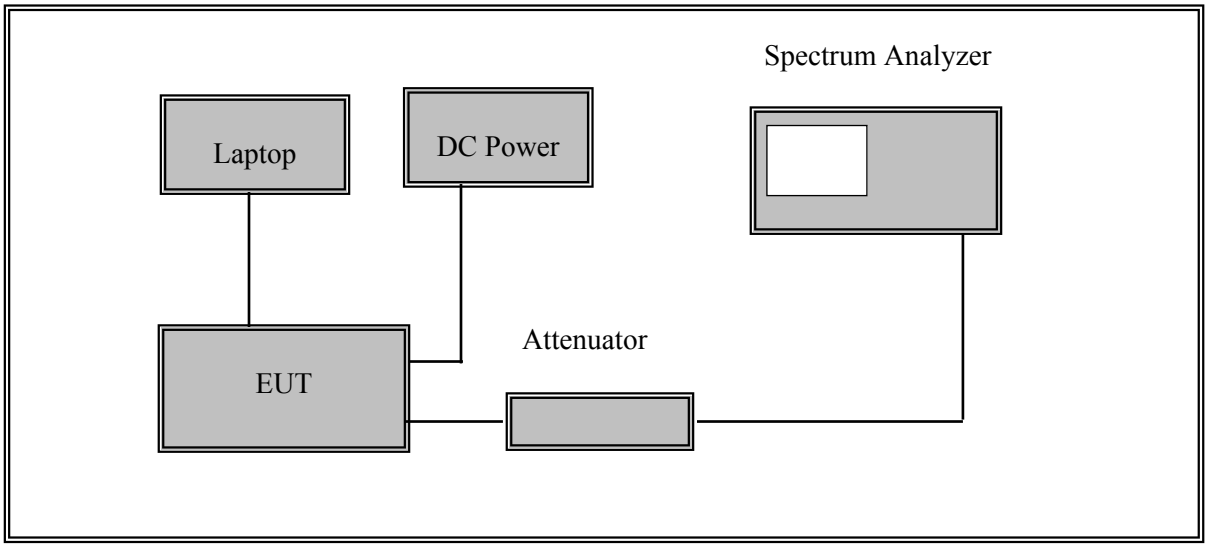
Cable Description	Length (m)	From	To
Serial cable	>1.0	Laptop Serial port	EUT Serial Port
Power Supply Cable	>1.0	Power Supply	EUT
RF cable	>1.0	EUT Output	PSA

2.8 Test Setup Block Diagram

Radiated Test



Conducted Test



3 Summary of Test Results

FCC and IC Rules	Description of Tests	Results
FCC §1.1310, §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §2.1046, §90.205 IC RSS-119 §5.4	RF Output Power	Compliant
FCC §2.1047, §90.207 IC RSS-119 §5.2	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	Compliant[1]
FCC §2.1049, §90.209, §90.210 IC RSS-119 §5.5 and §5.8	Occupied Bandwidth and Emission Mask	Compliant
FCC §2.1051, §90.221 IC RSS-119 §5.8	Spurious Emissions at Antenna Terminals	Compliant
FCC §2.1055, §90.213 IC RSS-119 §5.3	Frequency Stability	Compliant[1]
FCC §2.1053, §90.221 IC RSS-119 §5.8	Field Strength of Spurious Radiation	Compliant
FCC §90.214 IC RSS-119 §5.9	Transient Frequency Behavior	N/R[2]
FCC §2.1049, §90.221	Adjacent Channel Power	Compliant[1]
IC RSS-119 §5.11	Receiver Spurious Emission	Compliant

Note 1: This test was completed by Teltronic S.A.U with test report:
Modulation characteristic: D370000_RG90ed0400_Laboratory_Measurements
IC frequency stability: D260600_REP008ed0100_Frequency_stability_IC_RSS-119_Issue_11_June_11_3031737490
Adjacent channel Power: 3031737490_D260600_REPed0200_ACP_FCC_MDT-400_806-870
Note 2: This testis not required in this frequency range.

4 FCC §2.1091 & IC RSS-102 - 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)
(A) Limits for Occupational/Controlled Exposure				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

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

According to IC RSS-102 Issue 4 section 4.4, RF Field Strength Limits for Controlled Use Devices (Controlled Environment).

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	600	4.9	-	6
1-10	$600/f$	$4.9/f$	-	6
10-30	60	$4.9/f$	-	6
30-300	60	0.163	10^*	6
300-1500	$3.54\ f^{0.5}$	$0.0094\ f^{0.5}$	$f/30$	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f^{1.2}$
150000-300000	$0.354\ f^{0.5}$	$9.4 \times 10^{-4}\ f^{0.5}$	$3.33 \times 10^{-4}\ f$	$616000/f^{1.2}$

Antenna:

The manufacturer does not specify an antenna. This device has provisions for operation in a vehicle or a fixed location.

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 antenna

FCC Frequency: 809-824 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	34.8
Maximum peak output power at antenna input terminal (mW):	3019.95
Prediction distance (cm):	30
Prediction frequency (MHz):	809.1
Maximum Antenna Gain, typical (dBi):	16
Maximum Antenna Gain (numeric):	39.81
Power density of prediction frequency at 30 cm (mW/cm^2):	2.658
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.697

FCC Frequency: 854-869 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	34.1
Maximum peak output power at antenna input terminal (mW):	2570.40
Prediction distance (cm):	30
Prediction frequency (MHz):	854.1
Maximum Antenna Gain, typical (dBi):	16
Maximum Antenna Gain (numeric):	39.81
Power density of prediction frequency at 30 cm (mW/cm^2):	2.262
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.847

IC Frequency: 806-824 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	34.1
Maximum peak output power at antenna input terminal (mW):	2570.40
Prediction distance (cm):	30
Prediction frequency (MHz):	806.1
Maximum Antenna Gain, typical (dBi):	16
Maximum Antenna Gain (numeric):	39.81
Power density of prediction frequency at 30 cm (W/m^2):	22.62
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	26.87

IC Frequency: 851-869 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	34.2
Maximum peak output power at antenna input terminal (mW):	2630.27
Prediction distance (cm):	30
Prediction frequency (MHz):	851.1
Maximum Antenna Gain, typical (dBi):	16
Maximum Antenna Gain (numeric):	39.81
Power density of prediction frequency at 30 cm (W/m^2):	23.15
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	28.37

Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 30 cm between the antenna with maximum 16 dBi gain, including any radiating structure, and any persons when normally operated.

5 FCC §2.1046, §90.205 & IC RSS-119 §5.4 – RF Output Power

5.1 Applicable Standard

According to FCC §2.1046, and §90.205. The transmitting power of base transmitters must not exceed the limits given in paragraphs (a), (b) and (c) of §90.635.

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

According to IC RSS-119 §5.4, the output power should be within ± 1.0 dB of the manufacture's rated power.

5.2 Test Procedure

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	E4446A	US44300386	2012-09-29	1 Year

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

5.4 Test Environmental Conditions

Temperature:	19 °C
Relative Humidity:	52 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2013-01-11 at the RF site.

5.5 Test Results

Test Mode: 25 kHz Channel Spacing, 22 kHz Bandwidth

FCC Band	Frequency (MHz)	Low Output Power (dBm)	Low Output Power (Watt)	High Output Power (dBm)	High Output Power (Watt)
809-824 MHz	809.1	15	0.032	34.8	3.02
	816.5	14.9	0.031	34.6	2.88
	823.9	14.7	0.030	34.4	2.75
854-869 MHz	854.1	14.3	0.027	34.1	2.57
	861.5	14.2	0.026	33.9	2.45
	868.9	14.2	0.026	34.1	2.57

Note: Manufacturer's rated power is 0.03-3 Watts

Test Mode: 25 kHz Channel Spacing, 22 kHz Bandwidth

IC Band	Frequency (MHz)	Low Output Power (dBm)	Low Output Power (Watt)	High Output Power (dBm)	High Output Power (Watt)
806-824 MHz	806.1	14.7	0.030	34.1	2.57
	816.5	14.9	0.031	34.6	2.88
	823.9	14.7	0.030	34.4	2.75
851-869 MHz	851.1	14.5	0.028	34.2	2.63
	861.5	14.2	0.026	33.9	2.45
	868.9	14.2	0.026	34.1	2.57

Note: Manufacturer's rated power is 0.03-3 Watts

6 FCC §2.1047, §90.207 & RSS-119 §5.2 – Modulation Characteristic

6.1 Applicable Standard

FCC §2.1047 & §90.207:

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

IC RSS-119 §5.2

Equipment that operates in frequency bands other than 764-776 MHz and 794-806 MHz may employ any type of modulation. The type of modulation used shall be reported. Equipment that operates in the bands 764-776 MHz and 794-806 MHz shall use digital modulation.

6.2 Test Results

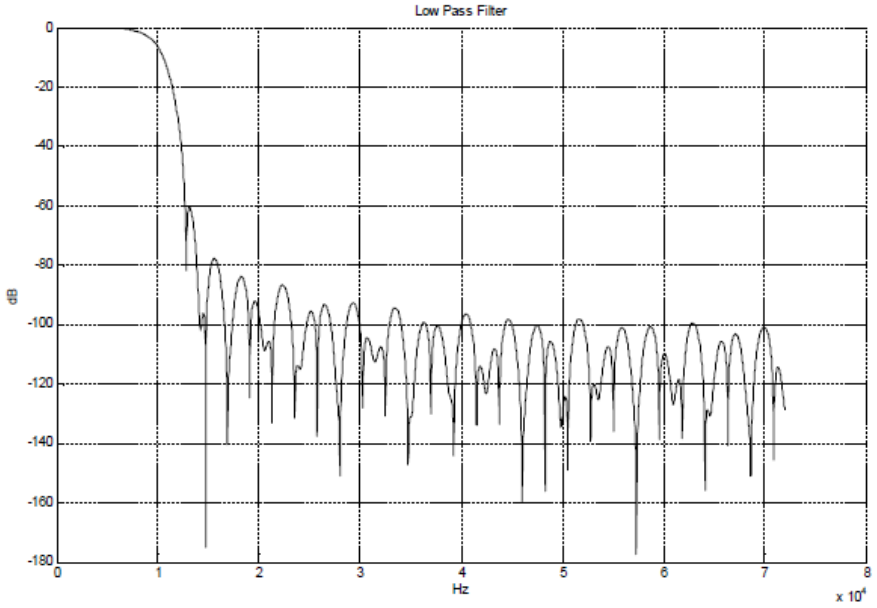
Transmitter Low Pass Filter

Type of Emission: 22K0Q7E, 22K0Q7D, 22K0Q7W, 22K0D7E, 22K0D7D, 22K0D7W
The modulation used is π/4-shifted Differential Quaternary Phase Shift Keying (π/4-DQPSK), with a modulation rate of 18k symbol/sec. (36k bit/sec).

A root-raised-cosine filter (RRC) is used as transmitting and receiving filter in this digital communication system to perform matched filtering.
The combined response of two such filters is that of the raised-cosine filter.
The raised-cosine filter is a filter frequently used for pulse-shaping in digital modulation known for its ability to minimize intersymbol interference (ISI).

The access scheme is TDMA with 4 physical channels per carrier.

The following graph is the transfer function of the aforementioned filter.



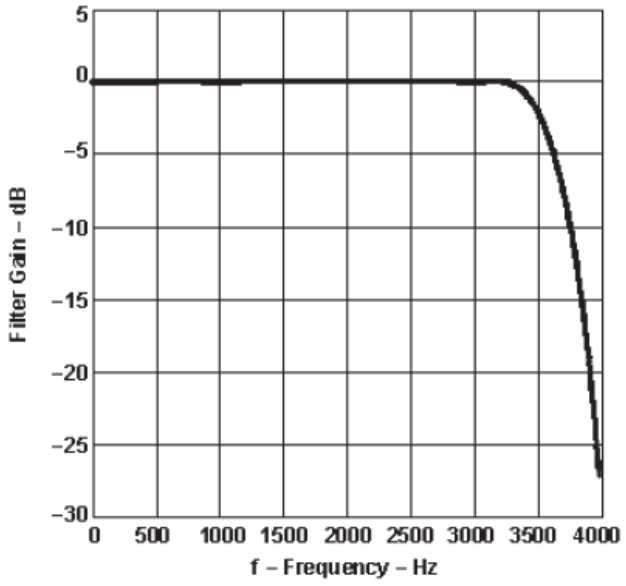
Note: Plot was provided by the manufacturer.

Audio Low Pass Filter

The modulation is limited by data characteristics and its filters.

In the previous section, the phase and quadrature branches (I and Q) are filtered with a root-raised-cosine filter (RRC) with a symbol rate of 18k symbol/sec. After that, the signal is pi/4 DQPSK modulated (see the plot in the previous section).

Signal processing is carried out using a Texas Instrument TLV320AIC12 codec that contains the following low pass filter.



Note: Plot was provided by Texas Instruments.

7 FCC §2.1049, §90.209, §90.210 & IC RSS-119 §5.5 & §5.8 – Occupied Bandwidth & Emission Mask

7.1 Applicable Standard

According to FCC §90.210:

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220-222	F	F
421-512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806-809/851-854	B	H
809-824/854-869 [3]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M.
5850-5925 [4]		
All other bands	B	C

1 Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.

2 Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.

3 Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

4 DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.

5 Equipment may alternatively meet the Adjacent Channel Power limits of §90.221, where applicable.

IC RSS-119 §5.5 & §5.8

Table 3 - Channel Spacing, Authorized Bandwidths and Applicable Spectrum Masks

Frequency Band (MHz)	Related SRSP for Channelling Plan and e.r.p.	Channel Spacing (kHz)	Authorized Bandwidth (kHz)	Spectrum Masks with Audio Filter	Spectrum Masks Without Audio Filter
27.41-28.0 and 29.7-50.0	N/A	20	20	B	C
72-76	N/A	20	20	B	C
138-144; 148-149.9 and 150.05-174	SRSP-500	30	20	B	C
		15	11.25	D	D
		7.5	6	E	E
217-218 and 219-220	N/A	12.5	11.25	D or I	D or J
220-222	SRSP-512	5	4	F	F
406.1-430 and 450-470	SRSP-501	25	20	B	C (G, Note 1)
			22	Y	Y
		12.5	11.25	D	D
		6.25	6	E	E
764-776 and 794-806	SRSP-511	6.25 12.5 25 50	Note 2	Section 5.8.9	Section 5.8.9
806-821-/851-866 and 821-824/866-869	SRSP-502		20	B	G
		25	22	Y	Y
		12.5	11.25	D	D
896-901/935-940	SRSP-506	12.5	13.6	I	J (G, Note 3)
929-930 and 931-932	SRSP-504 (for aging)	25	20	B	G
928-929/952-953 and 932-932.5/941-941.5	SRSP-505	25	20	B	G
		12.5	11.25	D	D
932.5-935/941.5-944	SRSP-507	25	20	B	G
		12.5	11.25	D	D

Emission Mask Y: Equipment with a 25 kHz channel spacing and an occupied bandwidth greater than 20 kHz shall have the power of any emission attenuated below the transmitter output power P (dBW) as follows:

Table 16 - Emission Mask Y

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$12.375 < f_d \leq 13.975$	whichever is the lesser attenuation: $30 + 16.67(f_d - 12.375)$ or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2
$f_d > 13.975$	whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2

7.2 Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ±50 kHz from the carrier frequency.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year

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:	19 °C
Relative Humidity:	52 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2013-01-11 in the RF Site.

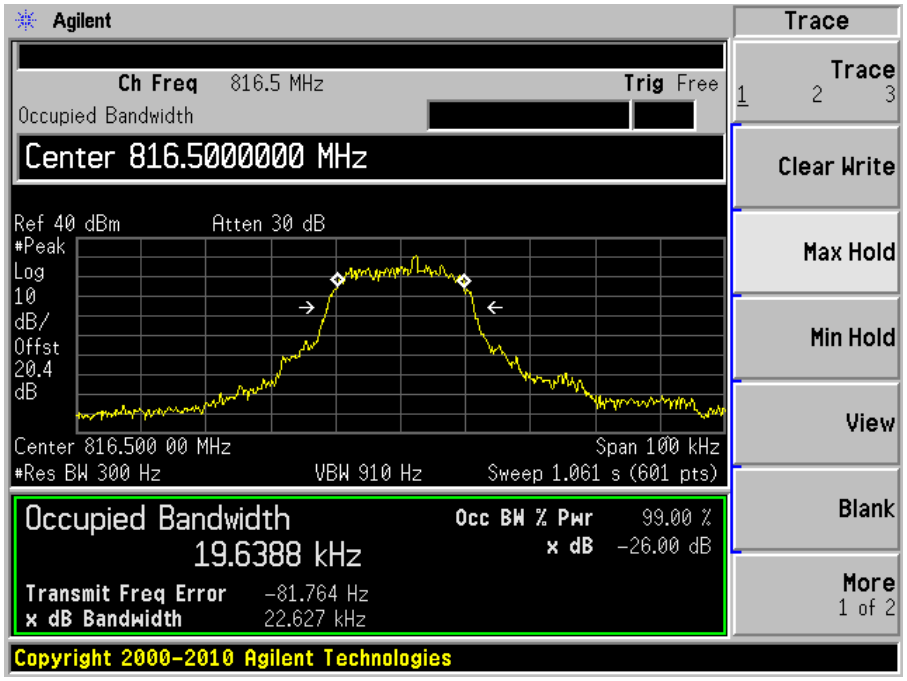
7.5 Test Results

Please refer to the following plots.

Occupied Bandwidth (High Power)

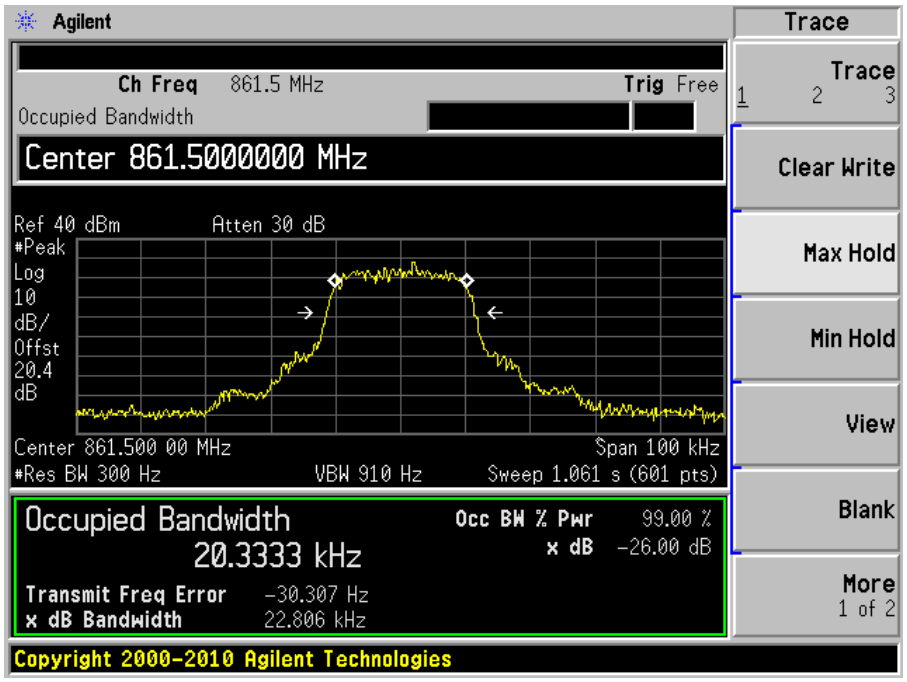
FCC: 809-824 MHz, IC: 806-824 MHz, 22 kHz Bandwidth

Middle Channel – 816.5 MHz



FCC: 854-869 MHz, IC: 851-869 MHz, 22 kHz Bandwidth

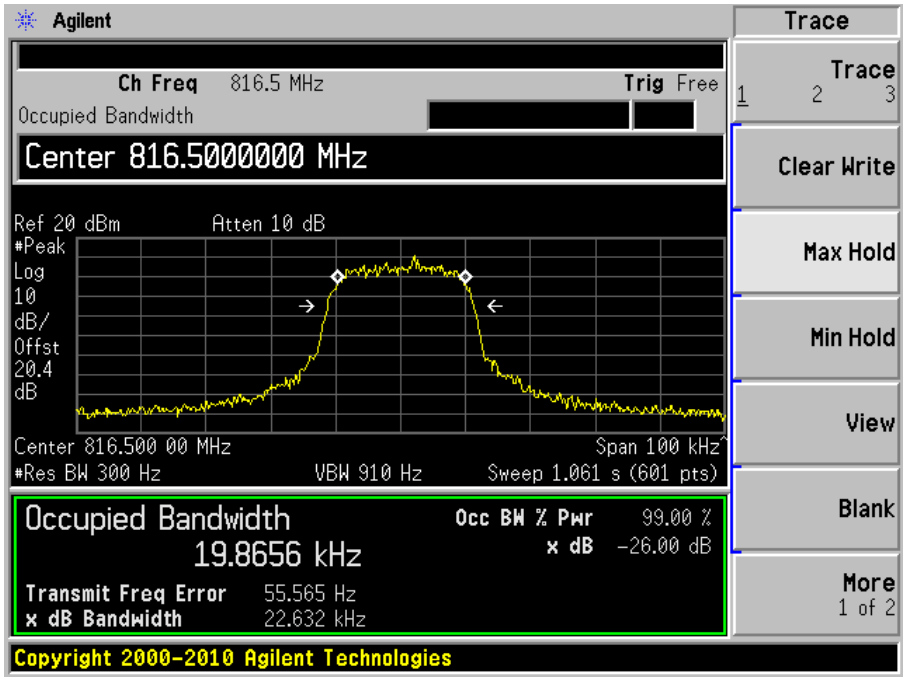
Middle Channel – 861.5 MHz



Occupied Bandwidth (Low Power)

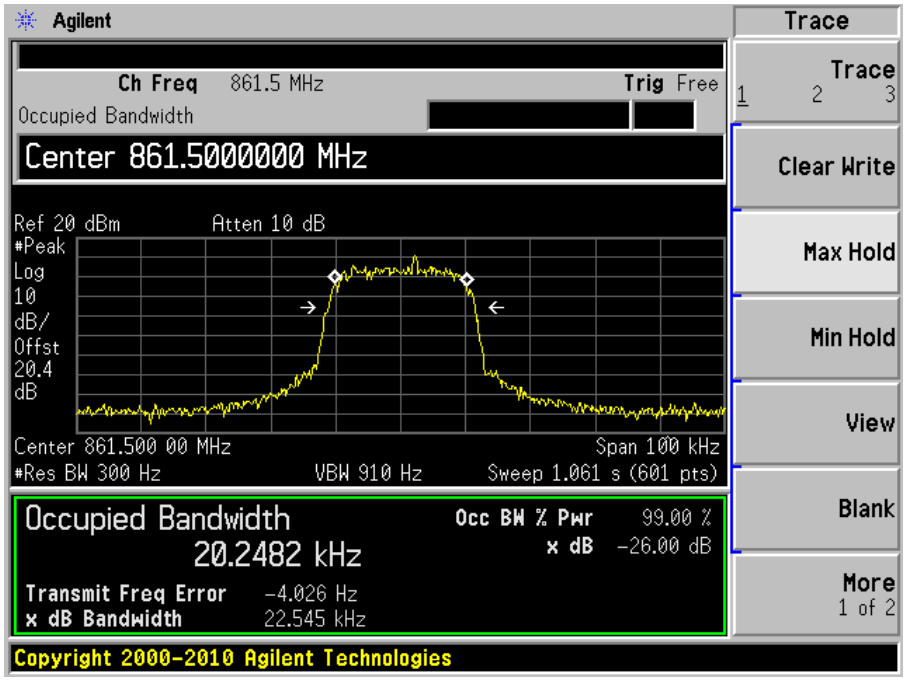
FCC: 809-824 MHz, IC: 806-824 MHz, 22 kHz Bandwidth

Middle Channel – 816.5 MHz



FCC: 854-869 MHz, IC: 851-869 MHz, 22 kHz Bandwidth

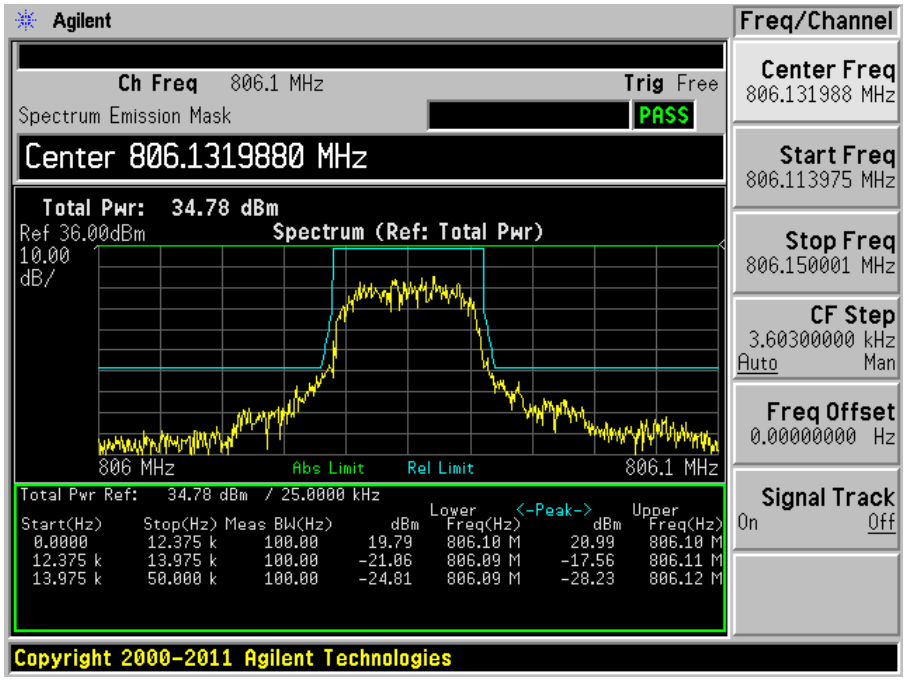
Middle Channel – 861.5 MHz



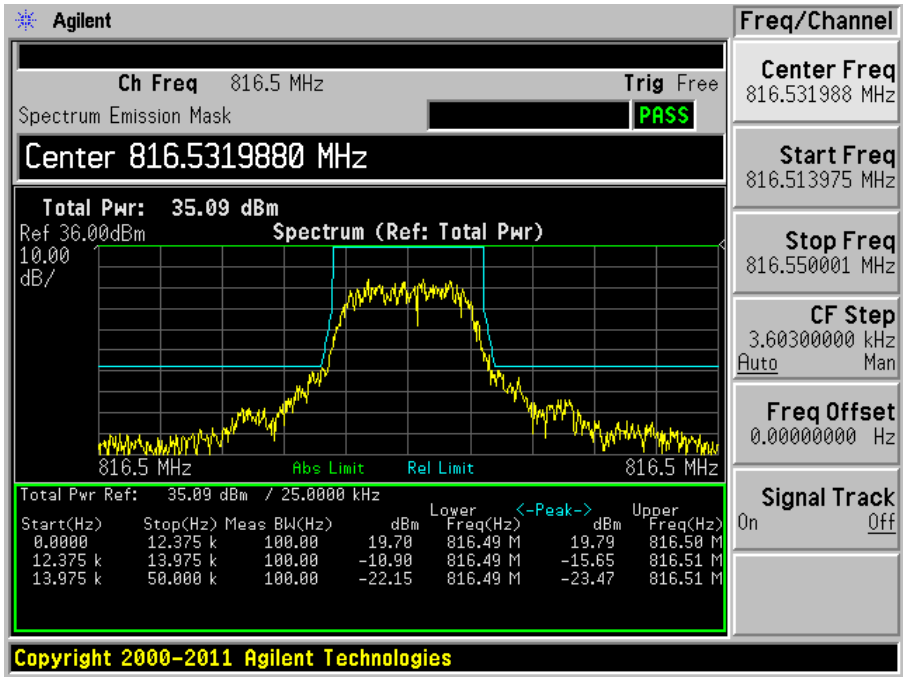
Emission Mask Y (High Power)

IC: 806-824 MHz, 22 kHz Bandwidth

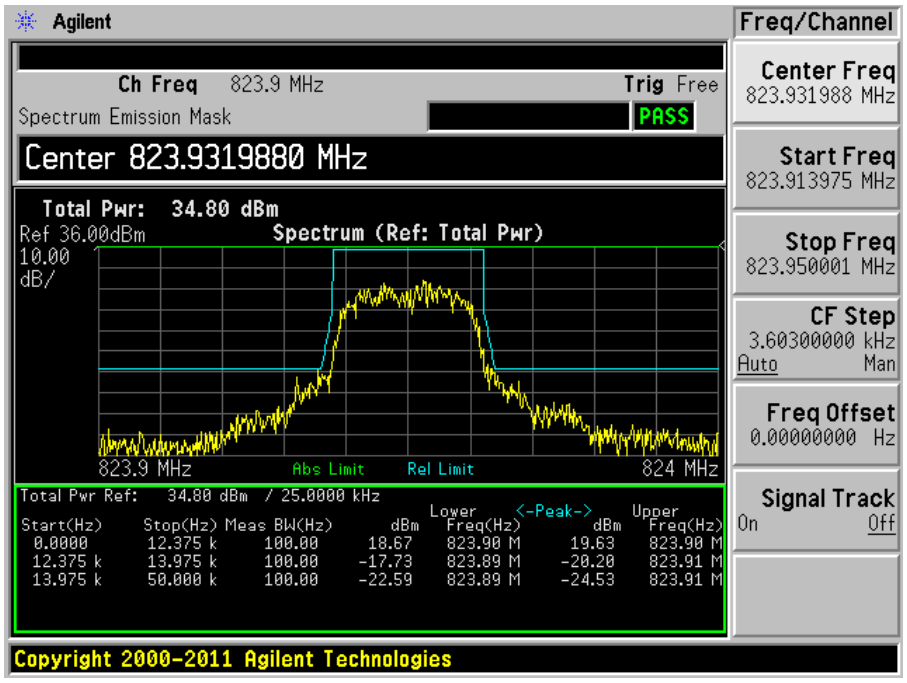
Low Channel – 806.1 MHz



Middle Channel – 816.5 MHz

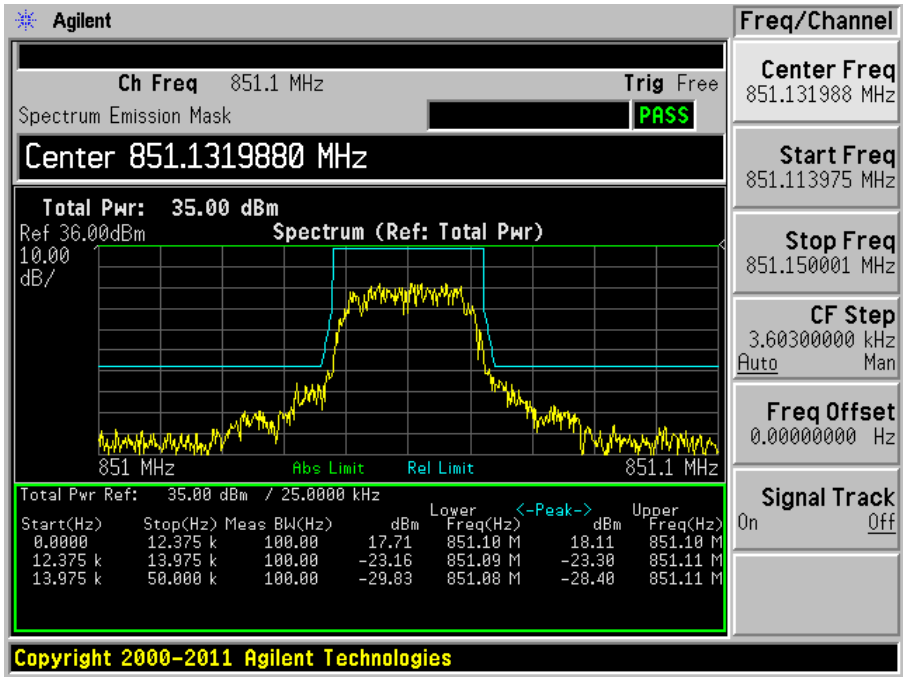


High Channel – 823.9 MHz

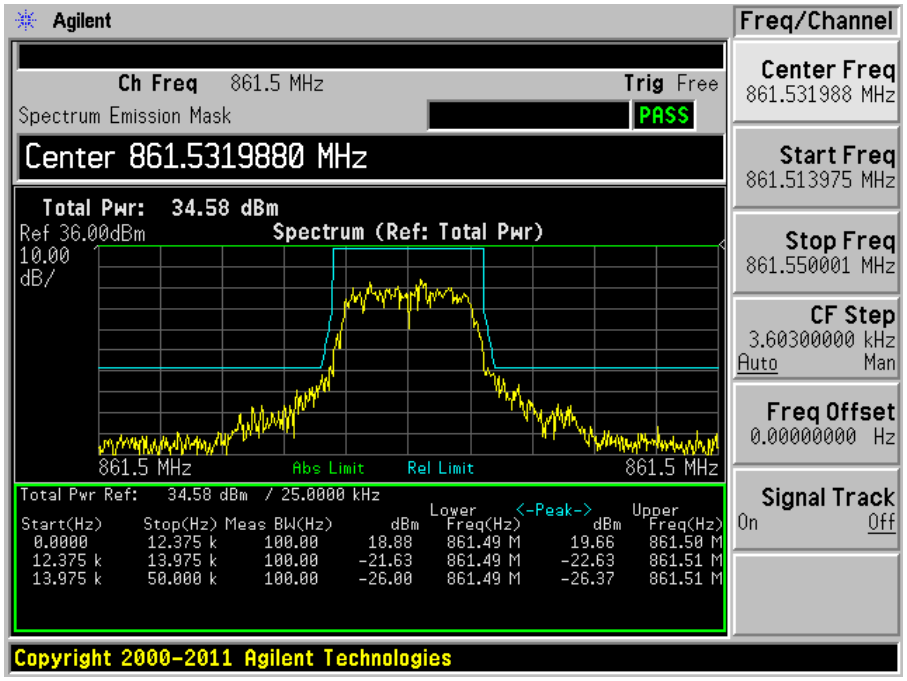


IC: 851-869 MHz, 22 kHz Bandwidth

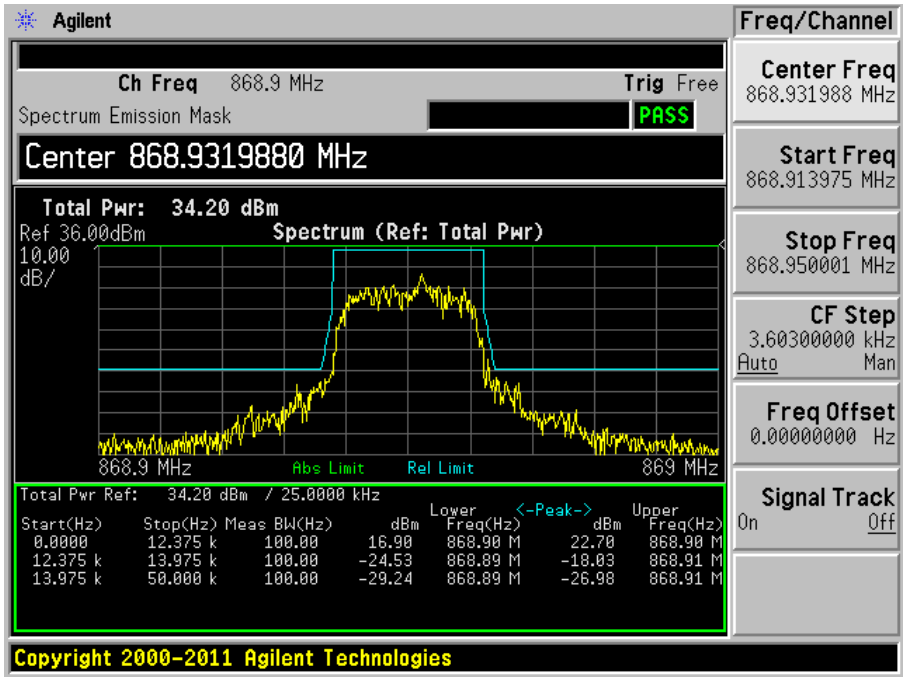
Low Channel – 851.1 MHz



Middle Channel – 861.5 MHz



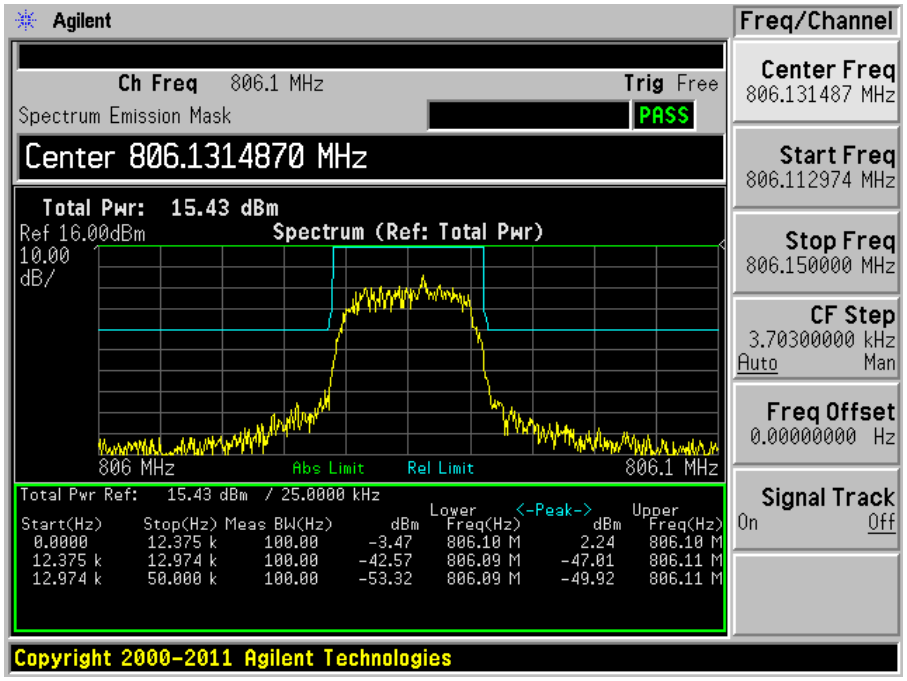
High Channel – 868.9 MHz



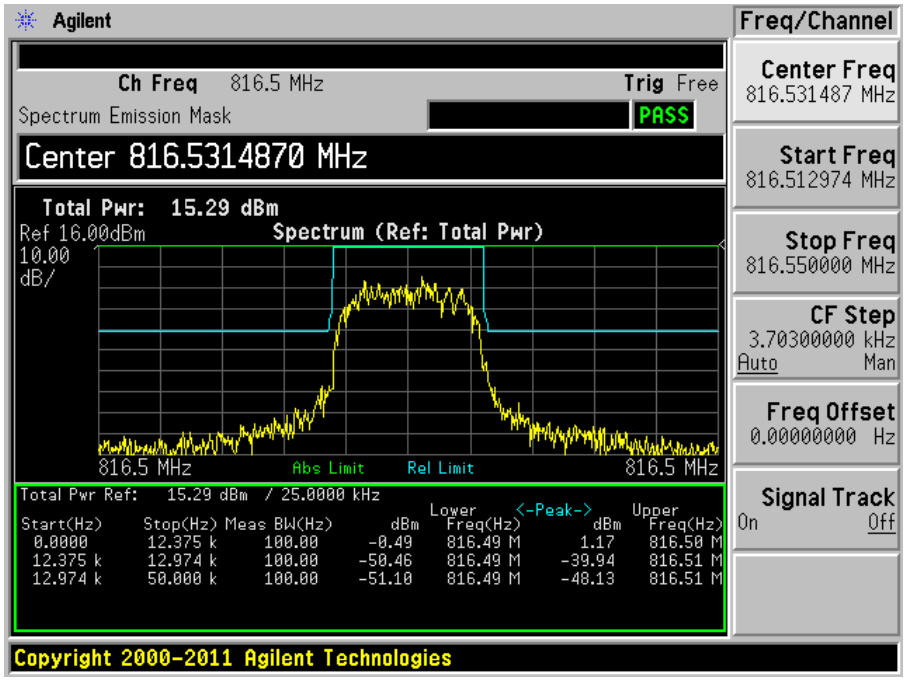
Emission Mask Y (Low Power)

IC: 806-824 MHz, 22 kHz Bandwidth

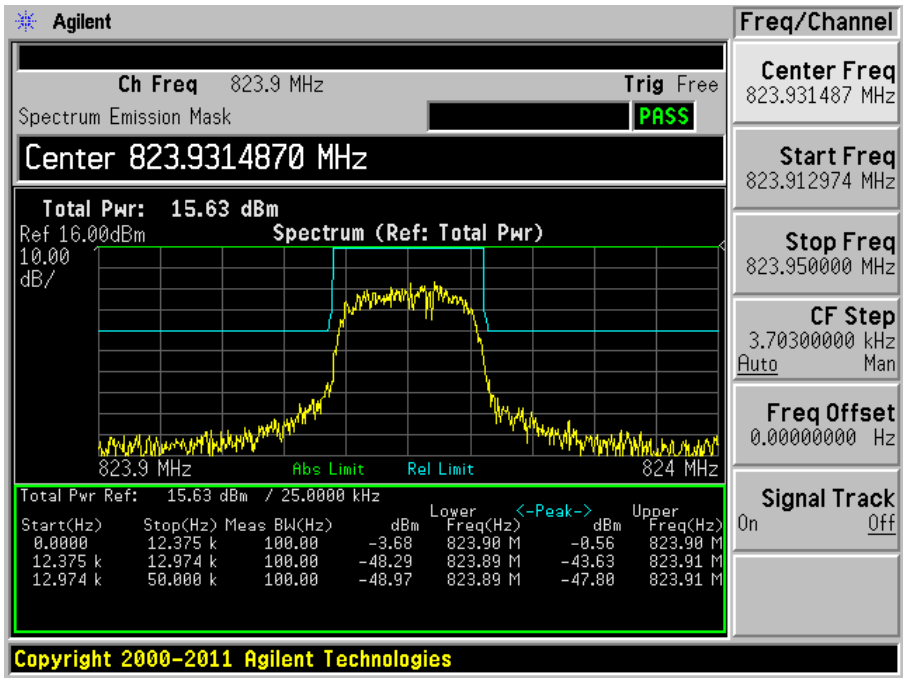
Low Channel – 806.1 MHz



Middle Channel – 816.5 MHz

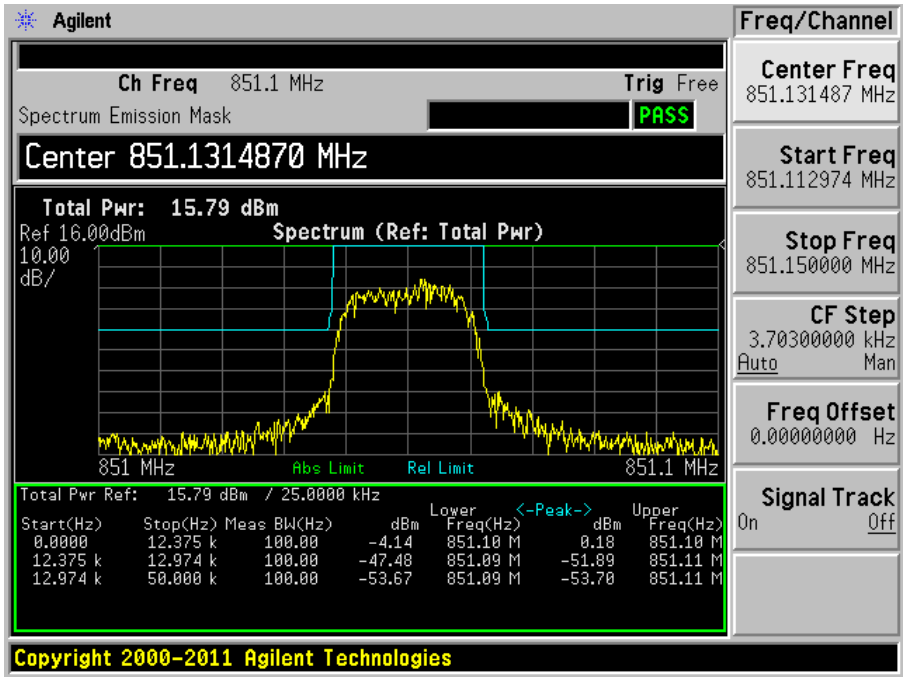


High Channel – 823.9 MHz

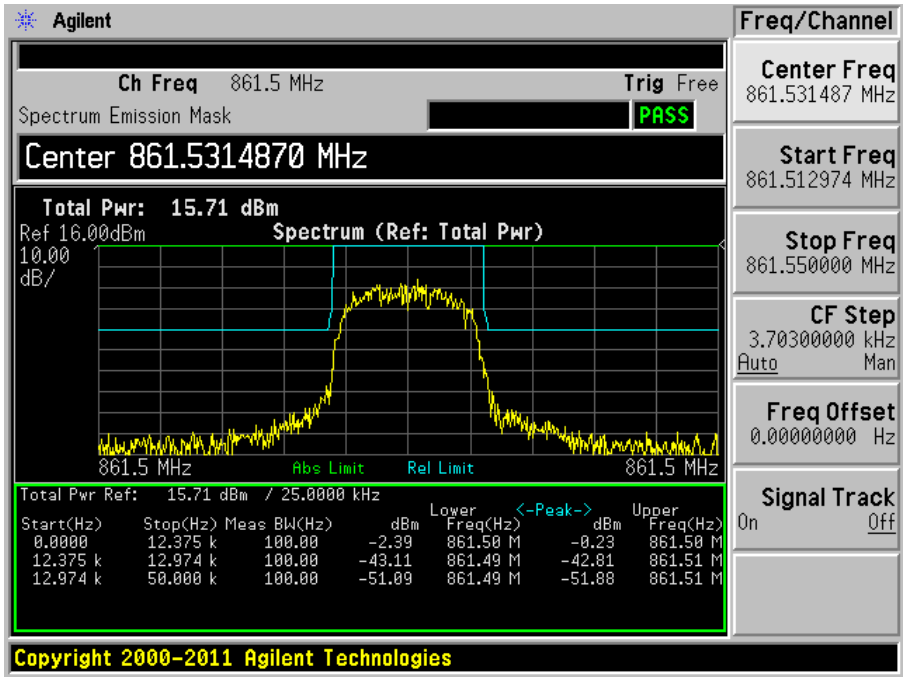


IC: 851-869 MHz, 22 kHz Bandwidth

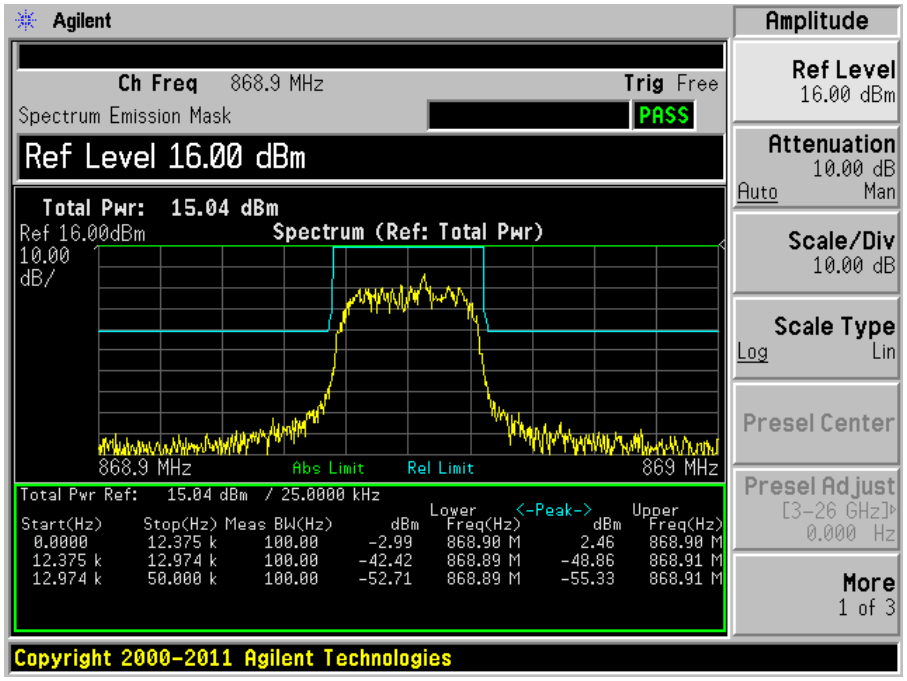
Low Channel – 851.1 MHz



Middle Channel – 861.5 MHz



High Channel – 868.9 MHz



8 FCC §2.1051, §90.221 & IC RSS-119 §5.8 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standard

According to FCC §90.221: (d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

IC RSS-119 §5.8

8.2 Test Procedure

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	E4446A	US44300386	2012-09-29	1 Year

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:	19 °C
Relative Humidity:	52 %
ATM Pressure:	101.1 kPa

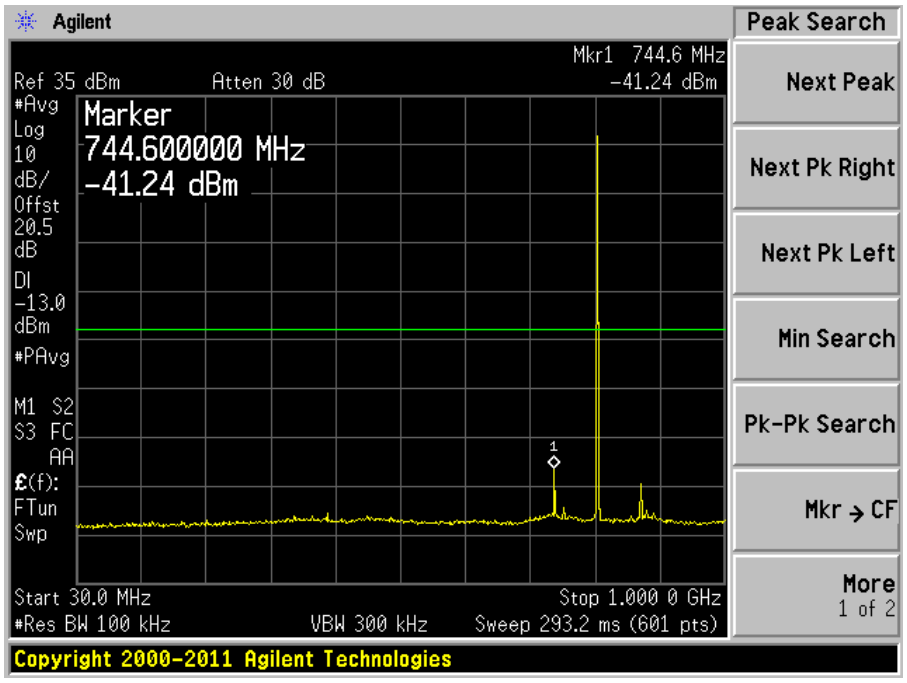
The testing was performed by Lionel Lara on 2013-01-11 in the RF Site.

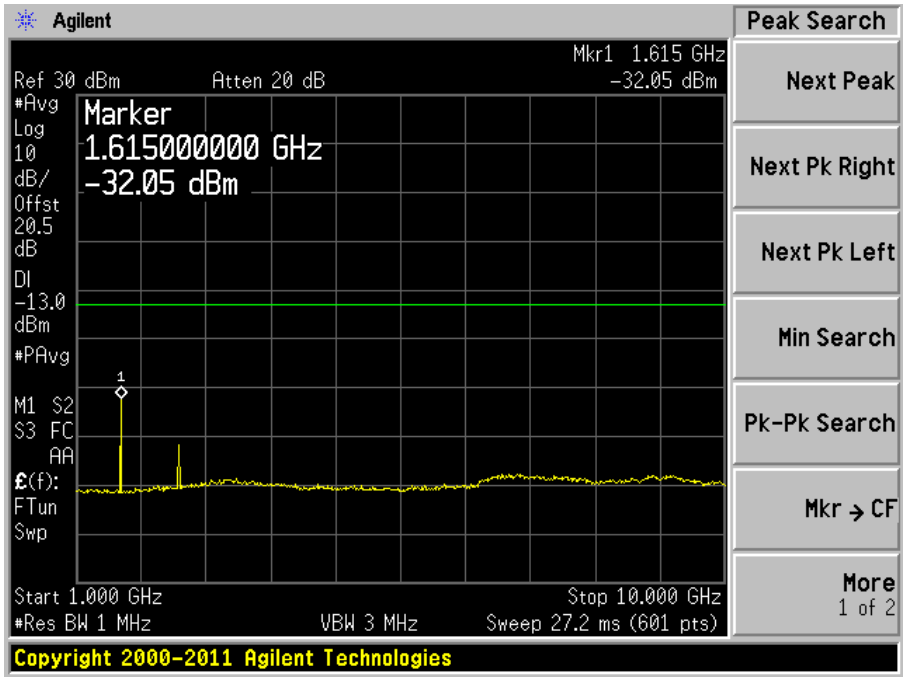
8.5 Test Results

Please refer to the following plots.

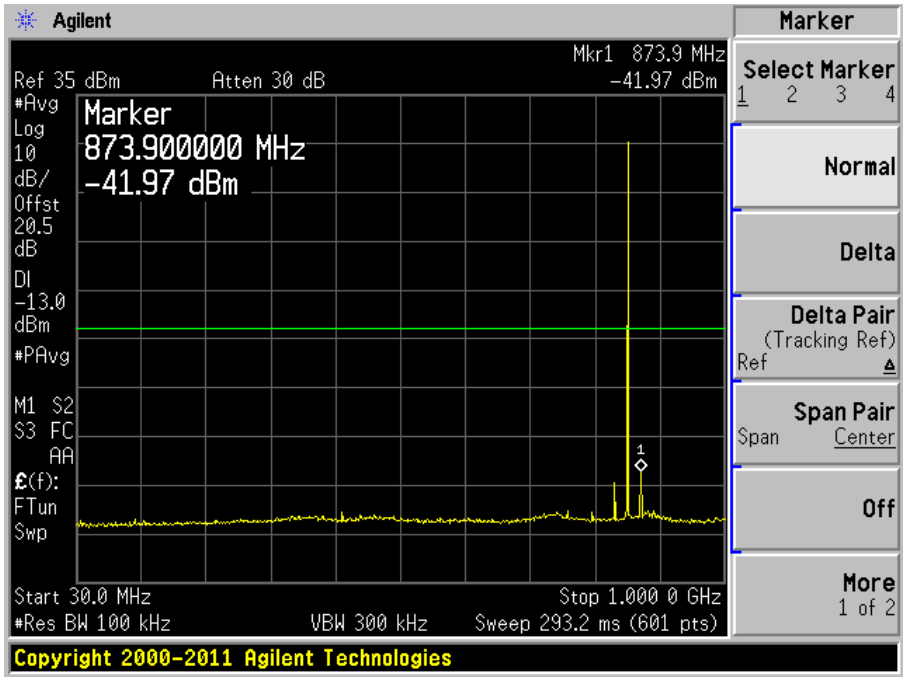
High Power

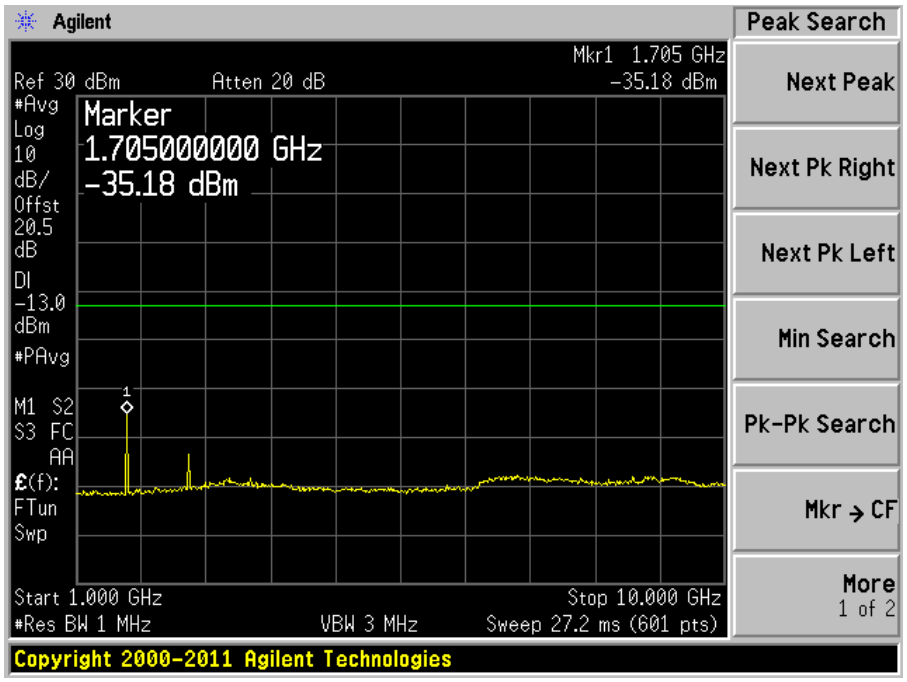
FCC: 809-824 MHz, 22 kHz, Low Channel – 809.1 MHz





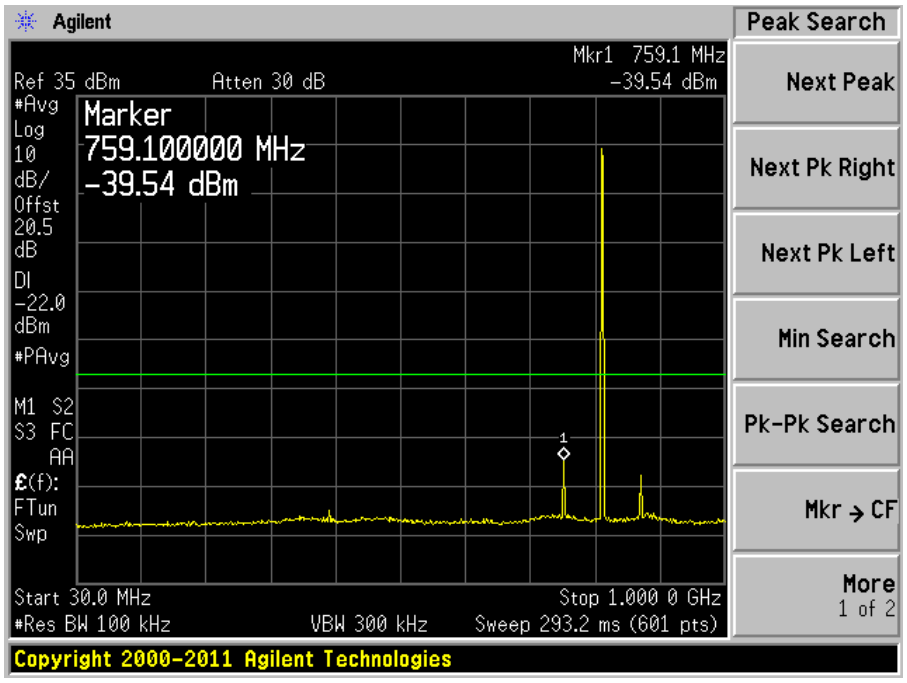
FCC: 854-869 MHz, 22 kHz, Low Channel – 854.1 MHz

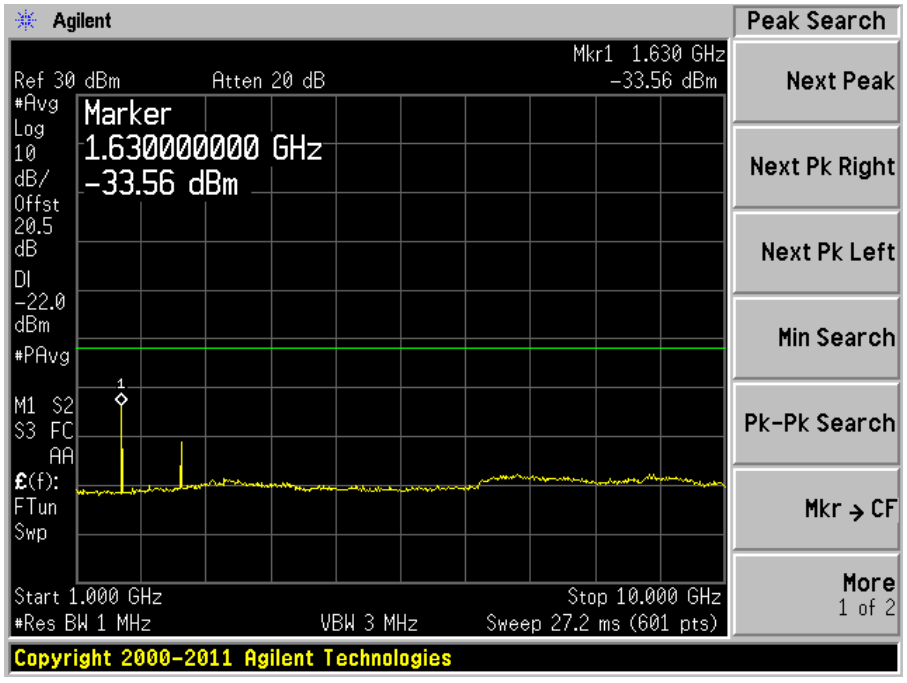




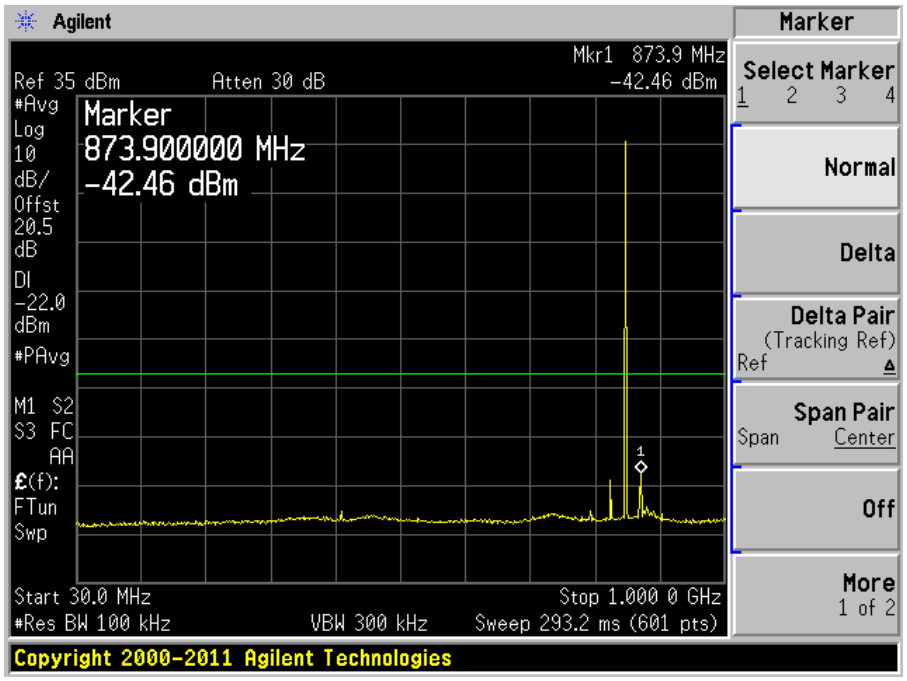
High Power

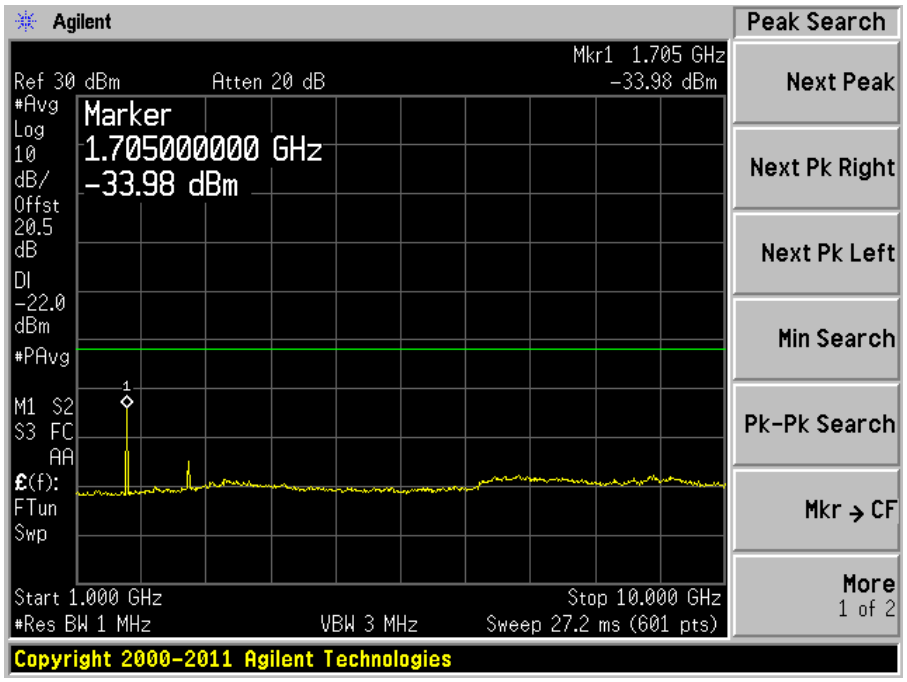
IC: 806-824 MHz, 22 kHz, Middle Channel – 816.5 MHz





IC: 851-869 MHz, 22 kHz, Low Channel – 851.1 MHz





9 FCC §2.1055, §90.213 & IC RSS-119 §5.3 - Frequency Stability

9.1 Applicable Standard

According to FCC §90.213: (a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3] 100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5,11] 5	[6] 5	[4,6] 50
216-220	1.0		1.0
220-222 [12]	0.1	1.5	1.5
421-512	[7,11,14] 2.5	[8] 5	[8] 5
806-809	[14] 1.0	1.5	1.5
809-824	[14] 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14] 0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928 [13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9] 300	300	300
Above 2450 [10]			

14 Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

IC RSS-119 §5.3: The carrier frequency shall not depart from the reference frequency in excess of the values given in the table below.

Frequency Band (MHz)	Channel Spacing (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile Station	
			>2 watts	≤ 2 watts
27.41-28 and 29.7-50	20	20	20	50
72-76	20	5	20	50
138-174	30	5	5	5
	15	2.5	5	5
	7.5	1	2	5
217-218 and 219-220	12.5	1	5	5
220-222 (Note 1)	5	0.1	1.5	1.5
406.1-430 and 450-470 (Note 6)	25 (Note 2)	0.5	1	1
	25	2.5	5	5
	12.5	1.5	2.5	2.5
	6.25	0.5	1	1
764-776 and 794-806 (Note 3)	6.25 12.5 25	0.1	0.4 (Note 4)	0.4 (Note 4)
	50	1	1.25 (Note 5)	1.25 (Note 5)
806-821/851-866 and 821-824/866-869 (Note 6)	25 (Note2)	0.1	0.1	0.1
	25	1.5	2.5	2.5
	12.5	1	1.5	1.5
896-901/935-940 (Note 6)	12.5	0.1	1.5	1.5
929-930/931-932	25	1.5	N/A	N/A
928-929/952-953 and 932-932.5/941-941.5	25	1.5	N/A	N/A
	12.5	1	3 (for remote station)	N/A
932.5-935/941.5-944	25	2.5	N/A	N/A
	12.5	2.5	N/A	N/A

Note 2: This provision is for digital equipment with channel spacing of 25 kHz and an occupied bandwidth greater than 20 kHz.

9.2 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to the Spectrum Analyzer via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 115% and 85% of the nominal value. The output frequency was recorded for each voltage.

9.3 Test Equipment List and Details

Equipment used by BACL for FCC Testing:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year
Espec	Temperature 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.

Equipment used by Teltronic S.A.U. for IC Testing:

Manufacturer	Description	Model	Serial Number	Calibration Valid	Calibratio Interval
Aeroflex	TETRA Radio Test Set	IFR2968	296501/190	2013-09-30	2 year
INELTEC	Climatic Chamber	CFCP-50/500	0602005	2013-10-25	1 year

9.4 Test Environmental Conditions

FCC Testing:

Temperature:	20 ºC
Relative Humidity:	52 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2013-01-11 in the RF Site.

IC Testing:

Temperature:	25.1ºC
Relative Humidity:	39.5%
ATM Pressure:	102.4 kPa

The testing was performed by Denny Soto on 2013-02-07 at Teltronic S.A.U.

9.5 FCC Test Results

809-824 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (MHz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency Tolerance with Temperature						
13.2	-30	816.5	816.499967	-3.3E-05	-0.04	±2.5
	-20	816.5	816.499967	-3.3E-05	-0.04	±2.5
	-10	816.5	816.499985	-1.5E-05	-0.02	±2.5
	0	816.5	816.499983	-1.7E-05	-0.022	±2.5
	10	816.5	816.49995	-5E-05	-0.062	±2.5
	20	816.5	816.49994	-6E-05	-0.072	±2.5
	30	816.5	816.499933	-6.7E-05	-0.082	±2.5
	40	816.5	816.499928	-7.2E-05	-0.09	±2.5
	50	816.5	816.499933	-6.7E-05	-0.08	±2.5
Frequency Tolerance with Supply Voltage						
15.18	20	816.5	816.49995	-5E-05	-0.06	±2.5
11.22	20	816.5	816.49994	-6E-05	-0.078	±2.5

854-869 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (MHz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency Tolerance with Temperature						
13.2	-30	861.5	861.500017	1.7E-05	0.023	±2.5
	-20	861.5	861.500024	2.4E-05	0.03	±2.5
	-10	861.5	861.500017	1.7E-05	0.02	±2.5
	0	861.5	861.500032	3.2E-05	0.04	±2.5
	10	861.5	861.49994	-6E-05	-0.07	±2.5
	20	861.5	861.49995	-5E-05	-0.05804	±2.5
	30	861.5	861.49995	-5E-05	-0.06	±2.5
	40	861.5	861.49995	-5E-05	-0.06	±2.5
	50	861.5	861.499963	-3.7E-05	-0.04	±2.5
Frequency Tolerance with Supply Voltage						
15.18	20	861.5	861.49995	-5E-05	-0.06	±2.5
11.22	20	861.5	861.49995	-5E-05	-0.06	±2.5

9.6 IC Test Results:

IC: 806-824 MHz

Test Condition		Reference Frequency (MHz)	Frequency Error (Hz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (ºC)				
Frequency vs. Temperature					
13.20	-30	815.000	-6.3	-0.008	±0.1
	-20	815.000	-8.5	-0.010	±0.1
	-10	815.000	-14.2	-0.017	±0.1
	0	815.000	-4.5	-0.006	±0.1
	10	815.000	+13.5	+0.017	±0.1
	20	815.000	-8.3	-0.010	±0.1
	30	815.000	-11.9	-0.015	±0.1
	40	815.000	+9.4	+0.012	±0.1
	50	815.000	-13.4	-0.016	±0.1
Frequency vs. Voltage					
15.18	20	815.000	+12.8	+0.016	±0.1
11.20	20	815.000	-8.9	-0.011	±0.1

IC: 854-869 MHz

Test Condition		Reference Frequency (MHz)	Frequency Error (Hz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (ºC)				
Frequency vs. Temperature					
13.20	-30	860.000	-14.0 Hz	-0.016	±0.1
	-20	860.000	-13.0 Hz	-0.015	±0.1
	-10	860.000	-23.3 Hz	-0.027	±0.1
	0	860.000	-20.2 Hz	-0.023	±0.1
	10	860.000	-12.3 Hz	-0.014	±0.1
	20	860.000	+17.5 Hz	+0.020	±0.1
	30	860.000	+4.7 Hz	+0.005	±0.1
	40	860.000	-7.2 Hz	-0.008	±0.1
	50	860.000	-12.1 Hz	-0.014	±0.1
Frequency vs. Voltage					
15.18	20	860.000	-18.4 Hz	-0.021	±0.1
11.20	20	860.000	+4.3 Hz	+0.005	±0.1

Note: IC Measurements were performed by Denny Soto on 2013-02-07 at Teltronic S.A.U.

10 FCC §2.1053, §90.221 & RSS-119 §5.8 – Field Strength of Spurious Radiation

10.1 Applicable Standard

According to FCC §90.221: (d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

IC RSS-119 §5.8

10.2 Test Procedure

The transmitter was placed on Styrofoam on the turntable, and it was normal transmitting with 50ohm termination 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 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 lg (TXpwr in Watts/0.001) – the absolute level

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 Year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	-
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-08-15	1 Year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 Year
Eaton	Horn antenna	96001	Mar-07	2012-10-17	1 Year
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03	1 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:	16 °C
Relative Humidity:	31 %
ATM Pressure:	101.5 kPa

The testing was performed by Lionel Lara on 2013-01-15 in 5 meter chamber 3.

10.5 Test Results

According to the data hereinafter, the EUT complied with the FCC Pt 90 and IC RSS-119 standard's radiated emissions limits, and had a worst case margin of:

Worst Margin: **-13.55 dB** at **1633 MHz** in the **Vertical** polarization.

Please see following table for detailed results.

High Power

22 kHz Bandwidth, Middle Channel–816.5 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
327.19	48.26	121	150	H	327.19	-54.38	0	1	-55.38	-22	-33.38
327.19	39.12	132	100	V	327.19	-63.52	0	1	-64.52	-22	-42.52
1633	32.08	120	100	H	1633	-46.56	9.11	1	-38.45	-22	-16.45
1633	34.98	332	149	V	1633	-43.66	9.11	1	-35.55	-22	-13.55
2499.5	33.62	235	118	H	2499.5	-62.93	9.77	1.5	-54.66	-22	-32.66
2499.5	29.58	221	150	V	2499.5	-66.97	9.77	1.5	-58.7	-22	-36.7

22 kHz Bandwidth, Middle Channel–861.5 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
327.19	47.61	125	150	H	327.19	-55.03	0	1	-56.03	-22	-34.03
327.19	38.55	130	100	V	327.19	-64.09	0	1	-65.09	-22	-43.09
1723	32.58	226	151	H	1723	-45.73	9.43	1	-37.3	-22	-15.3
1723	32.05	335	100	V	1723	-46.26	9.43	1	-37.83	-22	-15.83
2584.5	28.59	241	120	H	2584.5	-67.79	9.35	1.5	-59.94	-22	-37.94
2584.5	29.33	220	150	V	2584.5	-67.05	9.35	1.5	-59.2	-22	-37.2

11 FCC §2.1049 & §90.221 – Adjacent Channel Power

11.1 Applicable Standard

According to FCC §90.221: (a) For the frequency bands indicated below, operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

(c)(1) Maximum adjacent power levels for frequencies in the 809-824/854-869 MHz band:

Frequency offset	Maximum ACP (dBc) for devices less than 15 watts	Maximum ACP (dBc) for devices 15 watts and above
25 kHz	−55 dBc	−55 dBc
50 kHz	−65 dBc	−65 dBc
75 kHz	−65 dBc	−70 dBc

(2) In any case, no requirement in excess of −36 dBm shall apply.

(d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

11.2 Test Procedure

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

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Vailid
Agilent	PXA Signal Analyzer	N9030A	MY49430578	2013-11-23
BIRD	20 dB Attenuator / 10W	5-A-MFN-20	0646	N/A

11.4 Test Environmental Conditions

Temperature:	25.4ºC
Relative Humidity:	35%
ATM Pressure:	1008.1HPa

The testing was performed by Denny Soto from Teltronic on 2013-01-21.

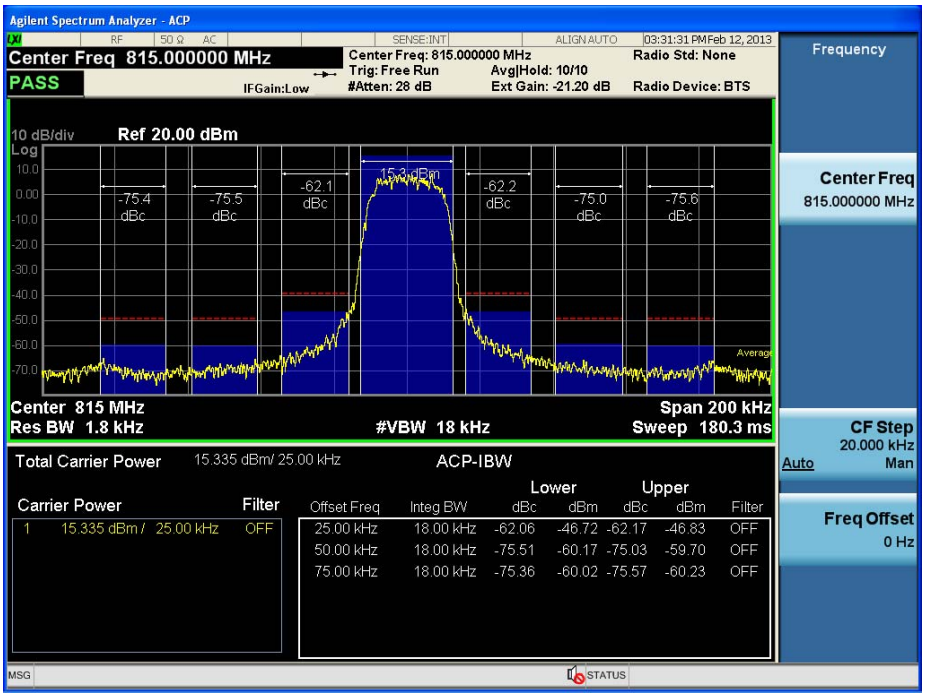
11.5 Test Results

Please refer to the following plots.

ACP (Low Power)

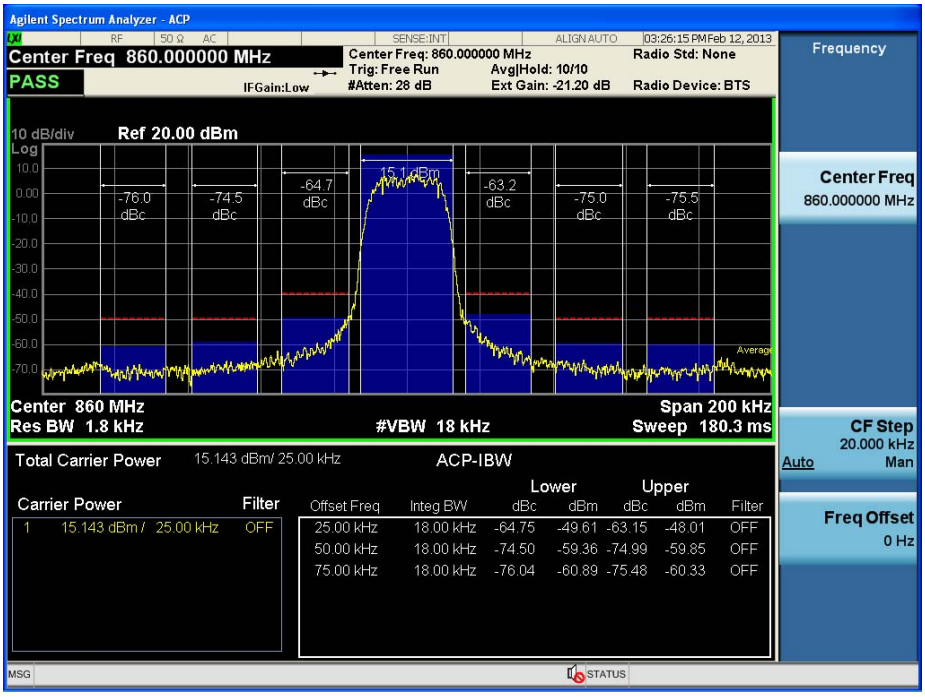
FCC: 809-824 MHz, 22 kHz Bandwidth

Middle Channel – 815 MHz



FCC: 854-869 MHz, 22 kHz Bandwidth

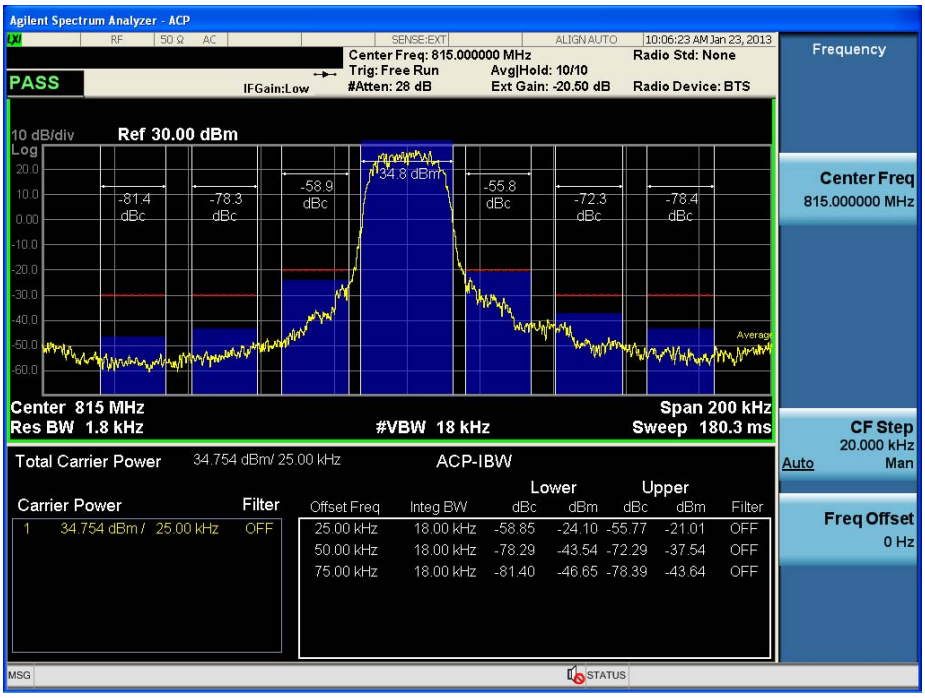
Middle Channel – 860 MHz



ACP (High Power)

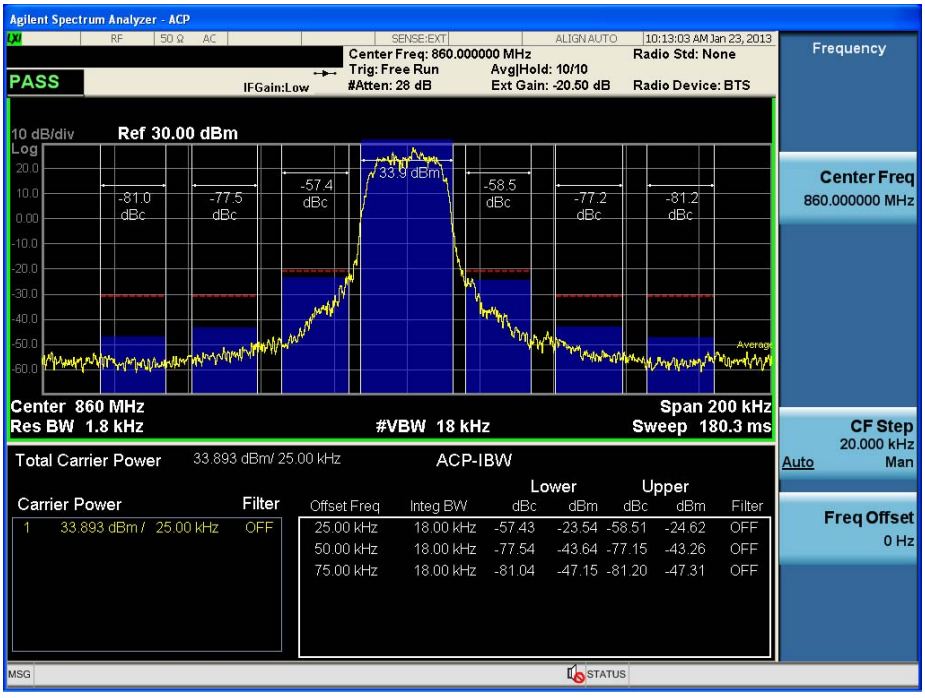
FCC: 809-824 MHz, 22 kHz Bandwidth

Middle Channel – 815 MHz



FCC: 854-869 MHz, 22 kHz Bandwidth

Middle Channel – 860 MHz



12 IC RSS-119 §5.11 - Receiver Spurious Radiated Emissions

12.1 Applicable Standard

IC RSS-119 §5.11, and RSS-Gen §6

The following receiver spurious emission limits shall be complied with:
(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1.

Table 1 - Spurious Emission Limits for Receivers

Frequency (MHz)	Field Strength Microvolts/m at 3 meters
30-88	100
88-216	150
216-960	200
Above 960	500

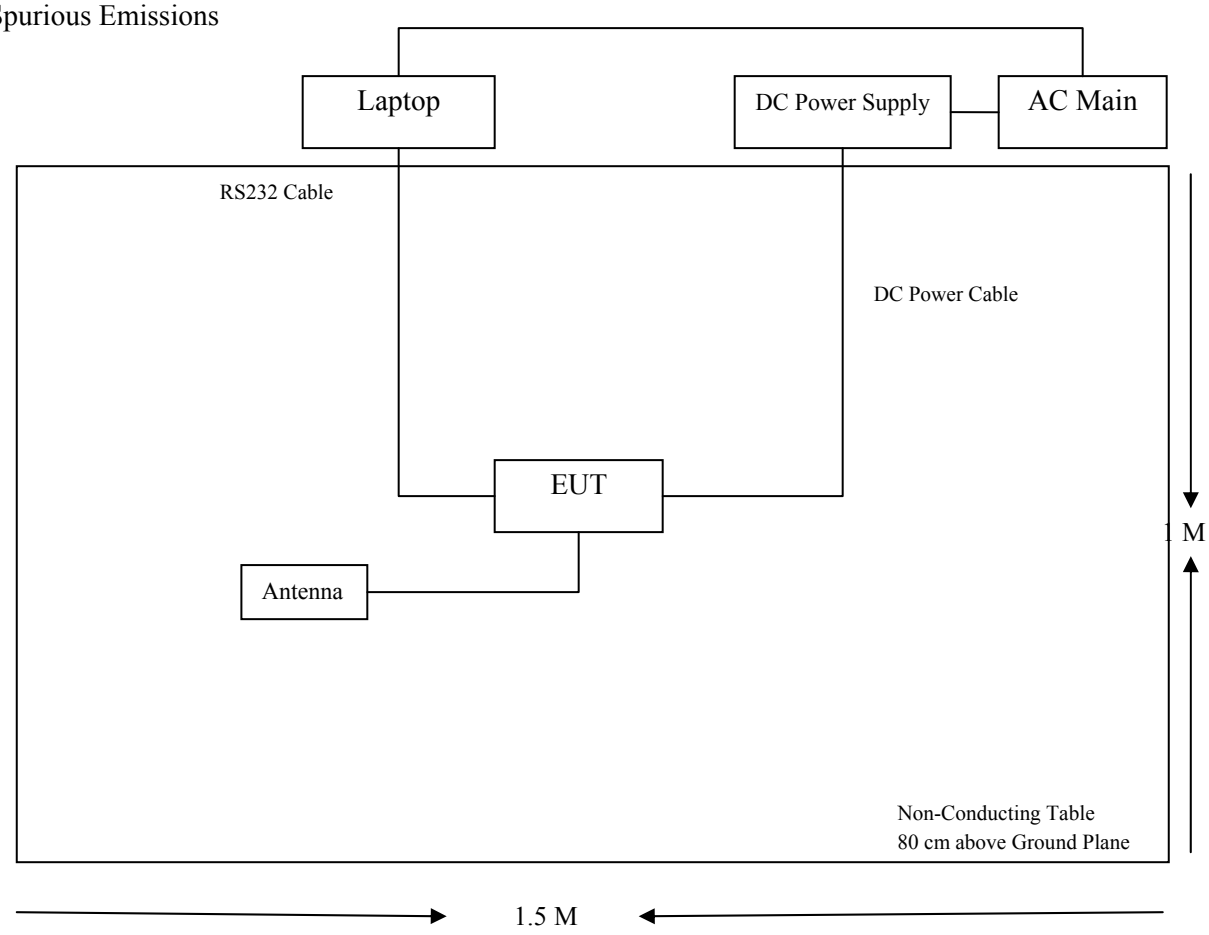
12.2 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "QP" in the data table.

12.3 Test Block Diagram

RX Spurious Emissions



12.4 Test Equipment Lists and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 Year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-08-15	1 Year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 Year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22	1 Year

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

12.5 Test Environmental Conditions

Temperature:	16-19 °C
Relative Humidity:	31-42 %
ATM Pressure:	101.5-101.8 kPa

The testing was performed by Lionel Lara on 2013-01-15 & 2013-1-29 in 5 meter chamber 3.

12.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

12.7 Summary of Test Results

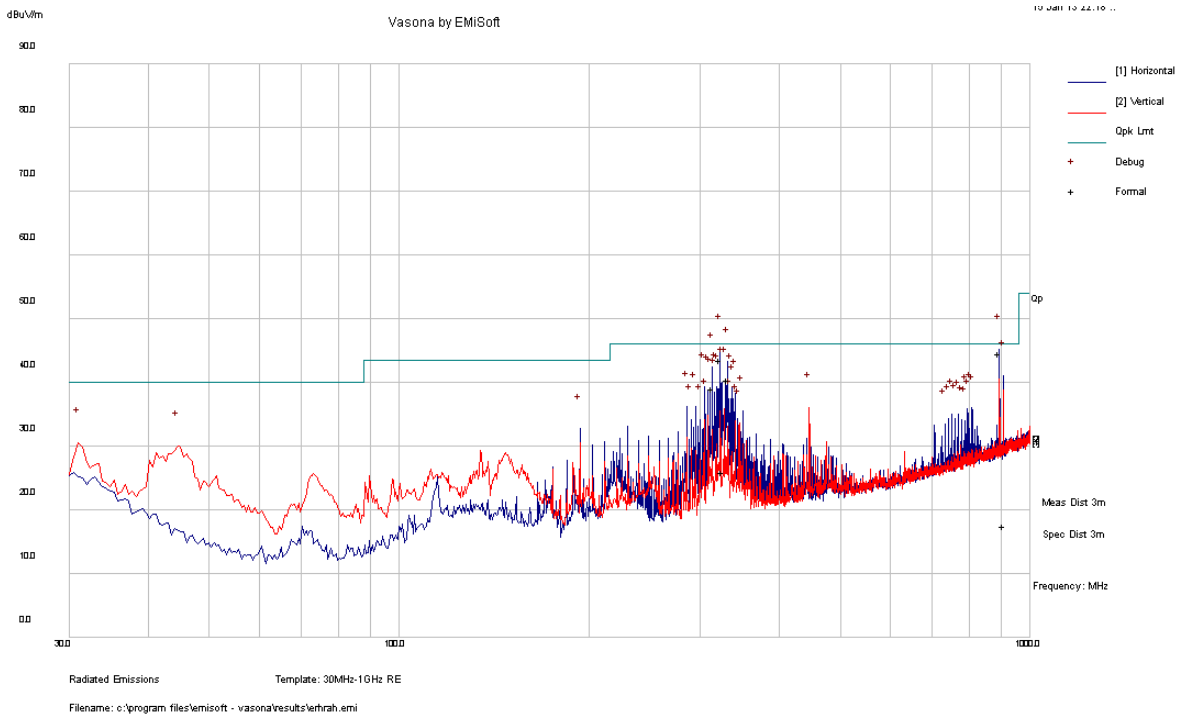
According to the test data, the EUT complied IC RSS-119, RSS-Gen, with the worst margins from the limit listed below:

Model: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Test Range**
-1.45	893.431	Horizontal	30 MHz-1 GHz

12.8 Radiated Spurious Emissions Data

RX Spurious Emissions

1) 30 MHz – 1 GHz, Measured at 3 Meter distance:



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments
893.431	44.55	104	H	19	46	-1.45	QP
322.575	43.47	100	H	127	46	-2.53	QP
331.7423	40.38	99	H	121	46	-5.62	QP
313.3375	39.07	102	H	107	46	-6.93	QP
325.0853	25.93	107	H	98	46	-20.07	QP
906.6313	17.53	244	H	161	46	-28.47	QP

2) Above 1 GHz, Measured at 3 Meter distance:

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
-[1]	-	-	-	-	-	-	-	-	-	-	-

Note 1: All spurious emissions at noise floor level.