FCC PART 27

TEST AND MEASUREMENT REPORT

For

Full Spectrum Inc.

687 N. Pastoria Avenue,

Sunnyvale, CA 94085, USA

FCC ID: X27FS-CP757787

Report Type:	**Product Type:**
Original Report	Point-to-Multipoint Broadband Radio

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Report Number:	R1701258-27 Rev A
Report Date:	2017-07-26
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1701258-27	Final	2017-06-15
1	R1701258-27	Adding peak power measurement in Section 5.5 Updating Section 4.3	2017-07-21

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Full Spectrum Inc.,* and their product model Cobalt Plus, FCC ID: X27FS-CP757787, which will henceforth be referred to as the EUT (Equipment under Test). The EUT is a radio platform that can act as either a remote station or a base station in the FullMAX multi-cell, point to multipoint broadband wireless system and operated at 757.5 MHz and 787.5 MHz.

1.2 Mechanical Description

The EUT measures approximately 21.6 cm (L) x 10.2cm (W) x 5.1 cm (H).

The test data gathered are from typical production sample, serial number: R1701258-1 assigned by BACL.

1.3 Objective

This type approval report was prepared on behalf of *Full Spectrum.*in accordance with Part 2, Subpart J, and Part 27, of the Federal Communication Commission's rules.

The objective was to determine compliance with FCC rules for RF output power, occupied bandwidth, spurious emissions at antenna terminal, radiated spurious emission, band edge, and frequency stability.

1.4 Related Submittal(s)/Grant(s)

None

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 part 27.

Applicable Standards: TIA/EIA603-D, FCC KDB 9771168 D01 v02r02.

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 CISPR16-4-2:2011, 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

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65:1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 C63.4-2009, 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-D and FCC KDB 9771168 D01 v02r02.
The final qualification test was performed with the EUT operating at normal mode.

2.2 EUT Exercise Software

The test firmware used was Stand Alone Cobalt-Plus Teansmission.exe and the software is comply with the standard requirements being tested against.

2.3 Duty Cycle Correction Factor

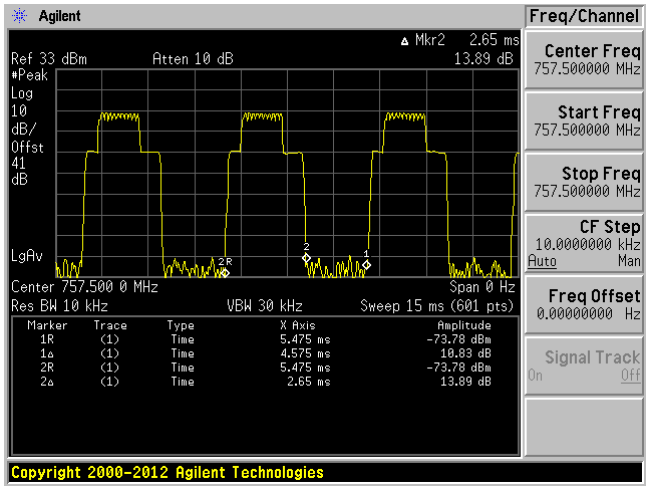
According to KDB 971168 D01 Power Meas License Digital Systems v02r02:

Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
757.5MHz 64QAM	2.65	4.575	57.92	2.37
787.5MHz 64QAM	2.709	4.557	59.45	2.26
757.5MHz BPSK	2.575	4.525	56.91	2.45
787.5MHz BPSK	2.767	4.667	59.29	2.27

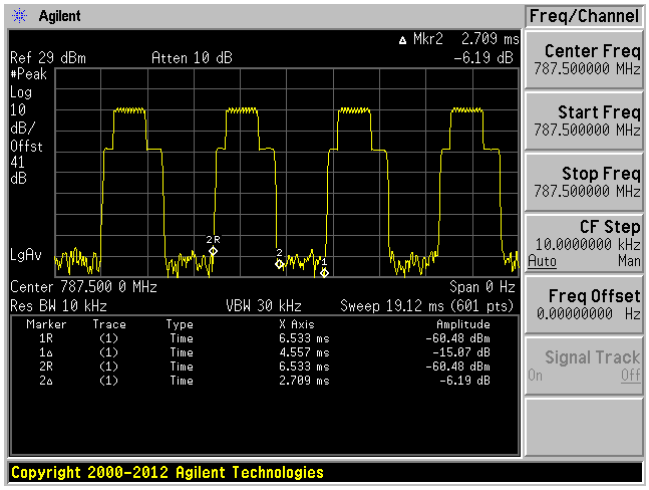
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log (1/Duty Cycle)

Please refer to the following plots.

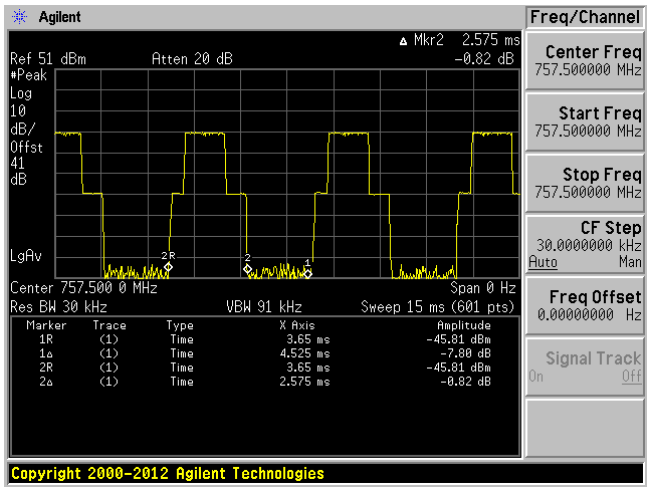
757.5 MHz 64QAM



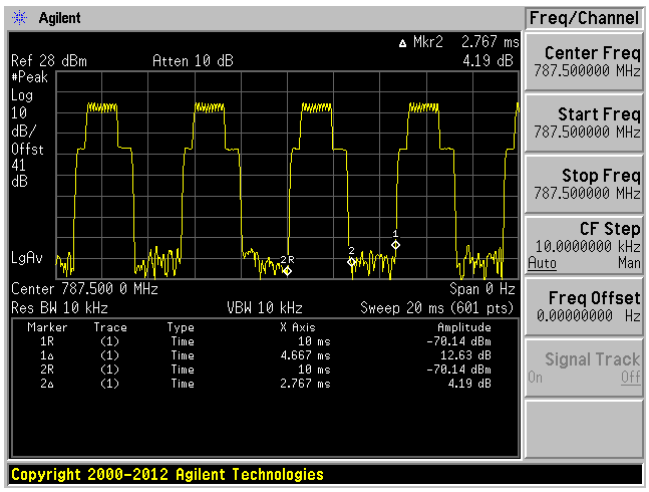
787.5 MHz 64QAM



757.5 MHz BPSK



787.5 MHz BPSK



2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Dell	Windows Laptop	E6410	-

2.6 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RJ45	> 1 m	Windows Laptop	EUT
RF Cable	< 1 m	PSA	EUT

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§27.50	Conducted Output Power	Compliant
§2.1049, §27.53	Occupied Bandwidth	Compliant
§2.1053, §27.53(c)(f)	Spurious Radiated Emissions	Compliant
§2.1051, §27.53(c)(f)	Spurious Emissions at Antenna Terminals	Compliant
§27.53(c)(f)	Band Edge	Compliant
§2.1055, §27.54	Frequency Stability	Compliant

4 FCC §2.1091 - RF Exposure

4.1 Applicable Standards

According to §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/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	/	/	1.0	30

Note: 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 antenna

4.3 Test Results

Maximum output power at antenna input terminal (dBm):	29.4
Maximum output power at antenna input terminal (mW):	870.96
Prediction distance (cm):	180
Prediction frequency (MHz):	757.5
Antenna Gain, typical (dBi):	23.5
Maximum Antenna Gain (numeric):	223.87
Power density at predication frequency and distance (mW/cm^2):	0.479
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	0.505

Results:

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 180 cm is 0.479 mW/cm^2.

5 FCC §2.1046 & §27.50 - RF Output Power

5.1 Applicable Standards

According to §27.50 (b):

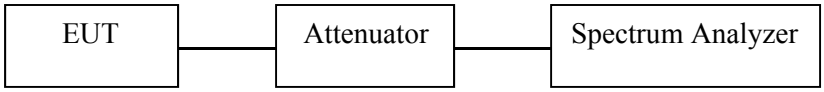
(1) Fixed and base stations transmitting a signal in the 757-758 and 775-776 MHz bands must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(9) Control stations and mobile stations transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands and fixed stations transmitting in the 787-788 MHz and 805-806 MHz bands are limited to 30 watts ERP.

5.2 Test Procedure

KDB 971168 D01 v02r02, Section 5.1.1 for Peak Power Measurement; Section 5.2.1 for Average Power Measurement.

Conducted Method: the EUT was connected to the spectrum analyzer through sufficient attenuator.



5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
-	RF cable	-	-	Each time[1]	N/A
-	40dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
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:	20-22° C
Relative Humidity:	39-42 %
ATM Pressure:	101.6-102 kPa

The testing was performed by Jin Yang 2017-03-03 in the RF Site.

5.5 Test Results

Average Power Measurement

64 QAM

Channel	Frequency (MHz)	Reading Level (dBm)	Duty Cycle Factor (dB)	Ave. Conducted Output Power (dBm)	Antenna Gain[1] (dBi)	ERP (dBm)	ERP Limit (dBm)
Low	757.5	26.62	2.37	28.99	23.5	50.34	60
High	787.5	25.29	2.26	27.55	9.5	34.9	44.77

BPSK

Channel	Frequency (MHz)	Reading Level (dBm)	Duty Cycle Factor (dB)	Ave. Conducted Output Power (dBm)	Antenna Gain[1] (dBi)	ERP (dBm)	ERP Limit (dBm)
Low	757.5	26.95	2.45	29.4	23.5	50.75	60
High	787.5	27.05	2.27	29.33	9.5	36.68	44.77

* Duty cycle factor was calculated based on the duty cycle measurement in Section 2.3 of this report.
* ERP=Average Power (dBm) + Antenna Gain (dBi)-2.15

Peak Power Measurement

64 QAM

Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	Antenna Gain[1] (dBi)	ERP (dBm)	ERP Limit (dBm)
Low	757.5	38.4	23.5	59.75	60
High	787.5	37.21	9.5	44.56	44.77

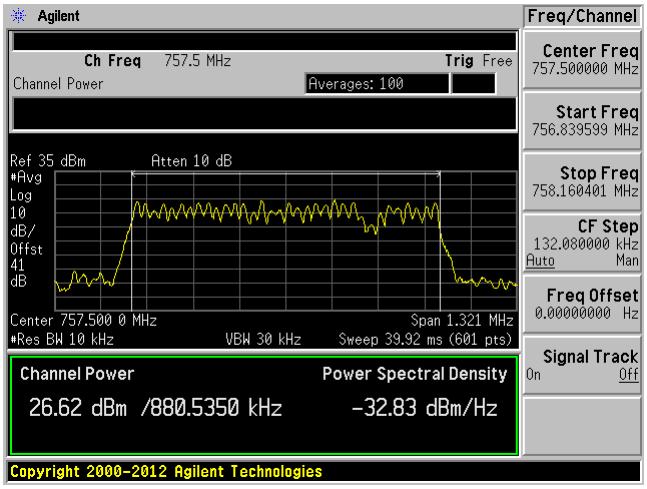
BPSK

Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	Antenna Gain[1] (dBi)	ERP (dBm)	ERP Limit (dBm)
Low	757.5	36.44	23.5	57.79	60
High	787.5	36.37	9.5	43.72	44.77

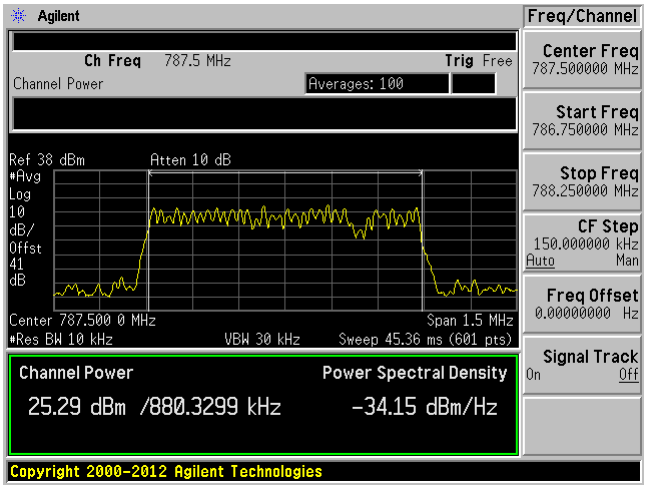
Note1: in order to meet the ERP limit, manufacturer declares the maximum allowable antenna gain is 23.5 dBi and 9.5 dBi at 757.5 MHz and 787.5 MHz respectively.

64 QAM (Average Power)

Low channel

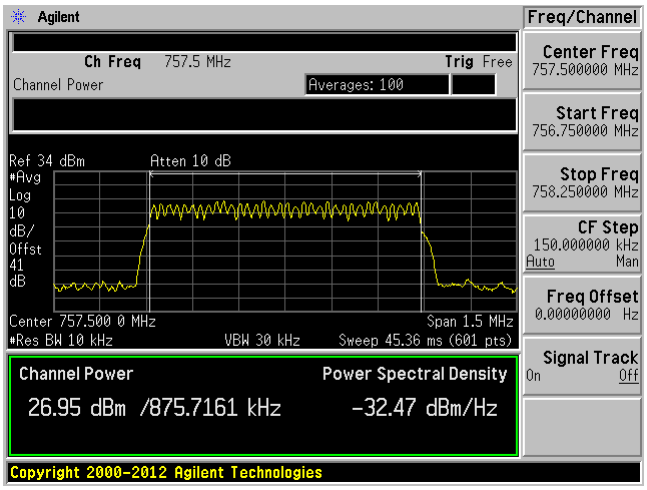


High channel

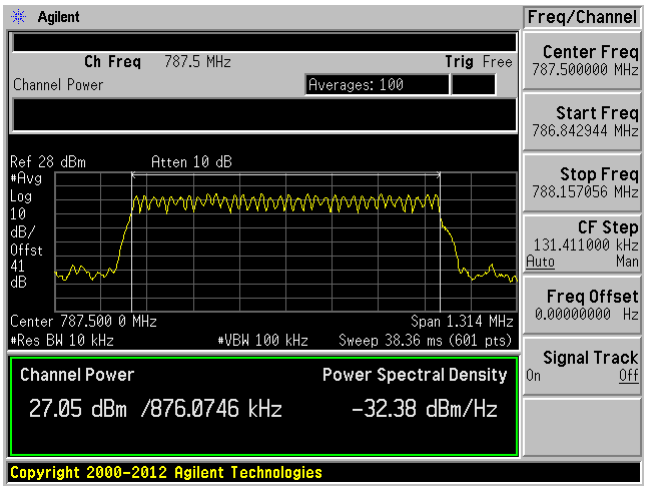


BPSK (Average Power)

Low channel



High channel



6 FCC §2.1049 - Occupied Bandwidth

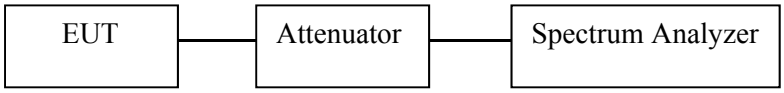
6.1 Applicable Standards

Requirements: FCC §2.1049

6.2 Test Procedure

The EUT was connected to the spectrum analyzer through sufficient attenuator.

The resolution bandwidth of the spectrum analyzer was set to 10 kHz and the 26 dB & 99% bandwidth was recorded.



6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
-	RF cable	-	-	Each time[1]	N/A
-	40 dB attenuator	-	-	Each time[1]	N/A

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

6.4 Test Environmental Conditions

Temperature:	21-23 °C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jin Yang 2017-03-03 in the RF Site.

6.5 Test Results

Please refer to the following table and plots.

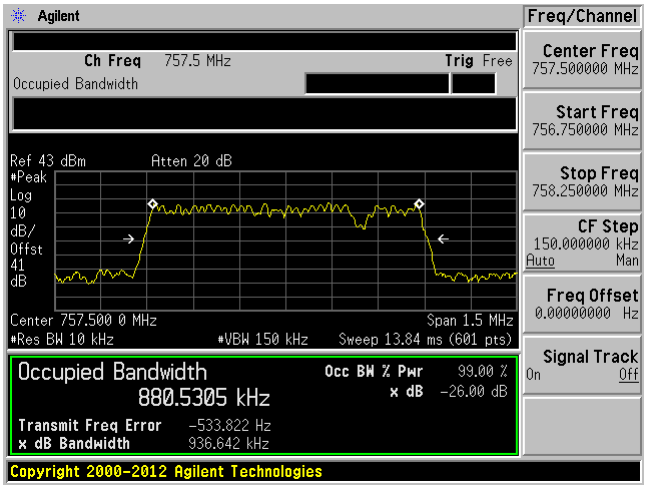
64 QAM

Channel	Frequency (MHz)	99% OBW (kHz)	26 dB BW (kHz)
Low	757.5	880.5305	936.642
High	787.5	880.3299	935.260

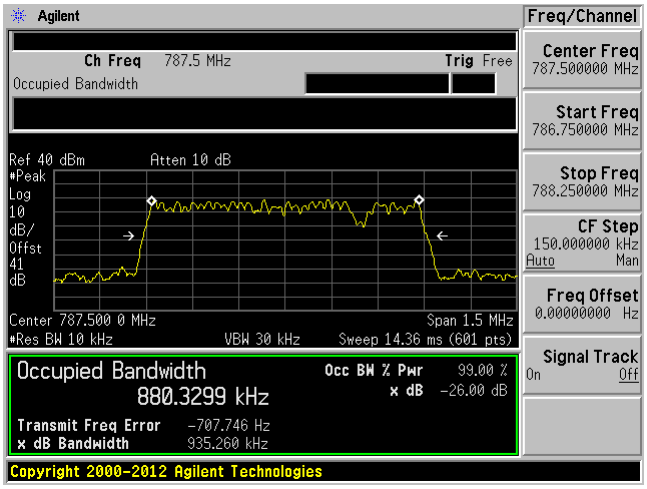
BPSK

Channel	Frequency (MHz)	99% OBW (kHz)	26 dB BW (kHz)
Low	757.5	875.7161	939.844
High	787.5	876.0746	940.491

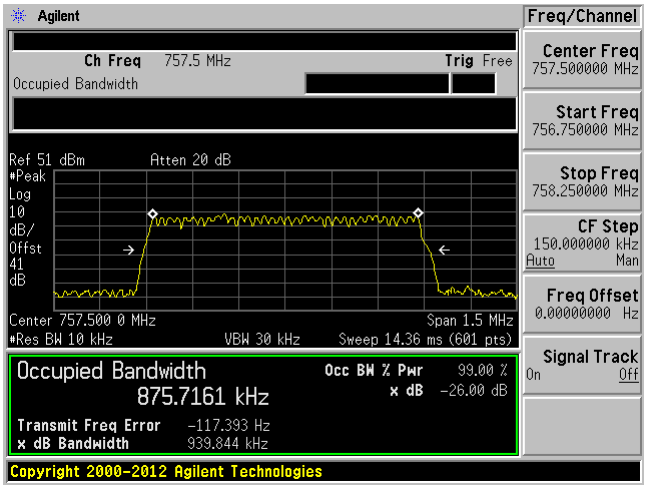
757.5 MHz 64QAM



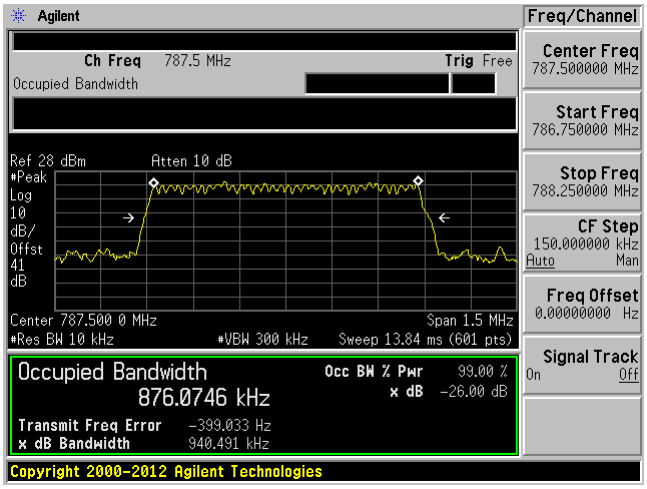
787.5 MHz 64QAM



757.5 MHz BPSK



787.5 MHz BPSK



7 FCC §2.1053 & §27.53 - Spurious Radiated Emissions

7.1 Applicable Standards

According to FCC §27.53(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

According to FCC §27.53 (f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

7.2 Test Procedure

The transmitter was placed on the turntable with a non-radiating load connected to the antenna terminal.

The measurement antenna was placed at a distance of 3 meters from the EUT. The receiving antenna’s height and polarity and the EUT’s azimuth were varied in order to identify the maximum emission levels.

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

A substitution antenna replaced the EUT once the highest emissions were identified. A signal generator was connected to the substitution antenna by a non-radiated cable to measure the correction factor needed to be added back to the emission levels.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2015-07-11	2 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2016-03-09	2 years
A. H. Systems	Antenna, Horn	SAS-200/571	261	2015-09-21	2 year
HP	Signal Generator	83650B	18485-91	2016-09-09	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1,721033DB2,721033DB3,721033DB4	2016-02-13	2 year
Wisewave	Amplifier, Low Noise	ALN-22093530-01	12263-01	2016-05-16	1 year
IW	Black High Frequency Cable	DC 1710	KPS-1501N-3960-KPS	2017-05-10	1 Year
-	SMA cable	-	C0002	Each time[1]	N/A

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

7.4 Test Environmental Conditions

Temperature:	20-21°C
Relative Humidity:	47-49 %
ATM Pressure:	101.4-101.6 kPa

The testing was performed by Frank Wang on 2017- 04-07 in 5 Meter Chamber 3

7.5 Test Results

1559-1610 MHz Band

64QAM

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5 MHz										
1602.35	24.759	0	100	V	-48.911	0.423	8.762	-40.572	-40	-0.572
1598.58	24.528	0	100	V	-49.142	0.423	8.762	-40.803	-40	-0.803
1588.71	25.116	0	100	H	-49.364	0.423	8.762	-41.025	-40	-1.025
1559.68	25.458	0	100	H	-48.722	0.423	8.762	-40.383	-40	-0.383
High Channel 787.5 MHz										
1572.68	24.638	0	100	V	-49.962	0.423	8.62	-41.765	-40	-1.765
1575	25.22	189	100	V	-49.38	0.423	8.62	-41.183	-40	-1.183
1566	24.68	189	100	H	-49.24	0.423	8.62	-41.043	-40	-1.043
1575	25.57	0	100	H	-48.43	0.423	8.62	-40.233	-40	-0.233

BPSK

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5 MHz										
1572.34	24.7	0	100	V	-49.9	0.423	8.62	-41.703	-40	-1.703
1564.72	24.92	0	100	V	-48.96	0.423	8.62	-40.763	-40	-0.763
1563.86	24.855	0	100	H	-49.325	0.423	8.62	-41.128	-40	-1.128
1581.27	24.62	0	100	H	-48.55	0.423	8.76	-40.211	-40	-0.211
High Channel 787.5 MHz										
1589.09	24.745	0	100	V	-48.925	0.423	8.762	-40.586	-40	-0.586
1575	24.586	0	100	V	-49.364	0.423	8.62	-41.167	-40	-1.167
1575	24.688	0	100	H	-49.312	0.423	8.62	-41.115	-40	-1.115
1588.24	24.301	0	100	H	-50.179	0.423	8.762	-41.84	-40	-1.84

*EUT in this range was test with antenna.

Below 1 GHz

64QAM

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5MHz										
52.27	54.86	283	100	V	-54.29	0.071	1.4	-52.961	-13	-39.961
300	48.99	299	100	V	-55.82	0.227	1.6	-54.447	-13	-41.447
275	47.01	111	103	V	-58.64	0.227	1.6	-57.267	-13	-44.267
376	51.93	176	166	H	-51.12	0.227	1.5	-49.847	-13	-36.847
250	52.2	303	263	H	-53.12	0.227	1.6	-51.747	-13	-38.747
400	54	115	195	H	-49.86	0.227	1.5	-48.587	-13	-35.587
High Channel 787.5 MHz										
54.95	53.47	296	171	V	-55.68	0.071	1.4	-54.351	-13	-41.351
400	51.63	218	228	V	-50.82	0.227	1.5	-49.547	-13	-36.547
350	49.74	210	223	V	-53.99	0.227	1.5	-52.717	-13	-39.717
400	56.46	102	234	H	-47.4	0.227	1.5	-46.127	-13	-33.127
375	54.25	310	164	H	-48.8	0.227	1.5	-47.527	-13	-34.527
350	53.49	237	100	H	-49.44	0.227	1.5	-48.167	-13	-35.167

BPSK

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5MHz										
56.08	54.01	306	126	V	-55.14	0.071	1.4	-53.811	-13	-40.811
275	48.37	256	154	V	-57.28	0.227	1.6	-55.907	-13	-42.907
300	47.91	218	144	V	-56.9	0.227	1.6	-55.527	-13	-42.527
325	51.68	120	170	H	-53.04	0.227	1.6	-51.667	-13	-38.667
400	54.83	297	225	H	-49.03	0.227	1.5	-47.757	-13	-34.757
250	53.91	270	240	H	-51.41	0.227	1.6	-50.037	-13	-37.037
High Channel 787.5 MHz										
54.38	54.59	249	100	V	-54.56	0.071	1.4	-53.231	-13	-40.231
300	49.03	284	133	V	-55.78	0.227	1.6	-54.407	-13	-41.407
275	47.92	262	146	V	-57.73	0.227	1.6	-56.357	-13	-43.357
400	55.03	105	245	H	-48.83	0.227	1.5	-47.557	-13	-34.557
375	54.09	318	136	H	-48.96	0.227	1.5	-47.687	-13	-34.687
350	53.33	218	162	H	-49.6	0.227	1.6	-48.227	-13	-35.227

Above 1 GHz

64QAM

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5 MHz										
2061.17	41.52	154	130	V	-30.29	0.591	9.083	-21.798	-13	-8.798
2272.23	34.36	150	120	V	-38.3	0.591	9.051	-29.84	-13	-16.84
2059.92	43.74	138	155	H	-27.63	0.591	9.083	-19.138	-13	-6.138
2272.33	34.77	126	150	H	-37.71	0.591	9.051	-29.25	-13	-16.25
High Channel 787.5 MHz										
2061.83	41.73	147	100	V	-30.08	0.591	9.083	-21.588	-13	-8.588
2608	28.36	0	100	V	-38.49	0.695	9.125	-30.06	-13	-17.06
2061.67	42.95	144	212	H	-28.42	0.591	9.083	-19.928	-13	-6.928
2159	27.83	0	100	H	-43.47	0.591	8.978	-35.083	-13	-22.083

BPSK

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle (Degree)	Rx Antenna		Substituted			Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel 757.5 MHz										
2060.58	41.56	159	159	V	-30.25	0.591	9.083	-21.758	-13	-8.758
3168	29.31	0	100	V	-39.89	0.786	9.036	-31.64	-13	-18.64
2059.58	43.25	127	151	H	-28.12	0.591	9.083	-19.628	-13	-6.628
2608.58	28.4	0	100	H	-38.49	0.695	9.125	-30.06	-13	-17.06
High Channel 787.5 MHz										
2059.67	41.78	162	168	V	-30.03	0.591	9.083	-21.538	-13	-8.538
3061.83	29.44	0	100	V	-37.96	0.786	9.362	-29.384	-13	-16.384
2061.58	42.81	125	136	H	-28.56	0.591	9.083	-20.068	-13	-7.068
2160	27.19	0	100	H	-44.11	0.591	8.978	-35.723	-13	-22.723

8 FCC §2.1051 & §27.53 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standards

According to FCC §27.53(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

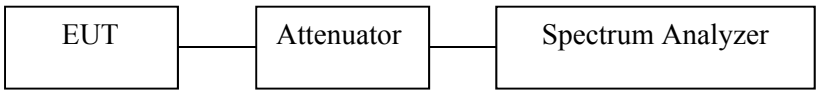
(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

8.2 Test Procedure

The EUT was connected to the spectrum analyzer through sufficient attenuator.

The resolution bandwidth of the spectrum analyzer was set 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
-	RF cable	-	-	Each time[1]	N/A
-	40dB attenuator	-	-	Each time[1]	N/A

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

8.4 Test Environmental Conditions

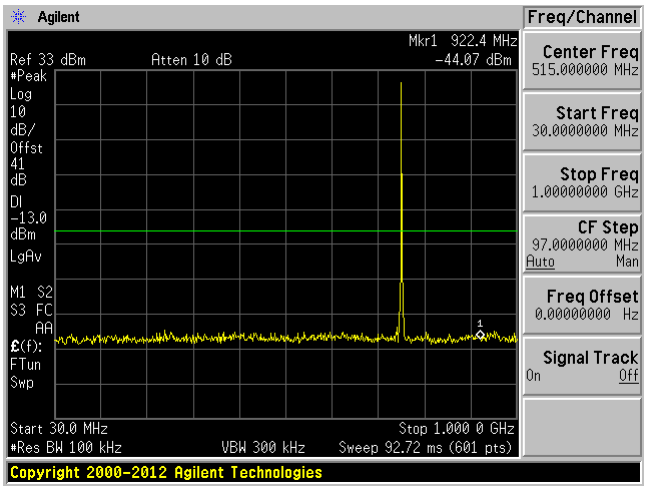
Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jin Yang 2017-03-03 in the RF Site.

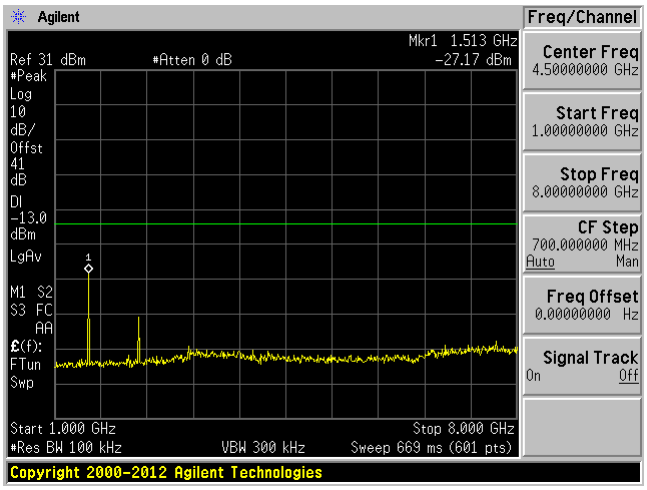
64 QAM

Low Channel 757.5 MHz

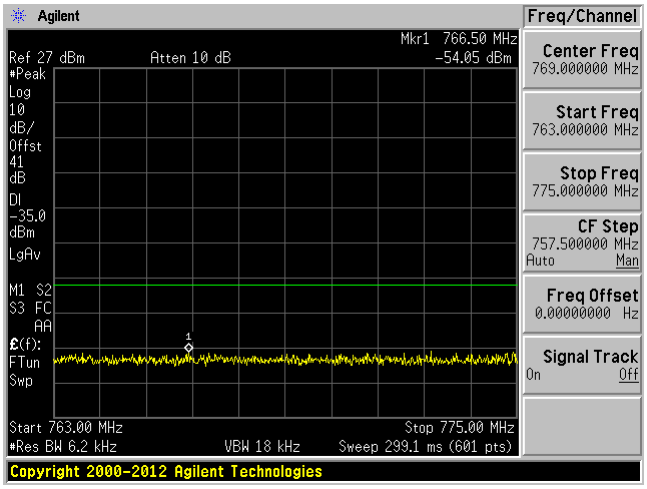
30 MHz – 1GHz



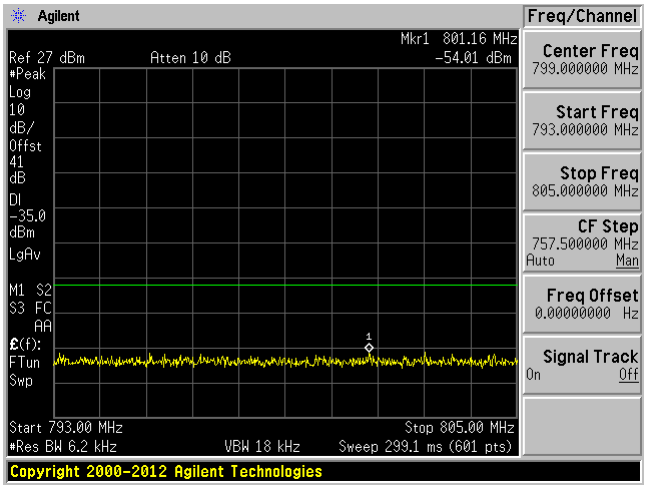
1 GHz – 8 GHz



763-775 MHz



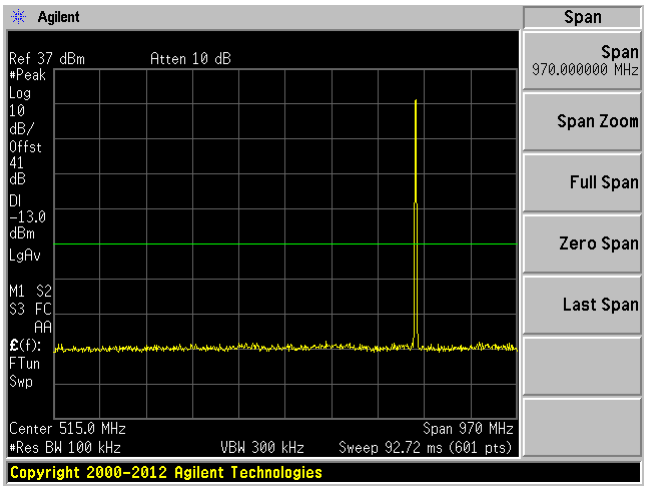
793-805 MHz



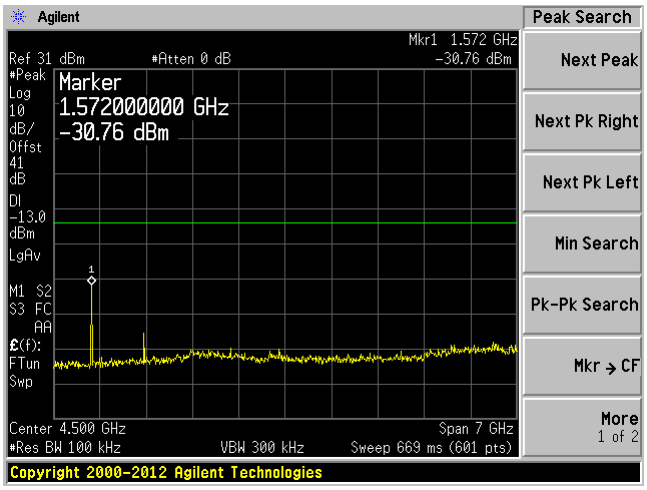
*The limit for on all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations; The limit is -46 dBm/6.25 kHz.

High Channel 787.5 MHz

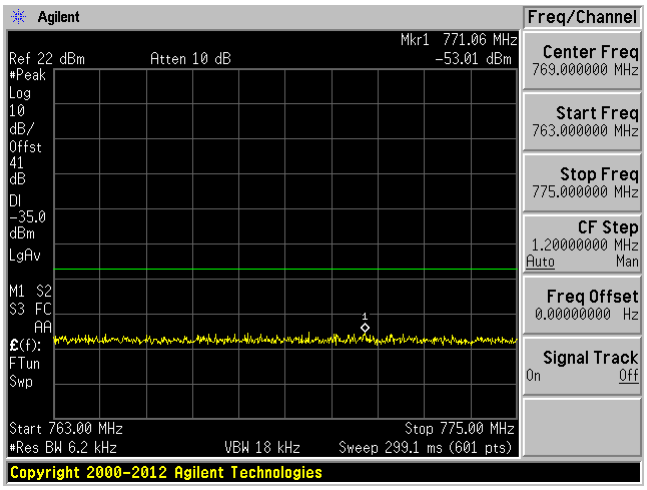
30 MHz – 1GHz



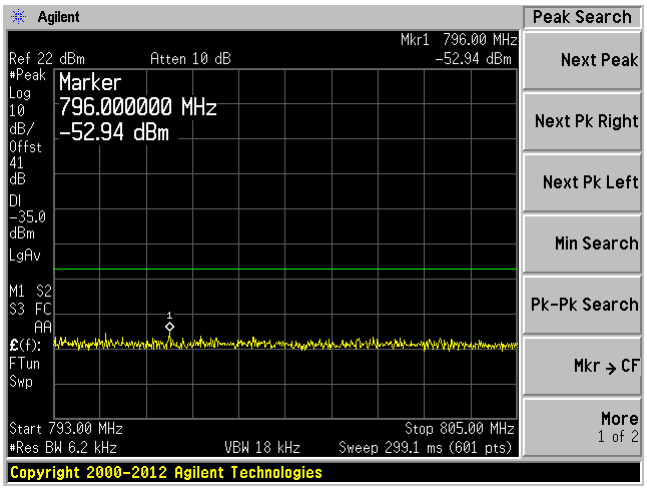
1 GHz – 8 GHz



763-775 MHz



793-805 MHz

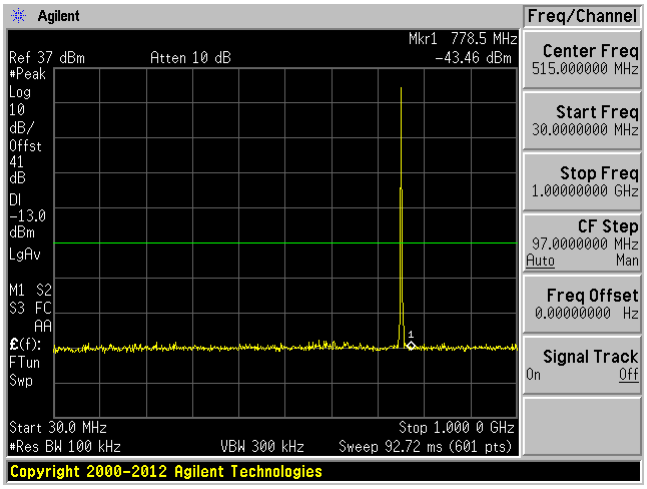


* On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations; The limit is -35dBm/6.25 kHz.

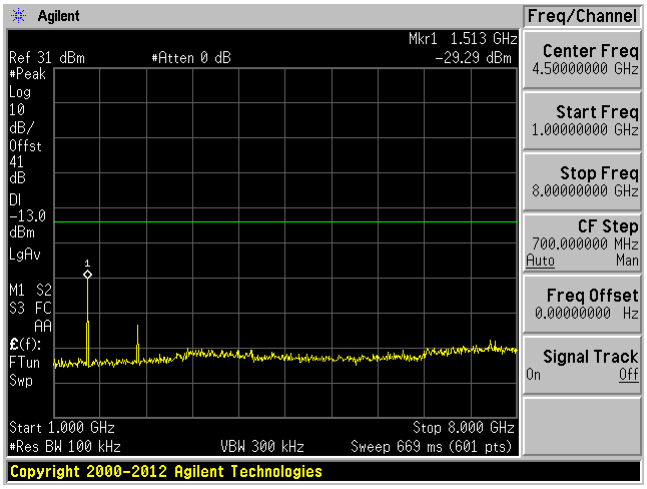
BPSK

Low Channel 757.5MHz

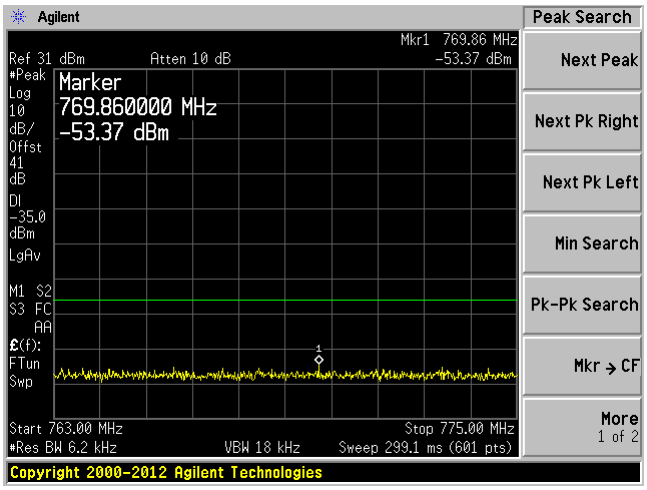
30 MHz – 1GHz



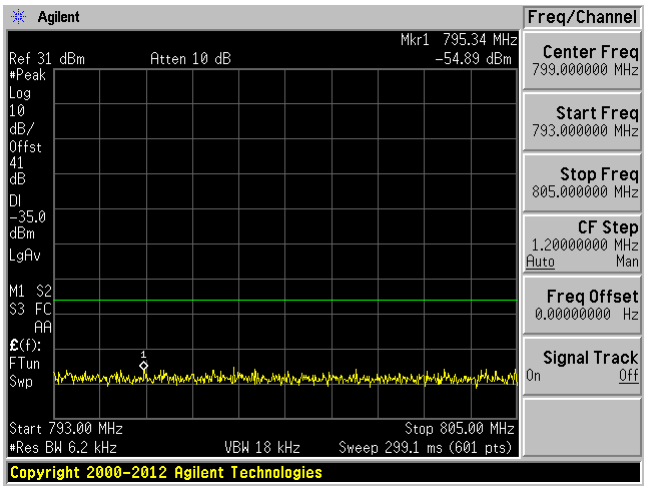
1 GHz – 8 GHz



763-775 MHz



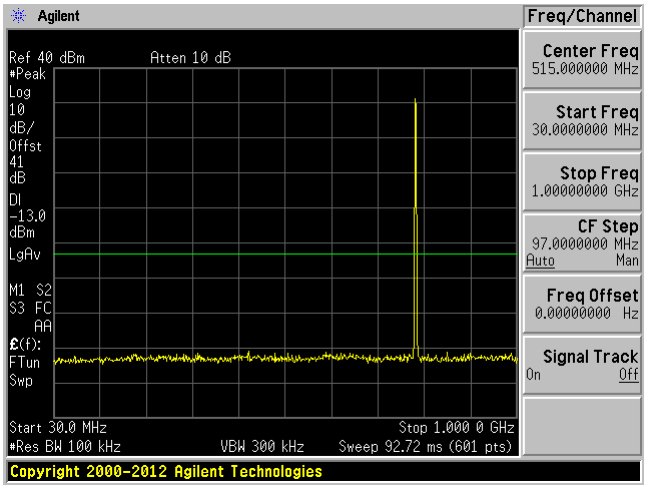
793-805 MHz



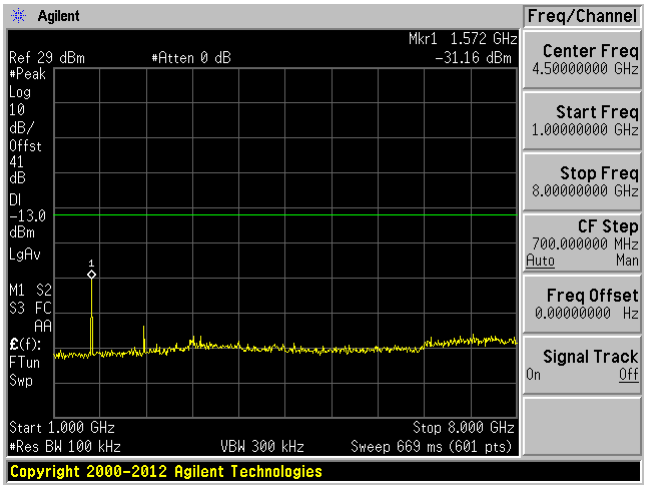
*The limit for on all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations; The limit is -46 dBm/6.25kHz.

High Channel 787.5 MHz

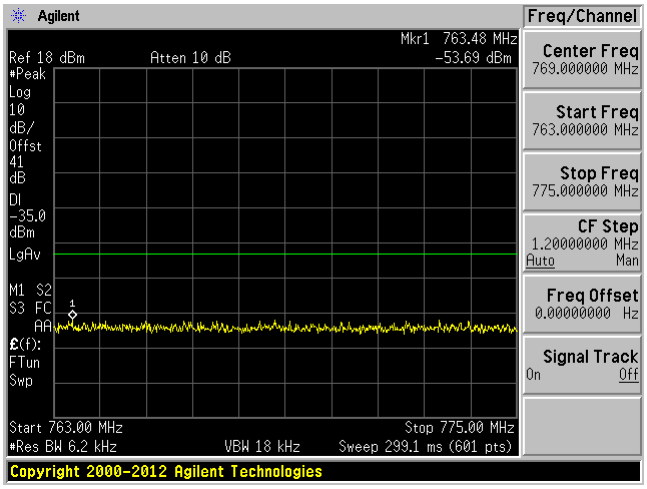
30 MHz – 1GHz



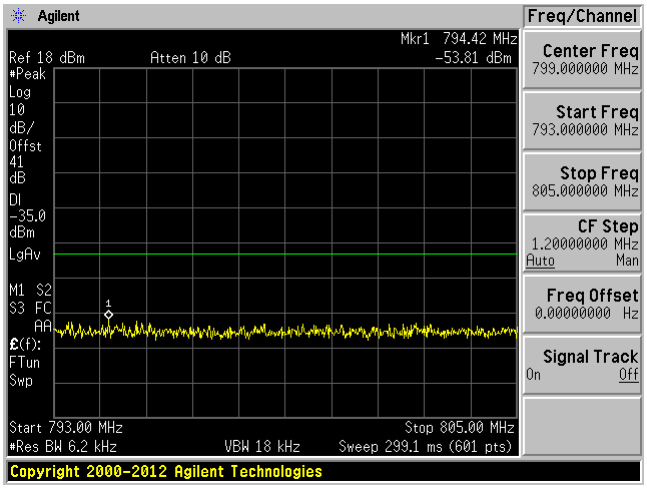
1 GHz – 8 GHz



763-775 MHz



793-805 MHz



* On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations; The limit is -35dBm/6.25 kHz.

9 FCC §27.53 - Band Edge

9.1 Applicable Standards

According to FCC §27.53(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

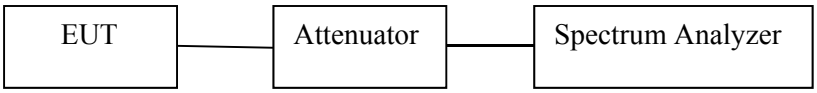
(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

9.2 Test Procedure

The EUT was connected to the spectrum analyzer through sufficient attenuation.

The center frequency of the spectrum analyzer was set to block edge frequency.



9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
-	RF cable	-	-	Each time[1]	N/A
-	40dB attenuator	-	-	Each time[1]	N/A

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

9.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jin Yang 2017-03-03 in the RF Site.

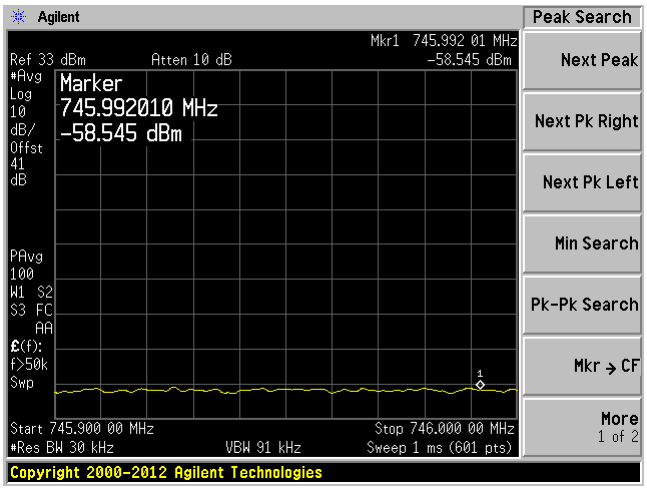
9.5 Test Results

Please refer to the following plots.

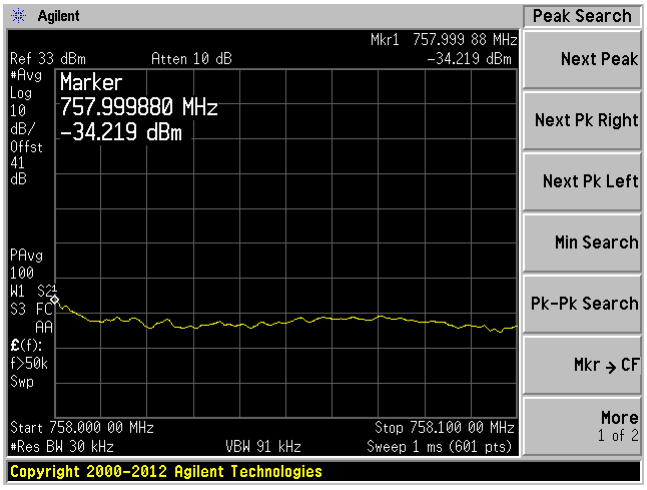
64 QAM

Low Channel 757.5 MHz

Lower Band Edge (746 MHz)

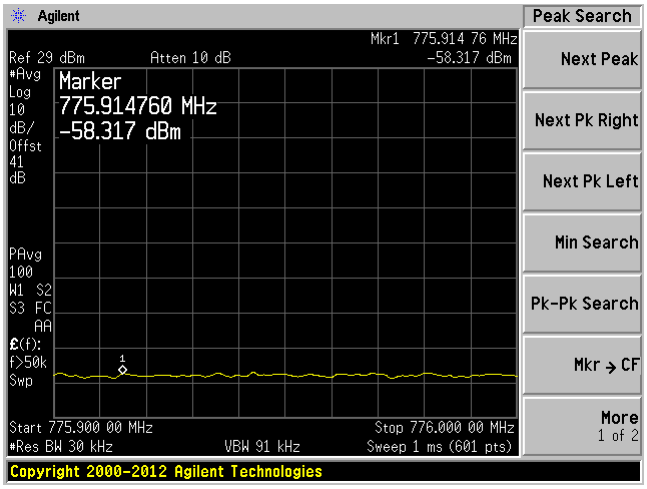


Upper Band Edge (758 MHz)

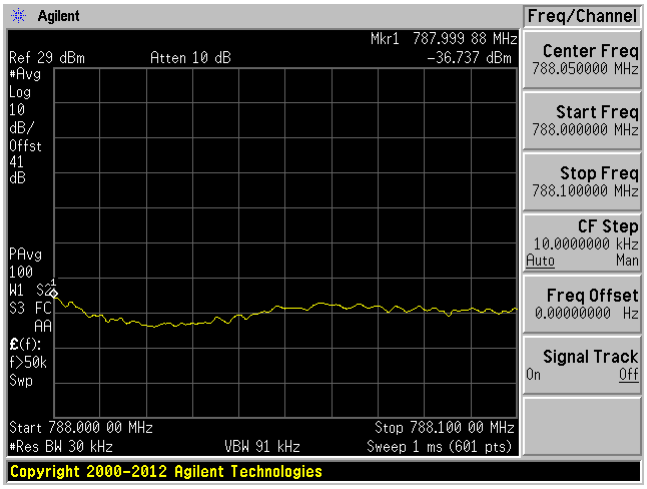


High Channel 787.5 MHz

Lower Band Edge (776 MHz)



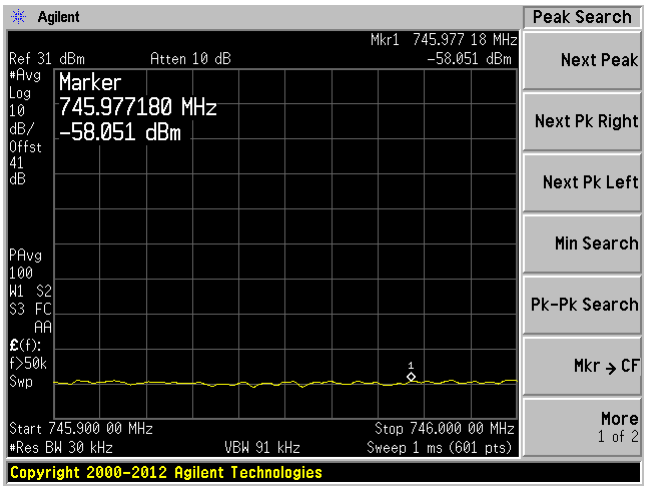
Upper Band Edge (788 MHz)



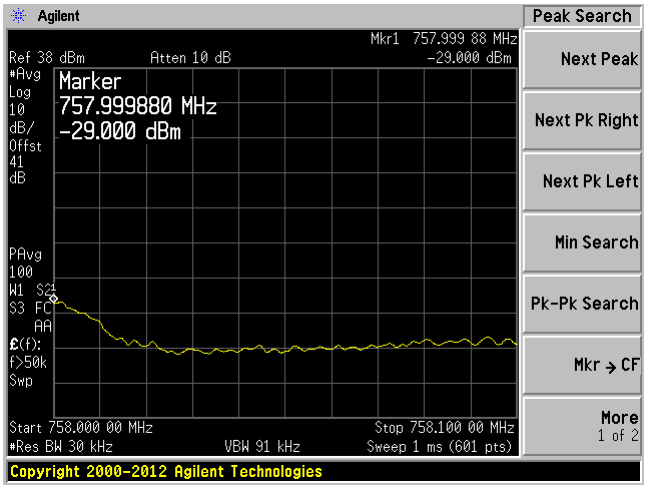
BPSK

Low Channel 757.5 MHz

Lower Band Edge (746 MHz)

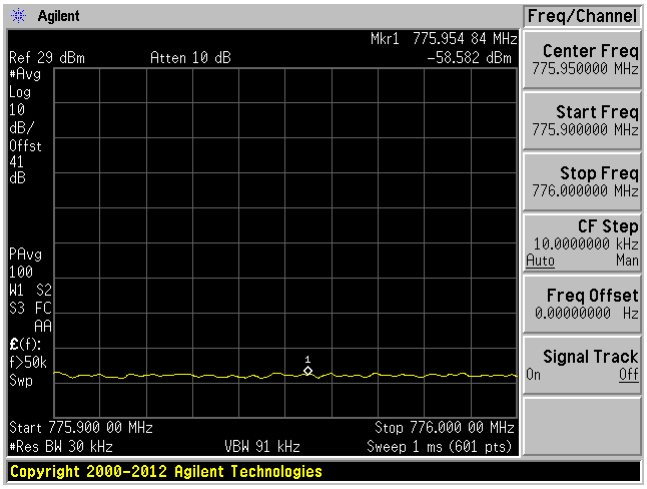


Upper Band Edge (758 MHz)

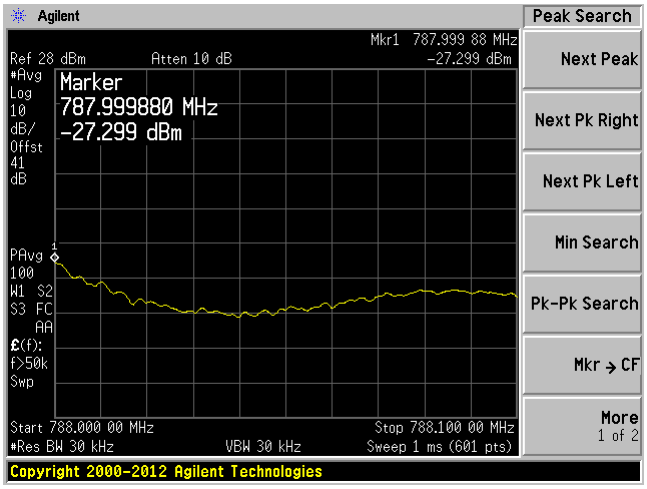


High Channel 787.5 MHz

Lower Band Edge (776 MHz)



Upper Band Edge (788 MHz)



10 FCC §2.1055 & §27. 54 - Frequency Stability

10.1 Applicable Standard

According to FCC §27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

10.2 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 Spectrum Analyzer through attenuator. 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: reduce and increase the primary supply voltage to operating voltage which shall be specified by manufacturer.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 42221851	2016-06-10	1 year
-	RF cable	-	-	Each time[1]	N/A
-	40dB attenuator	-	-	Each time[1]	N/A
Espec	Chamber, Humidity	ESL-4CA	18010	2017-02-24	1 year
KEPCO	Source, DC	25-10M	H1334526	N/A	N/A
Fluke	Multimeter	287	11820006	2016-04-05	1 year

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

10.4 Test Environmental Conditions

Temperature:	20° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Frank Wang on 2017-04-19 in the RF Site.

10.5 Test Results

BPSK

Low Channel (757.5 MHz)				
Temperature (° C)	**Power Supplied (Vdc)**	**Measured Frequency Range (MHz)**	**Authorized Band Range (MHz)**	**Results**
-40	48	757.015-757.985	746 ~ 758	PASS
-30		757.014-757.987		PASS
-20		757.010-757.985		PASS
-10		757.013-757.983		PASS
0		757.010-757.980		PASS
10		757.015-757.979		PASS
20		757.012-757.979		PASS
30		757.011-757.982		PASS
40		757.010-757.980		PASS
50		757.013-757.981		PASS
20	40.8	757.008-757.980		PASS
	55.2	757.012-757.982		PASS

64 QAM

Low Channel (757.5 MHz)				
Temperature (° C)	**Power Supplied (Vdc)**	**Measured Frequency Range (MHz)**	**Authorized Band Range (MHz)**	**Results**
-40	48	757.010-757.989	746 ~ 758	PASS
-30		757.012-757.990		PASS
-20		757.009-757.984		PASS
-10		757.012-757.985		PASS
0		757.010-757.981		PASS
10		757.013-757.979		PASS
20		757.012-757.977		PASS
30		757.011-757.973		PASS
40		757.008-757.975		PASS
50		757.011-757.982		PASS
20	40.8	757.012-757.979		PASS
	55.2	757.010-757.985		PASS

BPSK

High Channel (787.5 MHz)				
Temperature (° C)	**Power Supplied (Vdc)**	**Measured Frequency Range (MHz)**	**Authorized Band Range (MHz)**	**Results**
-40	48	787.017-787.985	776 ~ 788	PASS
-30		787.017-787.980		PASS
-20		787.014-787.990		PASS
-10		787.015-787.985		PASS
0		787.019-787.991		PASS
10		787.020-787.984		PASS
20		787.023-787.978		PASS
30		787.017-787.980		PASS
40		787.015-787.982		PASS
50		787.017-787.979		PASS
20	40.8	787.013-787.989		PASS
	55.2	787.017-787.984		PASS

64 QAM

Low Channel (787.5 MHz)				
Temperature (° C)	**Power Supplied (Vdc)**	**Measured Frequency Range (MHz)**	**Authorized Band Range (MHz)**	**Results**
-40	48	787.010-787.976	776 ~ 788	PASS
-30		787.009-787.970		PASS
-20		787.009-787.968		PASS
-10		787.012-787.976		PASS
0		787.010-787.973		PASS
10		787.013-787.970		PASS
20		787.012-787.975		PASS
30		787.012-787.973		PASS
40		787.008-787.975		PASS
50		787.015-787.981		PASS
20	40.8	787.009-787.980		PASS
	55.2	787.010-787.975		PASS

11 Exhibit A - FCC ID Labeling Requirements

11.1 FCC ID Label Requirements

FCC § 2.925 Identification of equipment

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term *FCC ID* in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID XXX123
Where: XXX—Grantee Code 123—Equipment Product Code

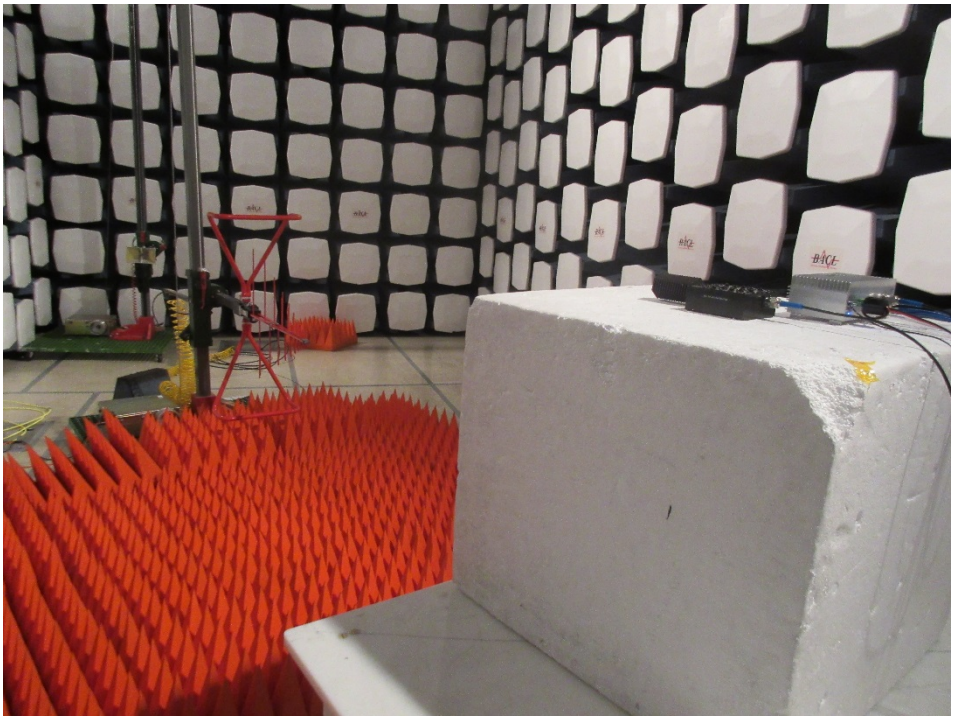
FCC ID: XXX-XXXXXX

11.2 Label Contents and Location

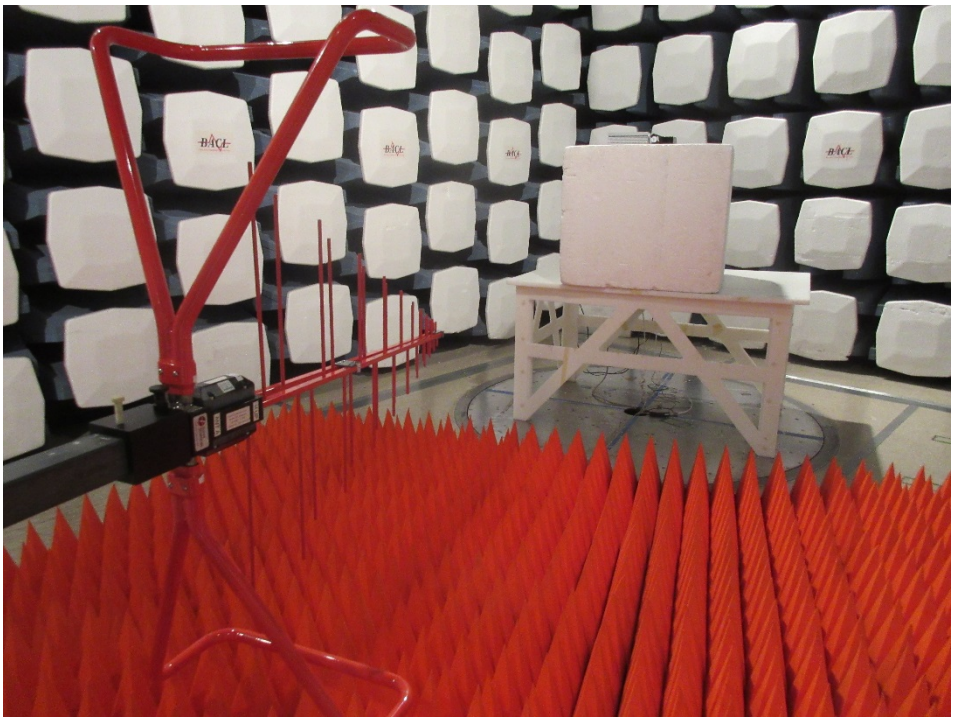
Company Name: Full Spectrum Inc.
Model Name: Cobalt-Plus
FCC ID: X27FS-CP757787

12 Exhibit B - EUT Setup Photographs

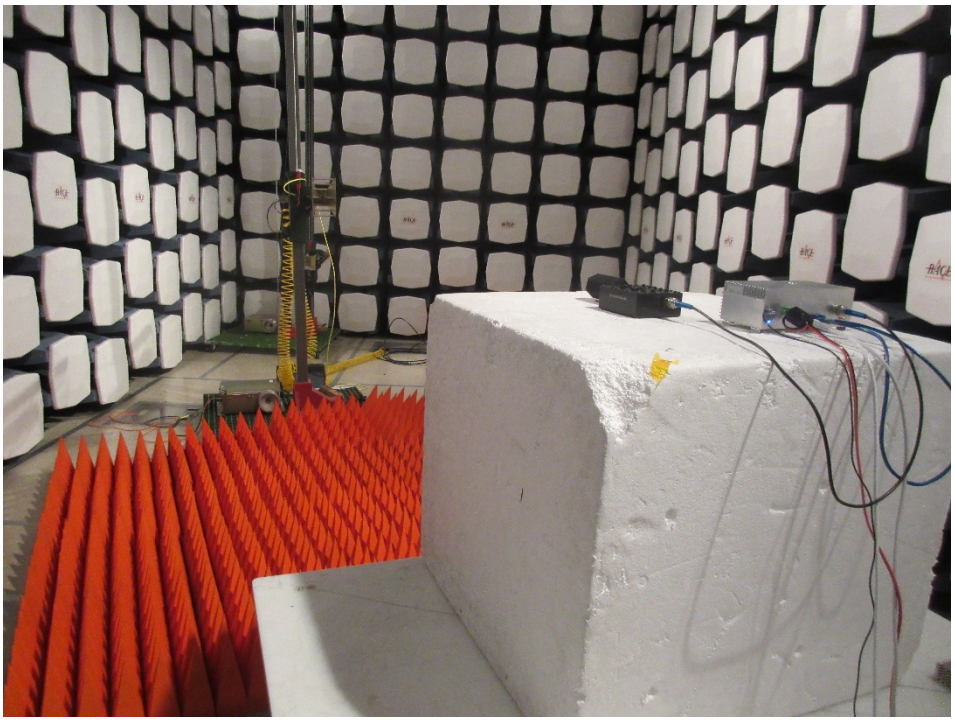
12.1 Radiated Emission below 1 GHz Front View (EUT with Terminator)



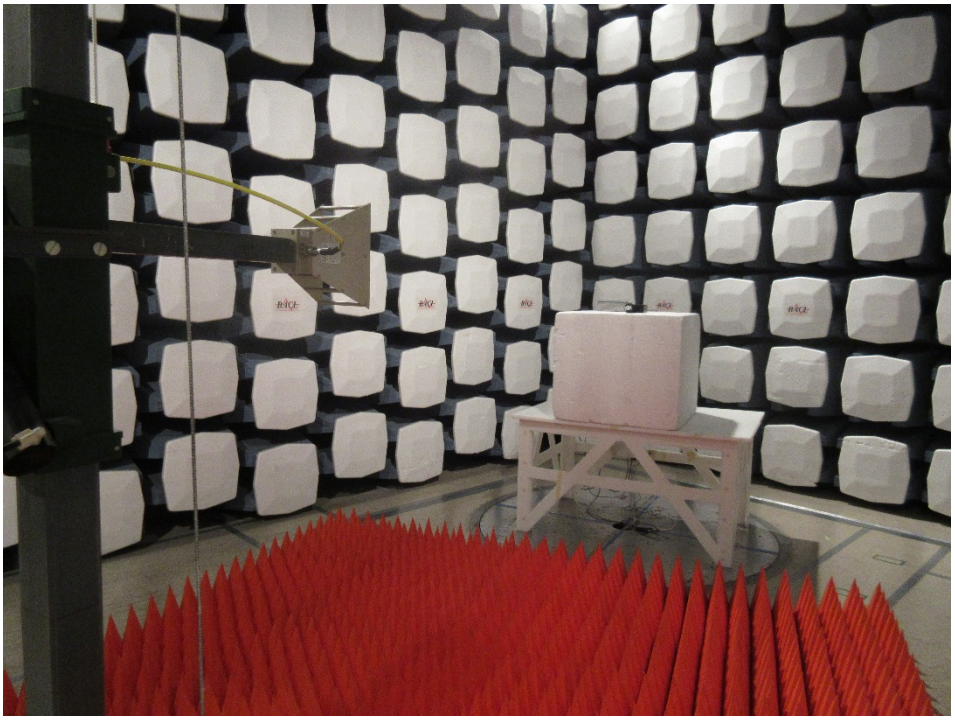
12.2 Radiated Emission below 1 GHz Rear View (EUT with Terminator)



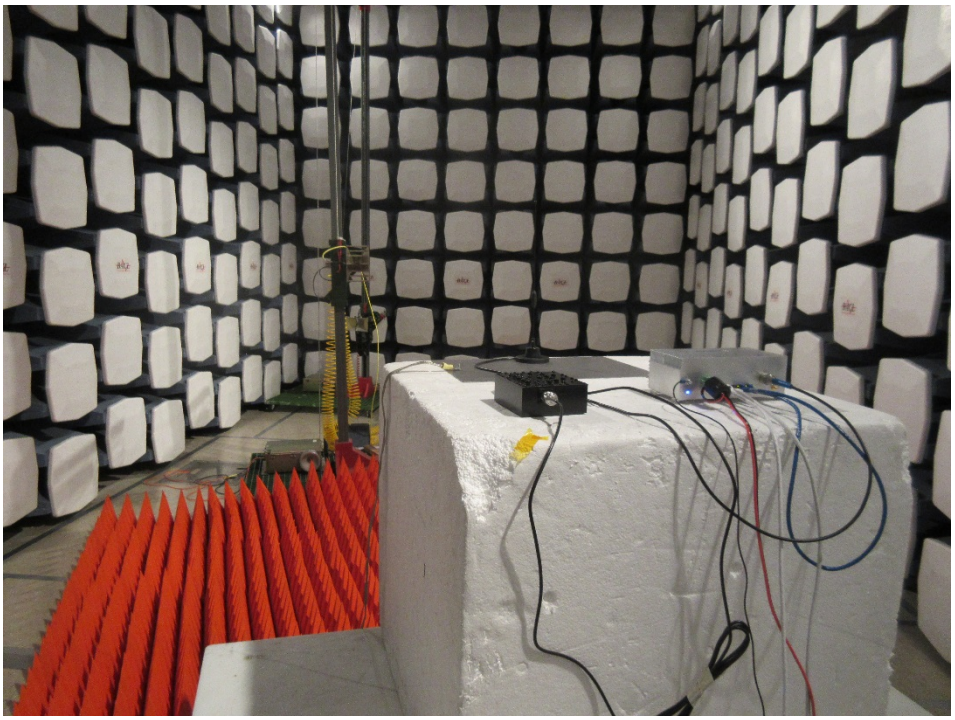
12.3 Radiated Emission above 1 GHz Front View (EUT with Terminator)



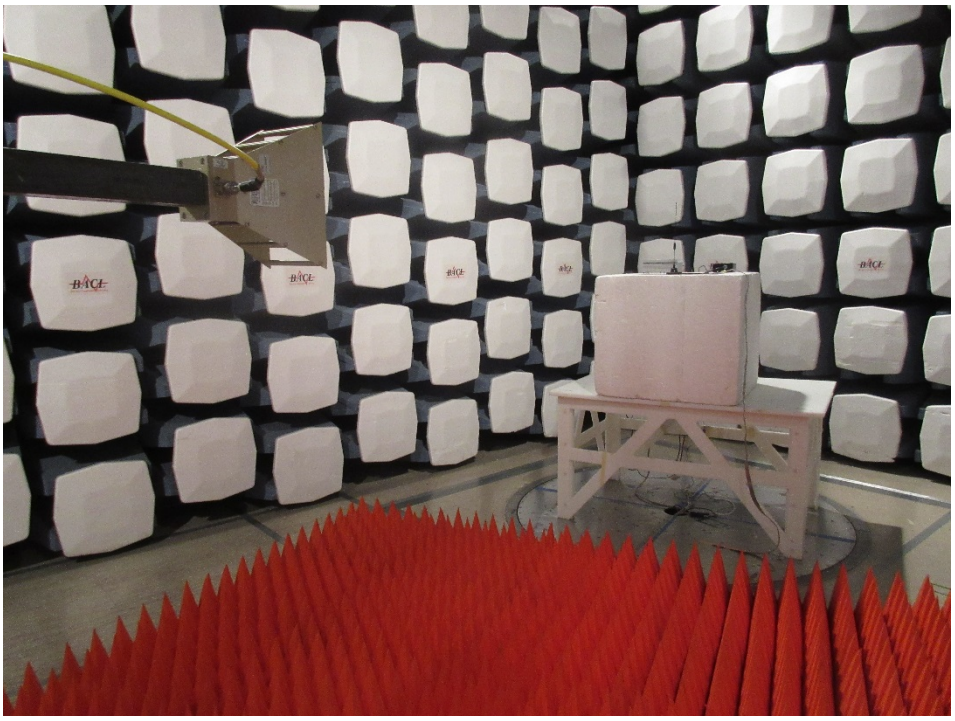
12.4 Radiated Emission above 1 GHz Rear View (EUT with Terminator)



12.5 Radiated Emission above 1 GHz Front View (EUT with Antenna)

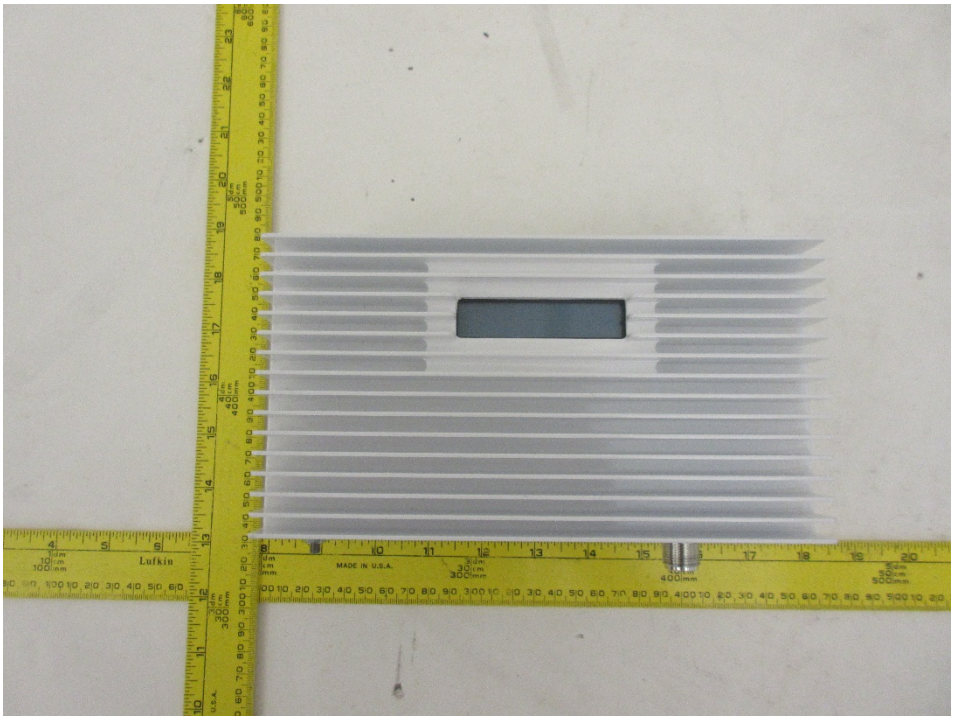


12.6 Radiated Emission above 1 GHz Rear View (EUT with Antenna)

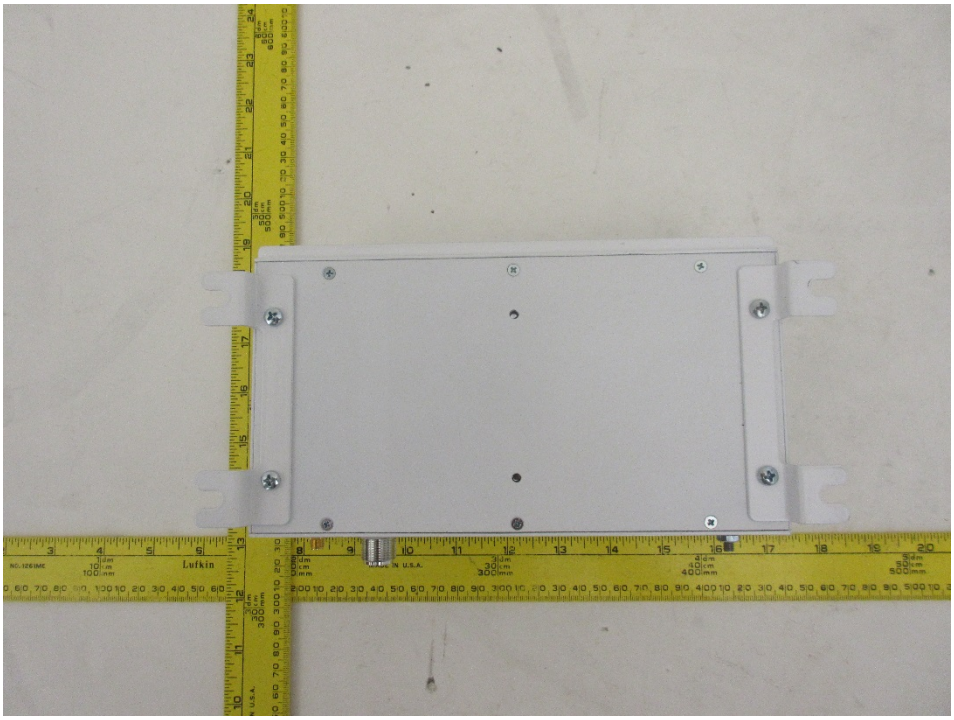


13 Exhibit C – EUT Photographs

13.1 EUT – Top View



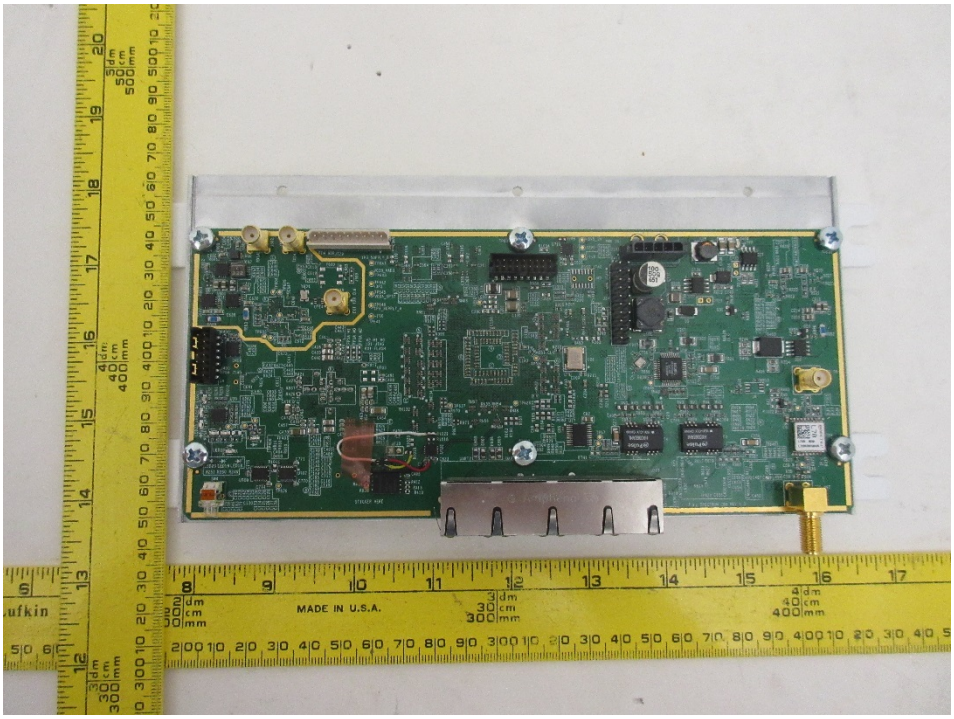
13.2 EUT – Bottom View



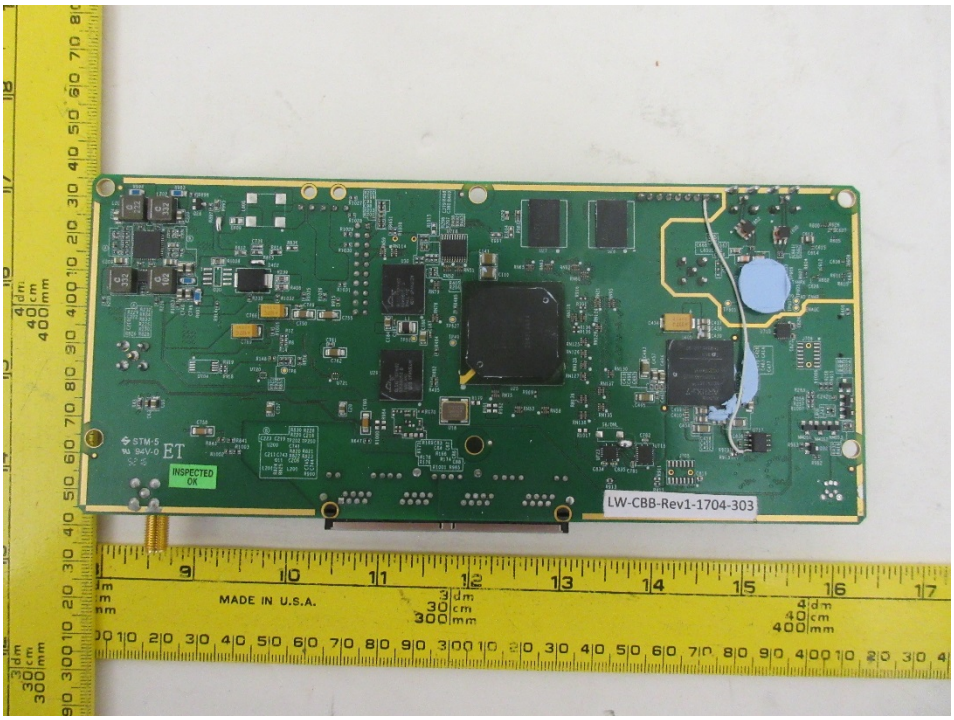
13.3 EUT – Front View

13.4 EUT – Rear View

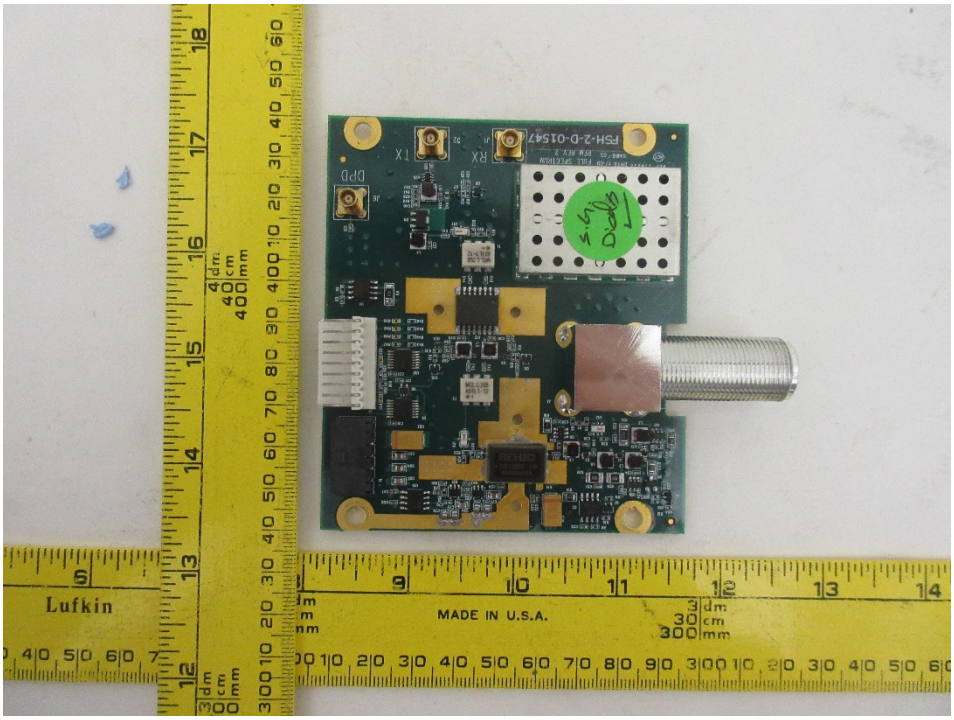
13.5 EUT Main Board – Top View



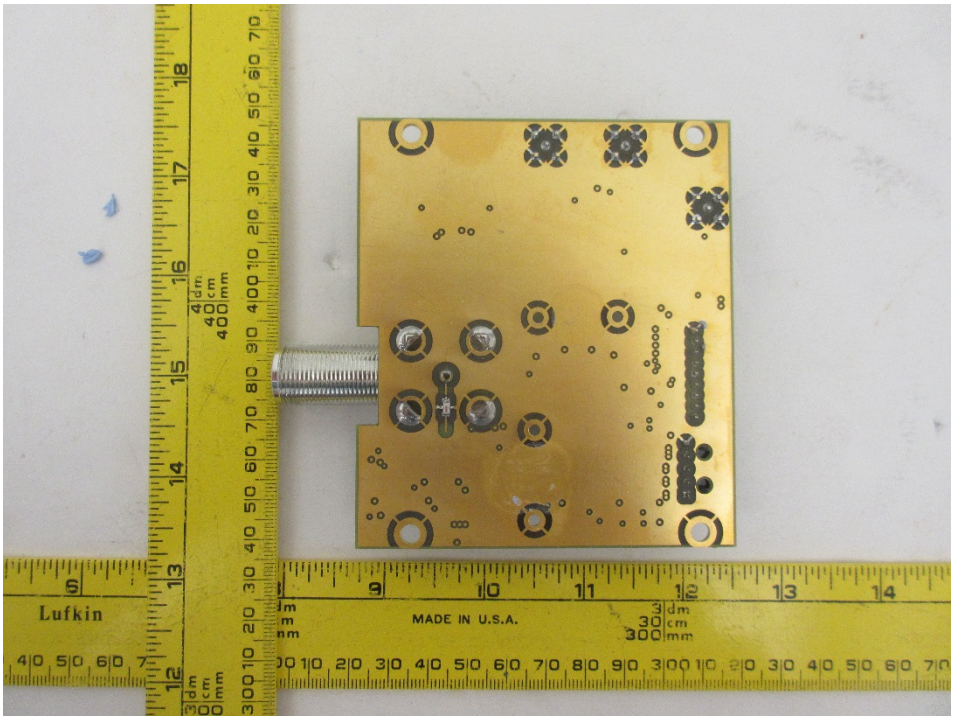
13.6 EUT Main Board – Bottom View



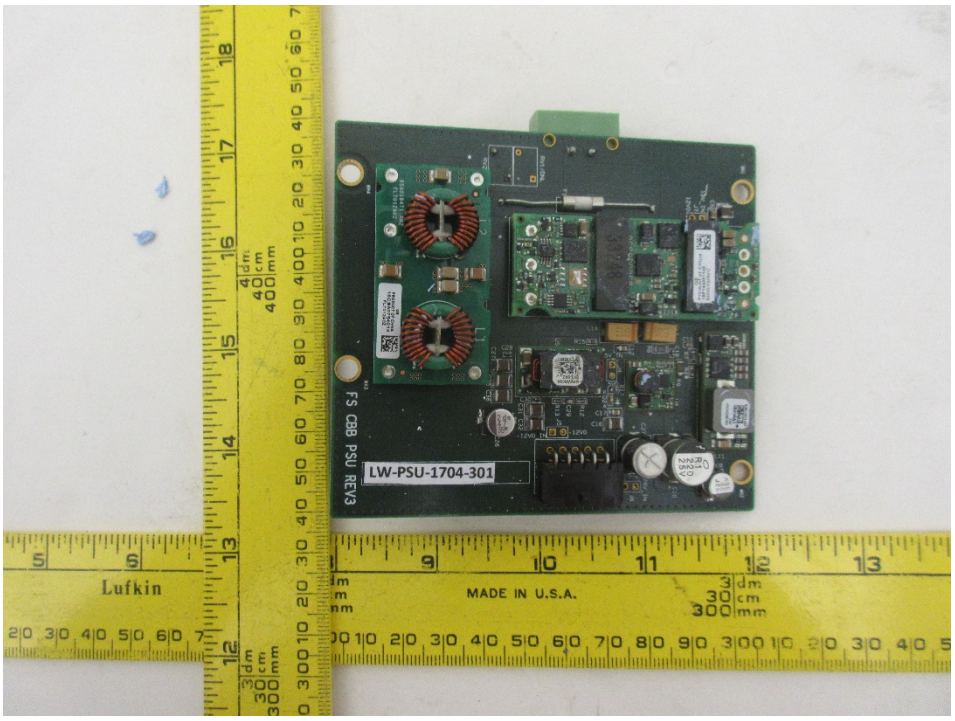
13.7 EUT Support Board 1– Top View



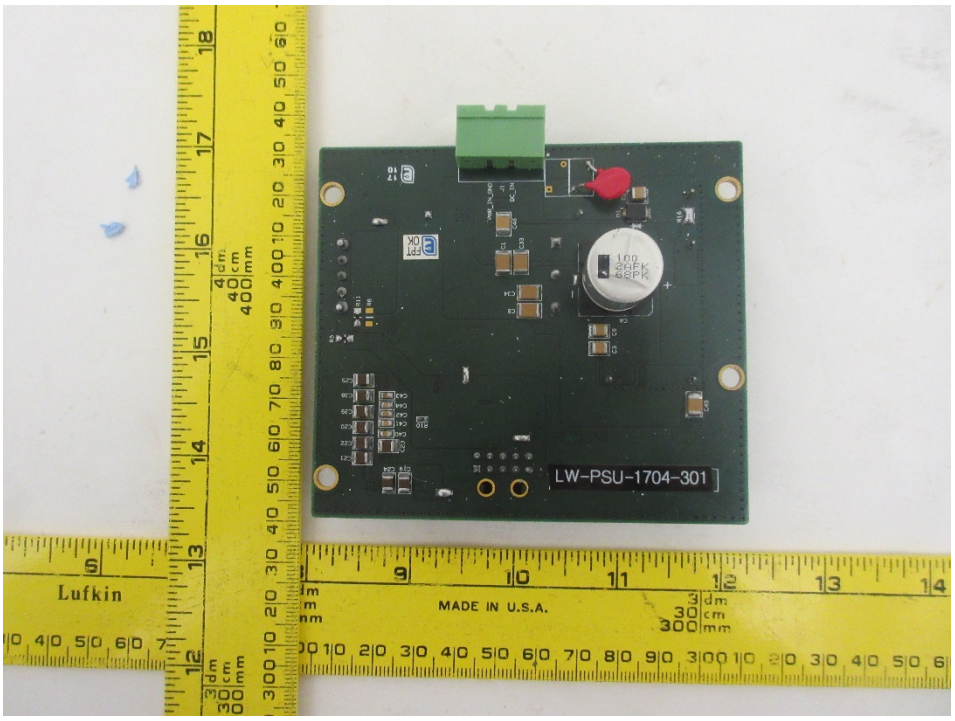
13.8 EUT Support Board 1– Bottom View



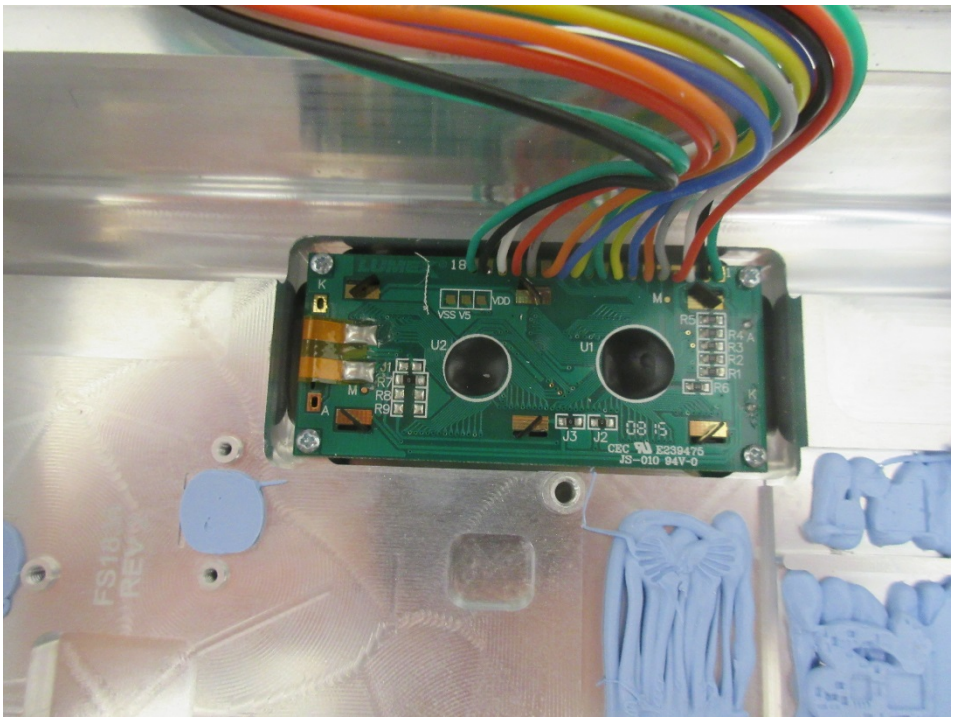
13.9 EUT Support Board 2– Top View



13.10 EUT Support Board 2– Bottom View



13.11 EUT Support Board 3



13.12 Antenna – Used for Radiated Emission Testing

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