FCC PART 24 & 90 TYPE APPROVAL
EMI MEASUREMENT AND TEST REPORT

For

HUNETEC CO., LTD

10 Fl, Hungkook Bldg, 6-7 Sunae-Dong, Bundang-Ku
Kyunggi-Do, South KOREA 463-020

FCC ID: RNGH200RFX

2003-11-20

This Report Concerns:	**Equipment Type:**
☒ Original Report	PCS Private Land Mobile Data Transceiver

Test Engineer:	Ling Zhang
Report No.:	R0310093
Test Date:	2003-11-05, 2003-11-22
Reviewed By:	Ming Jing
Prepared By:	Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Hunetec Co., Ltd's* Model: *H200RFX* or the "EUT" as referred to in this report is a PCS Private Land Mobile Data Transceiver which measured approximately 4.20"L x 2.75"W x 0.60"H.

The EUT operates at 896 – 902 MHz with maximum power of 25.67 dBm.

The EUT was fed by HuneTec AC power adapter, M/N: HR1-TC.

**The test data gathered are from production sample serial number 0003 provided by the manufacturer.*

1.2 Objective

This type approval report is prepared on behalf of *Hunetec Co., Ltd* in accordance with Part 2, Subpart J, Part 24 Subpart D and Part 90 of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for output power, modulation characteristic, occupied bandwidth, spurious emission at antenna terminal, field strength of spurious radiation, frequency stability, and conducted and radiated margin.

1.3 Related Submittal(s)/Grant(s)

No Related Submittals

1.4 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 24D - PCS
Part 90 - Private Land Mobile Radio Service

Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, TIA/EIA-603, ANSI 63.4-2001, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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.

1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation 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 has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2001.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. 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, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167.

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing in a typical fashion (as normally used in a typical application).

The final qualification test was performed with the EUT operating at normal mode.

2.2 Block Diagram

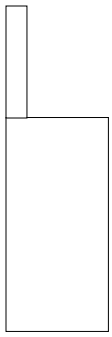
Please refer to Exhibit D.

2.3 Equipment Modifications

No modifications were necessary for the EUT to comply with the applicable limits and requirements.

2.4 Test Setup Block Diagram

The EUT is a standalone device.



EUT

3 - SUMMARY OF TEST RESULTS

3.1 Frequency Available

According to Part24D, the following frequency bands are available for narrowband PCS:
901 – 902 MHz
930 – 931 MHz
940 – 940 MHz

According to Part90S, the following frequency bands are available for private land mobile radio services:
806 – 824 MHz
851 – 869 MHz
896 – 901 MHz
935 – 940 MHz

3.2 Summary of test results

FCC RULE	DESCRIPTION OF TEST	RESULT
§ 2.1046 § 24.132 § 90.205	RF power output	Compliant
§ 2.1046 § 90.205 § 90.635	Conducted Output Power	Compliant
§ 2.1047	Modulation Characteristics	Compliant
§ 2.1049 § 24.131 § 90.210	Emission, Occupied Bandwidth	Compliant
§ 2.1051 § 24.133 § 90.210	Spurious emissions at antenna terminals	Compliant
§ 2.1053 § 24.133 § 90.210	Field strength of spurious radiation	Compliant
§ 2.1055 § 24.135 § 90.213	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant

3.3 Label Requirement

Each equipment for which a type acceptance applications is filed on or after May 1, 1981, shall bear an identification plate of label pursauant to § 2.295 (Identification of Equipment) and § 2.926 (FCC identifier).

4 - RF POWER OUTPUT

4.1 Applicable Standard

§2.1046
§24.132(b): <7Watts erp
§90.205: Power dependent upon station's antenna HAAT and required service area and may be from 1 to 500 watts.

4.2 Test Procedure

1. The EUT was placed at 1.5m height turnaround table and in a position for normal use declared by the manufacturer.
2. The test antenna was oriented initially for vertical position with 3m away from EUT.
3. The output of the antenna was connected to the measuring receiver and the quasi-peak detector is used for the measurement.
4. The transmitter was turned on and the measuring receiver was tuned to the frequency of the transmitter under the testing.
5. The test antenna was raised and lowered through specified ranged of height until the maximum signal level was detected by the measuring receiver.
6. The transmitter was rotated through 360˚ in the horizontal plane until the maximum signal level was detected.
7. The transmitter was then replaced by a dipole which is a substitution antenna.
8. The substitution antenna was oriented for vertical polarization and then connected to a calibrated signal generator.
9. The input attenuator of measuring receiver was adjusted to increased the sensitivity.
10. The substitution antenna was raised and lowered to ensure the maximum signal level was detected.
11. The input signal to the substitution antenna was adjusted to the level to produce a level which was equal to the level noted while the transmitter radiated power was measured, corrected for the change of the input attenuator of the measuring receiver.
12. The input level to the substitution antenna was recorded as power level in dBm, corrected for any change of input attenuator of the measuring receiver.
13. The measurement was repeated with the test antenna and the substitution antenna oriented for horizontal polarization.
14. The measure of the radiated output power is the larger one of the two level recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

4.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
EMCO	Biconical Antennas	3110B	9603-2315	2003-10-11
EMCO	Log-Periodic Antenna	3148	0004-1155	2003-10-11
A.H. System	Horn Antenna	SAS-200/571	2455-261	2003-08-02
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Rohde & Schwarz	Signal Generator	SMIQ03	DE237467	2003-07-03

*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

4.4 Test Results

Channel	Output Power in dBm	Output Power in W
896	24.8	0.302
901	25.4	0.347
902	25.2	0.331

Note: The power output may depend on the intended use of the EUT. For all tests, the EUT was set to maximum conditions.

5 - MODULATION CHARACTERISTIC

5.1 Applicable Standard

§2.1047: A curve of equipment data which shows that the equipment will meet the modulation requirement.

5.2 Test Procedure

Test Method: TIA/EIA-603 2.2.3

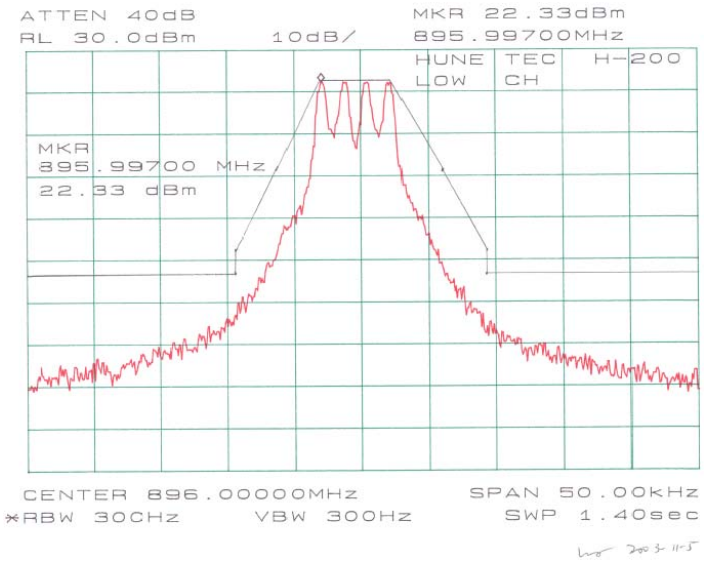
5.3 Test Equipment

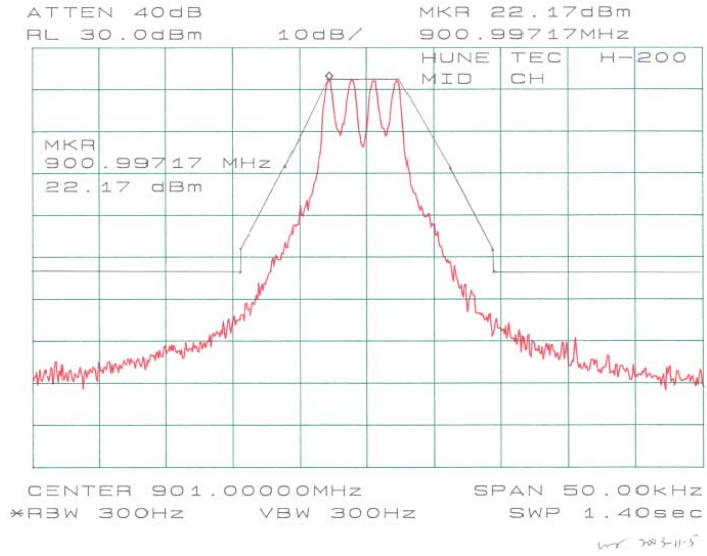
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Hewlett Packard	Modulation Analyzer	8901A	2026A00847	2003-08-09

*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

5.4 Test Results

Please refer to the hereinafter plots.


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 22.33dBm
895.99700MHz
HUNE TEC H-200
LOW CH
MKR
895.99700 MHz
22.33 dBm
CENTER 896.00000MHz
SPAN 50.00kHz
*RBW 30CHz
VBW 300Hz
SWP 1.40sec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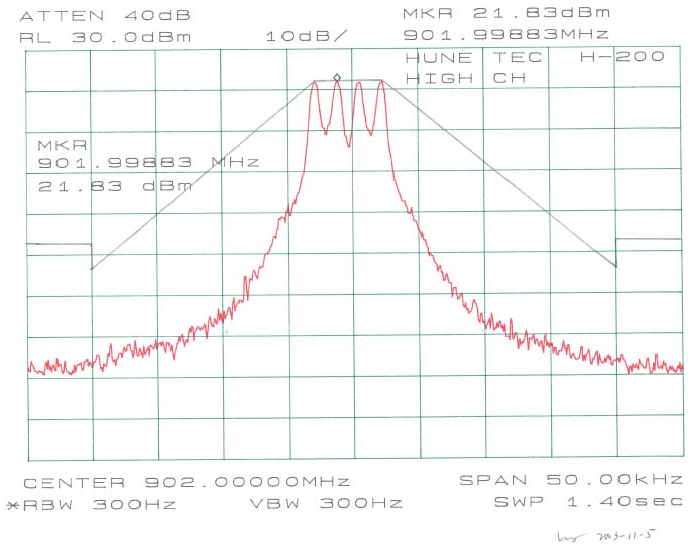
RL 30.0dBm
10dB/
MKR 22.17dBm
900.99717MHz
HUNE TEC H-200
MID CH
MKR
900.99717 MHz
22.17 dBm
CENTER 901.00000MHz
SPAN 50.00kHz
*RBW 300Hz
VBW 300Hz
SWP 1.40sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 21.83dBm
901.99883MHz
HUNE TEC H-200
HIGH CH
MKR
901.99883 MHz
21.83 dBm
CENTER 902.00000MHz
SPAN 50.00kHz
*RBW 300Hz
VBW 300Hz
SWP 1.40sec

6 - OCCUPIED BANDWIDTH

6.1 Applicable Standard

§2.1049, §24.131 and §90.209

According to §24.131, the authorized bandwidth of narrowband PCS channels will be 10KHz for 12.5KHz channels.

According to §90.209(b)(5), the authorized bandwidth will be 13.6KHz for 12.5 Channel spacing PLMR operating within the band 896 – 901 MHz / 935 –940 MHz.

6.2 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 30 KHz and the spectrum was recorded in the frequency band ±50 KHz from the carrier frequency.

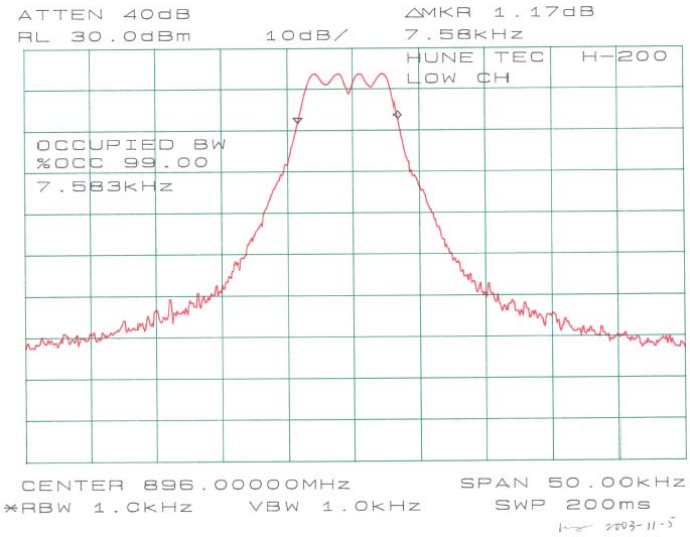
6.3 Test Equipment

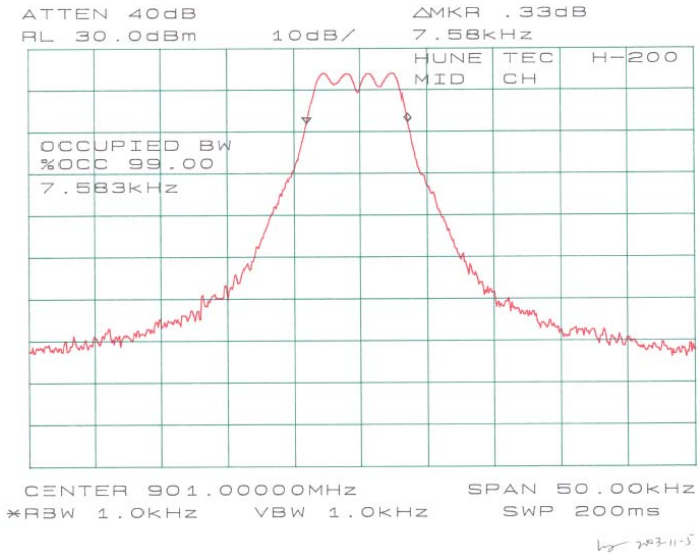
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Hewlett Packard	Plotter	HP7470A	N/A	N/A
NAAYAN	Audio Generator	NY2201	00042	N/A

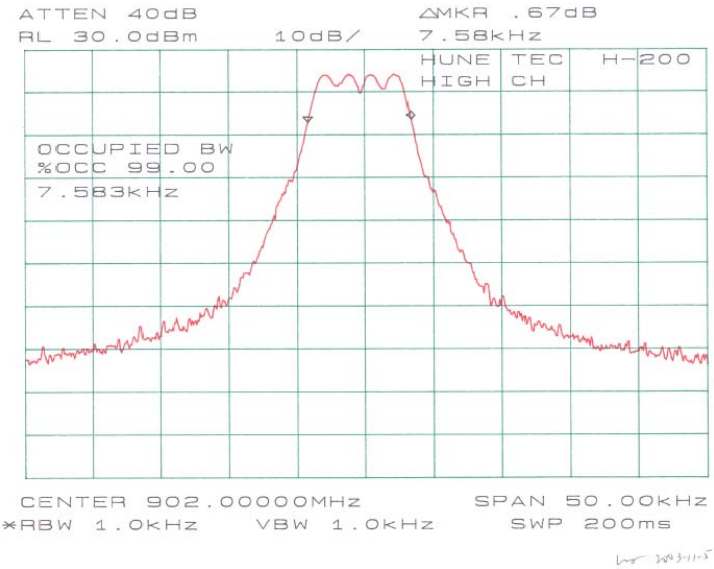
*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

6.4 Test Results

Please refer to the hereinafter plots.


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR 1.17dB
7.58kHz
HUNE TEC H-200
LOW CH
OCCUPIED BW
%OCC 99.00
7.583kHz
CENTER 896.00000MHz
SPAN 50.00kHz
*RBW 1.0kHz
VBW 1.0kHz
SWP 200ms
2003-11-5


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR .33dB
7.58kHz
HUNE TEC H-200
MID CH
OCCUPIED BW
%OCC 99.00
7.583kHz
CENTER 901.00000MHz
SPAN 50.00kHz
*RBW 1.0kHz
VBW 1.0kHz
SWP 200ms
2003-11-5


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR .67dB
7.58kHz
HUNE TEC H-200
HIGH CH
OCCUPIED BW
%OCC 99.00
7.583kHz
CENTER 902.00000MHz
SPAN 50.00kHz
*RBW 1.0kHz
VBW 1.0kHz
SWP 200ms
2003-11-5

7 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

7.1 Applicable Standard

§2.1051, §24.139 and §90.210

Measurement shall be made to detect spurious emission.

7.2 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 10^{th} harmonic.

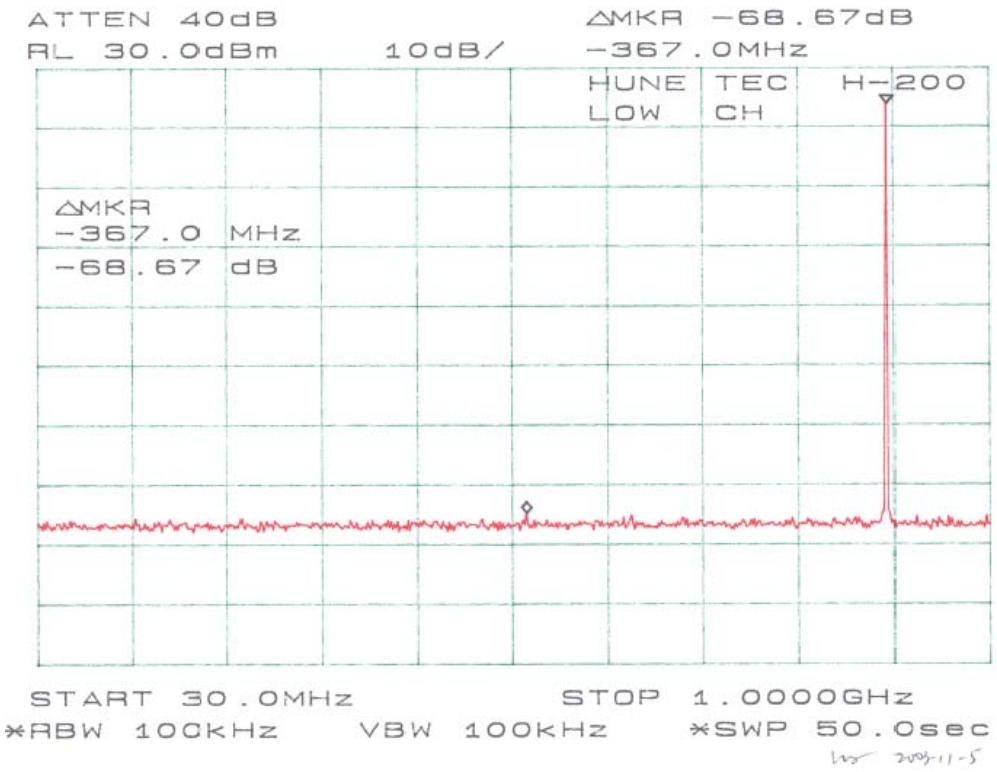
7.3 Test Equipment

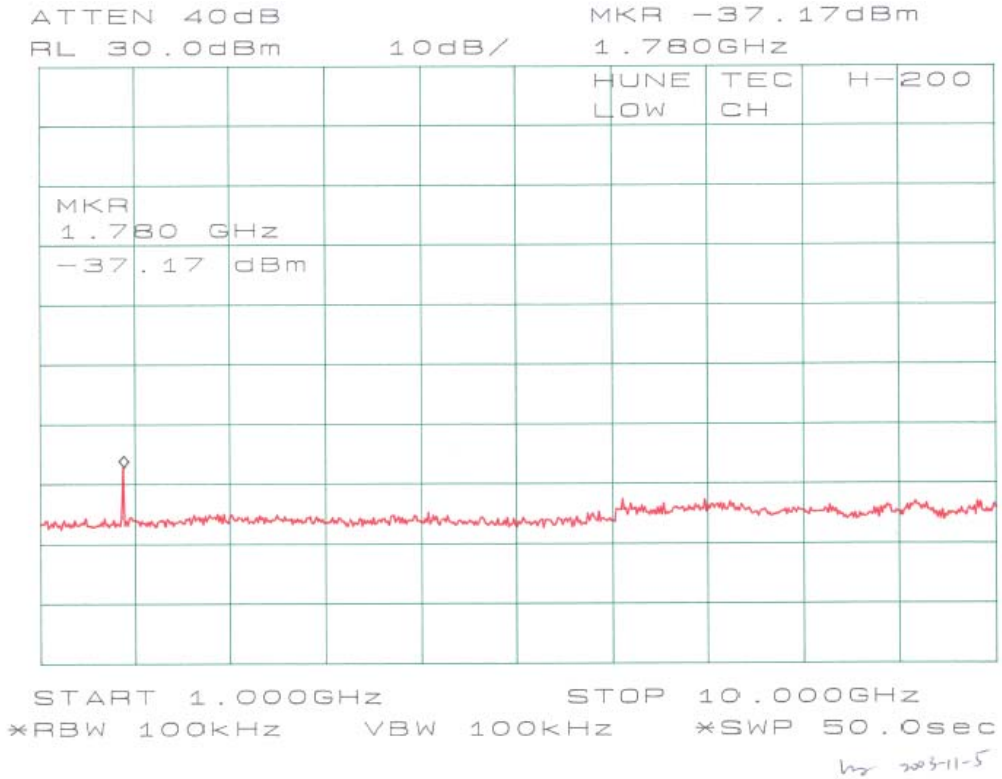
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30

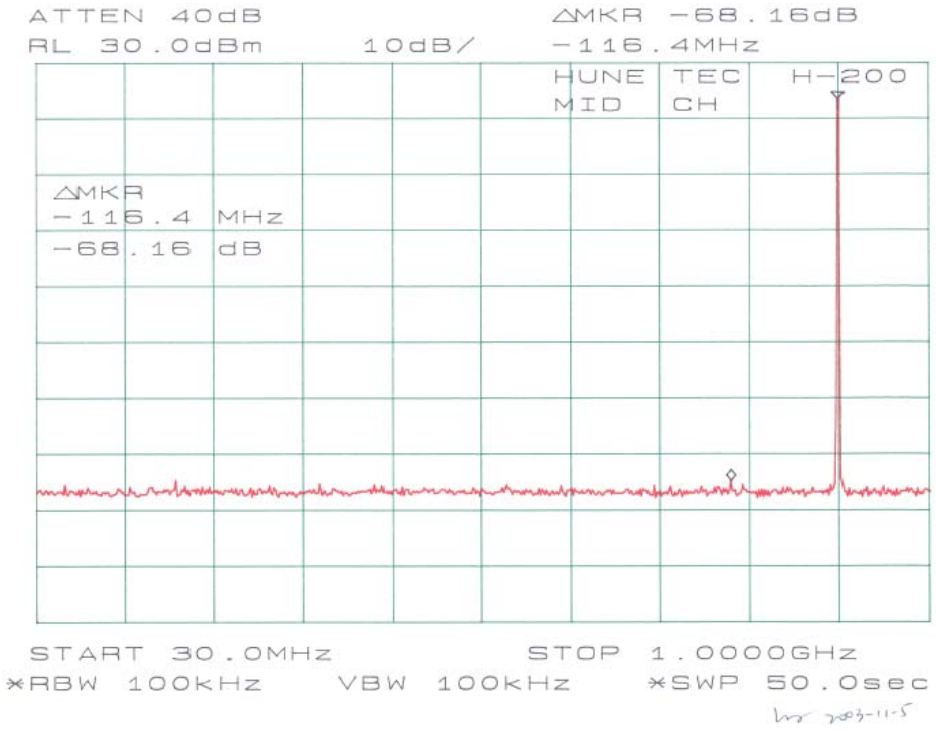
*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

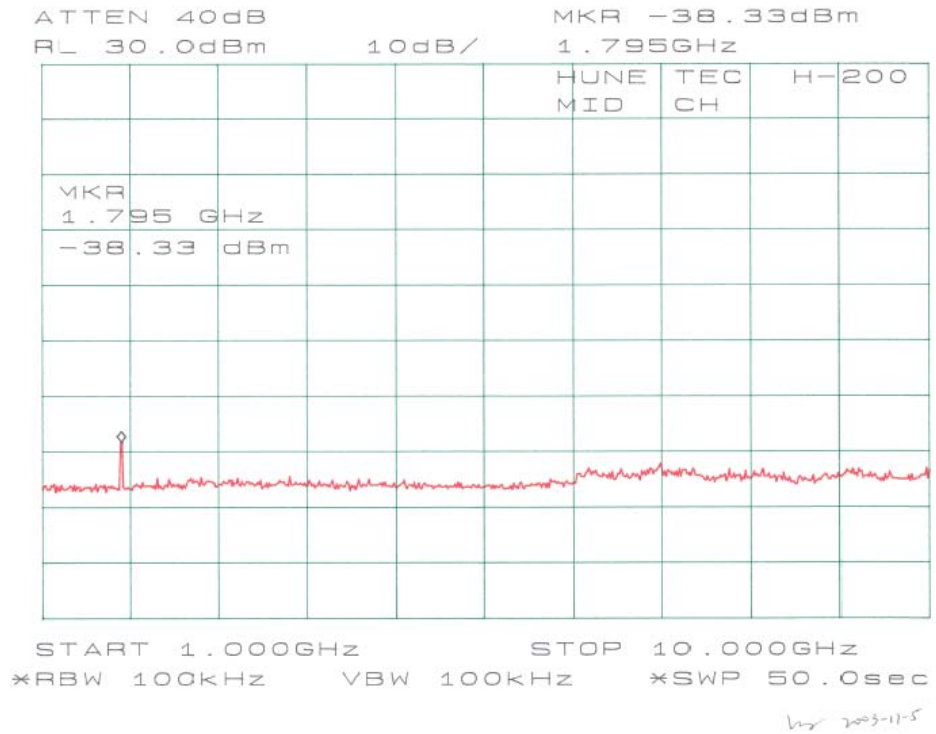
7.4 Test Results

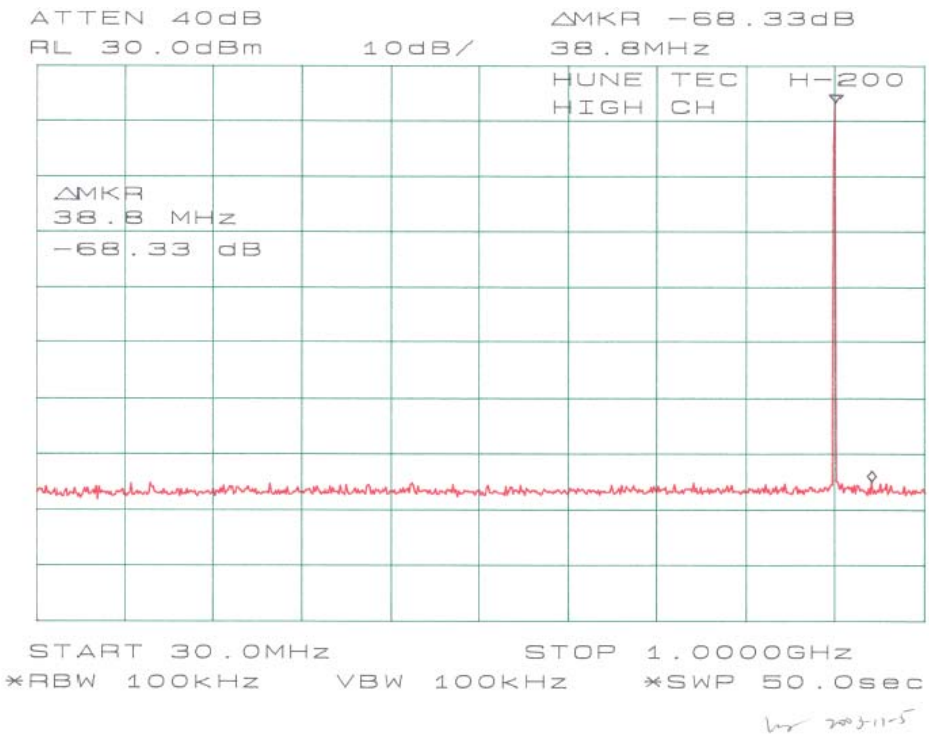
Please refer to the hereinafter plots.


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -68.67dB
-367.0MHz
HUNE TEC H-200
LOW CH
ΔMKR
-367.0 MHz
-68.67 dB
START 30.0MHz
STOP 1.0000GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0sec
2003-11-5

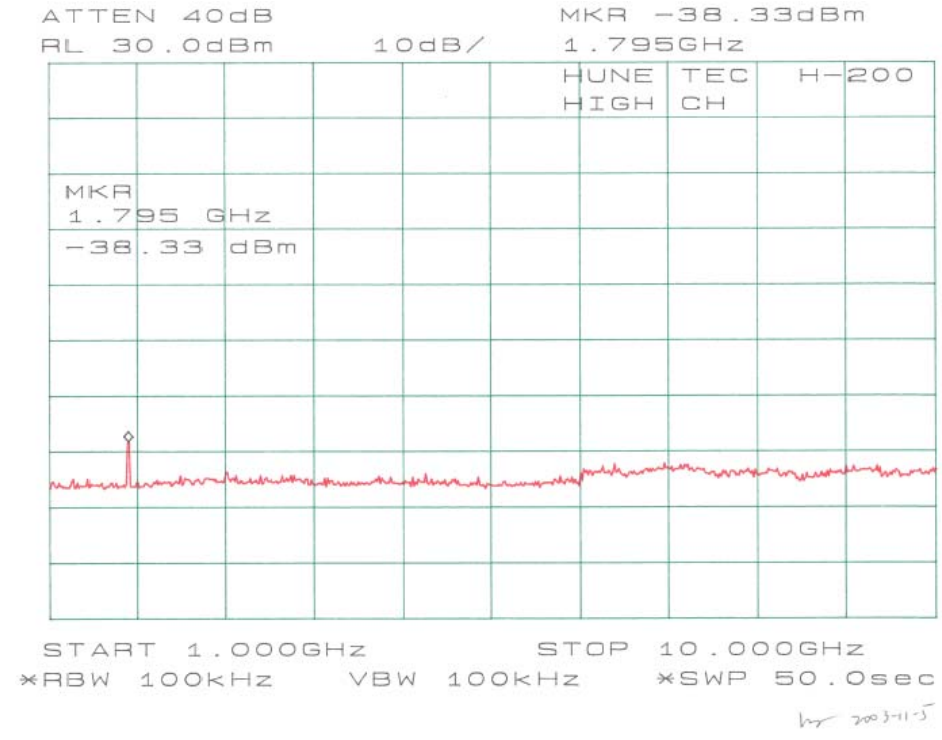

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -37.17dBm
1.780GHz
HUNE TEC H-200
LOW CH
MKR
1.780 GHz
-37.17 dBm
START 1.000GHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0sec
2003-11-5


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -68.16dB
-116.4MHz
HUNE TEC H-200
MID CH
ΔMKR
-116.4 MHz
-68.16 dB
START 30.0MHz
STOP 1.0000GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0sec
2003-11-5


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.33dBm
1.795GHz
HUNE TEC H-200
MID CH
MKR
1.795 GHz
-38.33 dBm
START 1.000GHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0sec
2003-11-5



2003-11-5



2003-11-5

8 - RADIATED SPURIOUS EMISSION

8.1 Applicable Standard

§2.1053, §24.133 and §90.210, measurements shall be made to detect spurious emission that may be radiated directly from the cabinet, control circuits, power leads, or intermediated circuit elements under normal condition of installation and operation. Information submitted shall include the relative radiated power of spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from a halfwave dipole antenna.

8.2 Test Procedure

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

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

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

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

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

8.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
EMCO	Biconical Antennas	3110B	9603-2315	2003-10-11
EMCO	Log-Periodic Antenna	3148	0004-1155	2003-10-11
A.H. System	Horn Antenna	SAS-200/571	2455-261	2003-08-02
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Rohde & Schwarz	Signal Generator	SMIQ03	DE237467	2003-07-03

*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

8.4 Test Result

Low Frequency: -10.3 at 2688MHz
Mid Frequency: -11.9dB at 2703MHz
High Frequency: -10.9dB at 2706MHz

EUT					Generator						Standard	
Indicated		Table	Test Antenna		Substitution			Antenna	Cable	Absolute	FCC	FCC
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Polar H/V	Gain Corrected	Loss dBm	Level dB	Limit dBm	Margin DBm
Low Channel												
896	88.00	0	1.6	v	896	17.2	v	6.3	0.1	23.4		
896	89.50	60	1.7	h	896	18.6	h	6.3	0.1	24.8		
2688	41.83	180	2.5	v	2688	-32.5	v	9.9	0.7	-23.3	-13	-10.3
2688	40.50	60	1.6	h	2688	-33.9	h	9.9	0.7	-24.7	-13	-11.7
1792	38.33	60	1.8	h	1792	-35.0	h	8.3	0.5	-27.2	-13	-14.2
1792	38.17	200	2.0	v	1792	-35.2	v	8.3	0.5	-27.4	-13	-14.4
3584	36.33	200	2.2	h	3584	-38.1	h	10.8	0.7	-28.0	-13	-15.0
3584	35.67	90	2.0	v	3584	-39.2	v	10.8	0.7	-29.1	-13	-16.1
MIDDLE CHANNEL												
901	88.83	180	1.7	v	901	17.9	v	6.3	0.1	24.1		
901	90.50	270	1.8	h	901	19.2	h	6.3	0.1	25.4		
2703	40.33	30	2.2	v	2703	-34.1	v	9.9	0.7	-24.9	-13	-11.9
2703	39.50	330	1.8	h	2703	-34.8	h	9.9	0.7	-25.6	-13	-12.6
3604	37.33	270	2.2	h	3604	-36.9	h	10.8	0.5	-26.6	-13	-13.6
3604	36.37	180	2.5	v	3604	-37.8	v	10.8	0.5	-27.5	-13	-14.5
1802	37.83	150	1.7	h	1802	-36.0	h	8.3	0.5	-28.2	-13	-15.2
1802	37.50	90	1.7	v	1802	-36.3	v	8.3	0.5	-28.5	-13	-15.5
HIGH CHANNEL												
902	87.00	330	2.0	v	902	16.3	v	6.3	0.1	22.5		
902	90.20	90	1.7	h	902	19.0	h	6.3	0.1	25.2		
2706	40.33	220	1.8	v	2706	-33.1	v	9.9	0.7	-23.9	-13	-10.9
2706	40.00	180	2.0	h	2706	-33.3	h	9.9	0.7	-24.1	-13	-11.1
3608	37.17	90	1.8	v	3608	-37.2	v	10.8	0.5	-26.9	-13	-13.9
1804	38.17	90	1.8	v	1804	-35.2	v	8.3	0.5	-27.4	-13	-14.4
3608	36.67	180	2.2	h	3608	-37.7	h	10.8	0.5	-27.4	-13	-14.4
1804	37.83	60	1.7	h	1804	-36.8	h	8.3	0.5	-29	-13	-16.0

9 - FREQUENCY STABILITY

9.1 Applicable Standard

Requirements: FCC § 2.1055 (a), § 2.1055 (d), § 24.135 and §90.213.

According to FCC §2.1055(a)(1), the frequency stability shall be measure with variation of ambient temperature from –30ºC to +50ºC, and according to FCC 2.1055(d)(2), the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point which is specified by the manufacturer. According to FCC §24.135, the frequency stability shall be within +-1ppm. According to FCC §90.213, the minimum frequency stability for this device is 1.5ppm.

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 a frequency counter 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 counter.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the battery terminals of the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the battery end point. The output frequency was recorded for each battery voltage.

9.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Tenney	Temperature Chamber -50^0 to $+100^0$C	Versa	12.222-193	2003-04-23
Agilent	DRG Spectrum Analyzer	8565EC	3946A00131	2003-06-30

*** Statement of Traceability: BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

9.4 Test Results

Reference Frequency: 901 MHz, Limit: 1.5 ppm		
Environment Temperature	Frequency Measure with Time Elapsed	
(°C)	MCF (MHz)	PPM Error
50	901.0004	0.44
40	901.0002	0.22
30	901.0001	0.11
20	901.0001	0.11
10	901.0001	0.11
0	900.9999	-0.11
-10	900.9998	-0.22
-20	900.9998	-0.22

Frequency Stability Versus Input Voltage

Reference Frequency: 901 MHz, Limit: 1.5 ppm		
Power Supplied (Vdc)	MHz	ppm
3.6	901.0001	0.11

Battery End Point: 3.6V