FCC Part 24E
Transmitter Certification

Test Report

FCC ID: DNY020MPAD

FCC Rule Part: CFR 47 Part 24 Subpart E

ACS Report Number: 07-0090-24E

Manufacturer: EMS Wireless
Equipment Type: PCS Bi-Directional Repeater
Tradename: MirrorCell® II
Model: 020MPAD

Test Begin Date: April 23, 2007
Test End Date: April 27, 2007

Report Issue Date: April 30, 2007

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

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This report contains **24** pages

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1.0 GENERAL

1.1 Purpose
The purpose of this report is to demonstrate compliance with Part 2 Subpart J and Part 24 Subpart E of the FCC's Code of Federal Regulations.

1.2 Product Description

1.2.1 General
The MirrorCell® II model 020MPAD is a RF repeater utilizing the Part 24 Subpart E PCS frequency band and is used improve or increase signal strength in areas such as highways, tunnels, larger indoor applications and problem terrain situations such as mountains, valleys and buildings This fully featured repeater is designed primarily for large outdoor use (several miles radius of coverage, depending on terrain), or for indoor use with medium sized buildings (100,000 to 200,000+ square feet [10,000 to 20,000 square meters]). The repeater is contained in a weatherproof outdoor NEMA 4 enclosure. It may be used as a simple and inexpensive alternative to a base station (BTS).

For indoor applications, the MirrorCell II makes great economic sense for buildings that are too large for the other repeaters, but too small to justify a fiber optic DAS (Distributed Antenna System). One MirrorCell II can cover most typical buildings up to approximately 200,000 square feet using ½" coax and several power dividers feeding approximately eight indoor server antennas.

Manufacturer Information:
EMS Wireless
2805 Colonnades Court, NW
Norcross, GA 30071

Detailed photographs of the EUT are filed separately with this filing.

1.3 Test Methodology and Considerations
The EUT was configured and tested utilizing the maximum input drive level resulting in maximum gain conditions for all tests. If the maximum input drive level is exceeded, internal attenuators are activated to produce a level RF output and eliminate the device from operating beyond the maximum RF output power that is below the saturated RF output power.

For unintentional radiated emissions measurements the EUT was configured with one port loaded with a 50 Ohm non-radiating load and the other port loaded with a representative antenna. Both ports could not be loaded with representative antennas within the test environment due to the isolation required between antennas and the fact the device would receive and transmit any received signals via the antennas. Both the uplink and downlink ports were evaluated with antennas attached and the worst case provided in this report.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

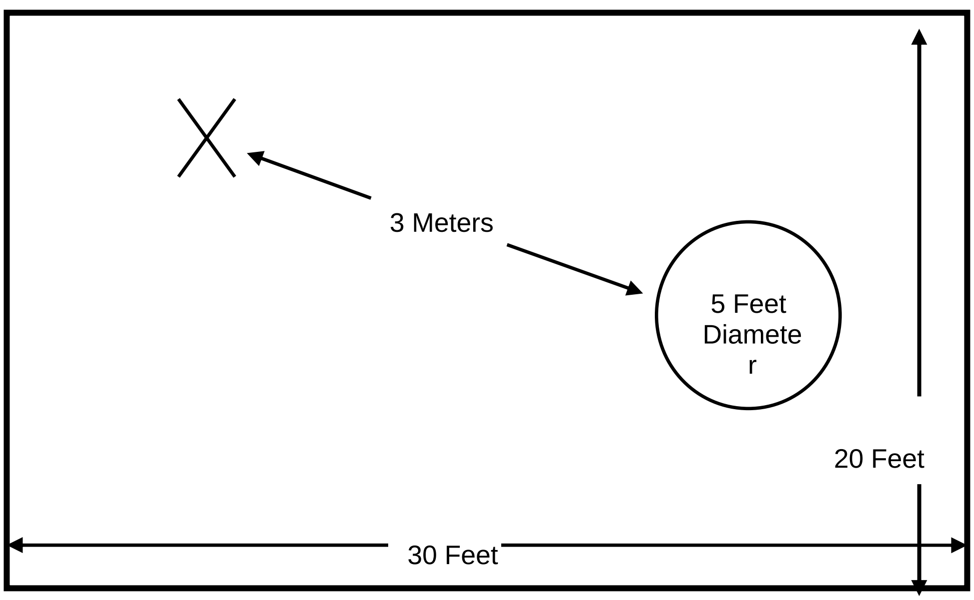

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)
The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

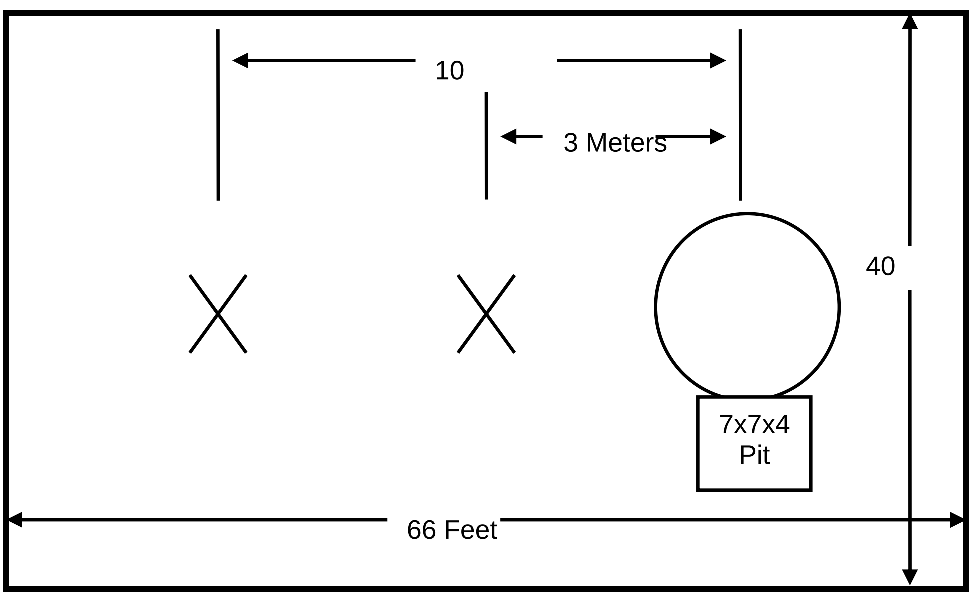

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description
The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

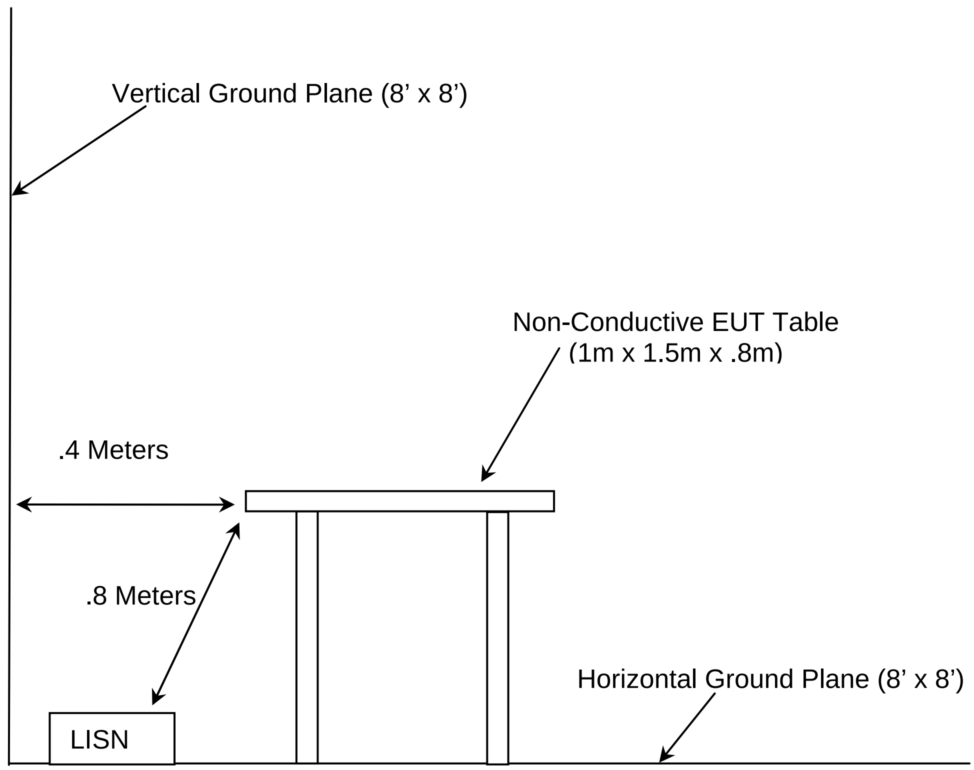

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz

2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures (October 2006)

3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart E: Cellular Radiotelephone Service (October 2006)

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☒ 25	Chase	Bi-Log Antenna	CBL6111	1043	5/30/07
☒ 041	ElectroMetrics	Bi-Con Antenna	BIA-25	2925	5/25/07
☒ 090	ElectroMetrics	LPA Antenna	LPA-25	1476	5/25/07
☒ 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/07
☒ 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/07
☒ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/12/07
☒ 329	A.H.Systems	Horn Antenna	SAS-571	721	8/24/2007
☒ 282	Microwave Circuits	High Pass Filter	H3G020G4	74541 DC0608	3/12/08
☒ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/05/08
☒ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/05/08
☒ 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	10/24/07
☒ 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	10/24/07
☒ 283	Rohde & Schwarz	Spectrum Analyzer	FSP-40	1000033	11/9/08
☒ 167	ACS	Chamber EMI Cable Set	RG6	167	1/5/08
☒ 290	Florida RF Labs	HF RF Cable	SMSE-200-72.0-SMRE	NA	5/08/07
☒ 291	Florida RF Labs	HF RF Cable	SMRE-200W-12.0-SMRE	NA	5/08/07
☒ 292	Florida RF Labs	HF RF Cable	SMR-280AW-480.0-SMR	NA	5/24/07
☒ 269	Weinschel	20 dB Attenuator	24-20-34	BL0387	2/5/08
☒ 349	Weinschel	30 dB Attenuator	47-30-43	BU7390	12/8/2007
☒ NA	Termaline	Coaxial Resistor 50W	8085	13328	N/A
☒ N/A	Termaline	Coaxial Resistor 100W	8164	7655	N/A
☒ N/A	Agilent	Signal Generator	E4437B	MY41000179	4/9/08
☒ 268	Agilent	Power Sensor	N1921A	MY45240184	10/26/07
☒ 267	Agilent	Power Meter	N1911A	MY45100129	10/26/07
☒ N/A	Gigatronics	Signal Generator	1018	315110	4/16/08

5.0 SUPPORT EQUIPMENT AND ACCESSORIES

Table 5-1: Support Equipment and Accessories

Diagram #	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
1	Agilent	Signal Generator	E4438C	MY45082439	NA

.

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

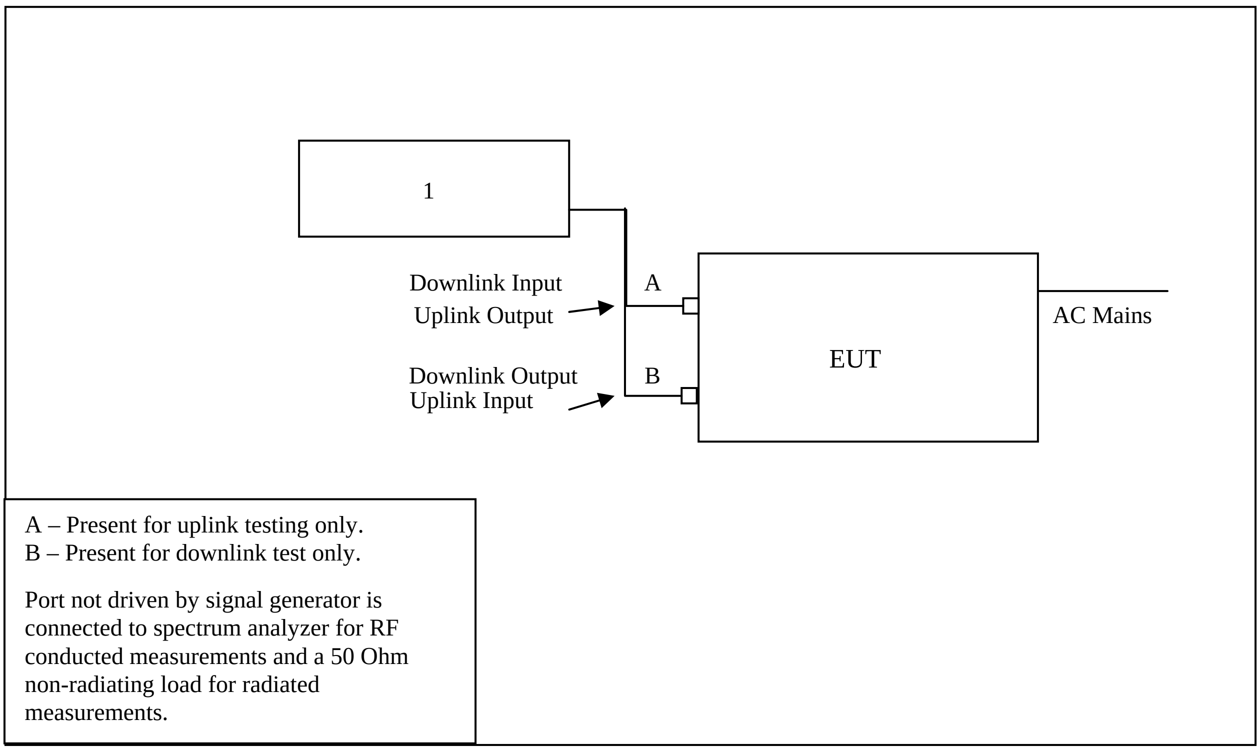

Figure 6-1: EUT Test Setup

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document. Data plots can be found in the test report appendix 07-0090-24E-A.

7.1 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Power Meter. Results for uplink and downlink configurations are shown below in Table 7.1-1.

7.1.2 Measurement Results

Table 7.1-1: Peak Output Power

Configuration	Modulation	Channel	Frequency (MHz)	RF Power Output (dBm)
Uplink	CDMA	Low	1851.25	22.31
Uplink	CDMA	Middle	1860	22.51
Uplink	CDMA	High	1868.75	22.25
Uplink	TDMA	Low	1850.04	23.05
Uplink	TDMA	Middle	1860	23.14
Uplink	TDMA	High	1869.96	22.46
Uplink	GSM	Low	1850.2	24.43
Uplink	GSM	Middle	1860	25.12
Uplink	GSM	High	1869.8	23.67
				22.31
Downlink	CDMA	Low	1931.25	43.23
Downlink	CDMA	Middle	1940	43.43
Downlink	CDMA	High	1948.75	43.5
Downlink	TDMA	Low	1930.04	43.33
Downlink	TDMA	Middle	1940	43.12
Downlink	TDMA	High	1949.96	43.05
Downlink	GSM	Low	1930.2	43.25
Downlink	GSM	Middle	1940	43.16
Downlink	GSM	High	1949.8	42.69

7.2 Occupied Bandwidth (Emission Limits)

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth. The analyzer was set for Max Hold using a peak detector. Both the input and output bandwidths were evaluated to show similar characteristics of the emissions. Results for uplink and downlink configurations are shown below in Table 7.2-1.

7.2.2 Measurement Results

Occupied bandwidth plots are listed below and are supplied in the test report appendix 07-0090-24E-A.

Table 7.2-1: Occupied Bandwidth

Configuration	Modulation	Channel	Frequency (MHz)	Plot Reference
Uplink	CDMA	Low	1851.25	Figure 1.
Uplink	CDMA	Middle	1860	Figure 2.
Uplink	CDMA	High	1868.75	Figure 3.
Uplink	TDMA	Low	1850.04	Figure 4.
Uplink	TDMA	Middle	1860	Figure 5.
Uplink	TDMA	High	1869.96	Figure 6.
Uplink	GSM	Low	1850.2	Figure 7.
Uplink	GSM	Middle	1860	Figure 8.
Uplink	GSM	High	1869.8	Figure 9.
Downlink	CDMA	Low	1931.25	Figure 10.
Downlink	CDMA	Middle	1940	Figure 11.
Downlink	CDMA	High	1948.75	Figure 12.
Downlink	TDMA	Low	1930.04	Figure 13.
Downlink	TDMA	Middle	1940	Figure 14.
Downlink	TDMA	High	1949.96	Figure 15.
Downlink	GSM	Low	1930.2	Figure 16.
Downlink	GSM	Middle	1940	Figure 17.
Downlink	GSM	High	1949.8	Figure 18.

7.3 Spurious Emissions at Antenna Terminals and Inter-modulation Products

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. For inter-modulation products the two tone two test method was used with the device operating at maximum drive levels. Two tones were placed at the lower band-edge and upper band-edge. Inter-modulation products were tested using TDMA, CDMA, and GSM signals. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth

For out of band spurious emissions the spectrum analyzer resolution and video bandwidths were set to 1 MHz according to Section 24.238. The spectrum was investigated for the 30 MHz to 20 GHz in accordance to CFR 47 Part 2.1057. The analyzer was set for Max Hold using a peak detector. Spurious emissions were evaluated for all modulation modes.

7.3.2 Measurement Results

Emission plots are listed below in Table 7.3-1 and Table 7.3-2 and plots are supplied in the test report appendix 07-0090-24E-A.

Table 7.3-1: Spurious Emissions - Uplink

Configuration	Modulation	Channel	Frequency Range (MHz)	Plot Reference
Uplink	CDMA	Low	IM - In Band	Figure 19.
Uplink	CDMA	Low	IM - 30 - 2200	Figure 20.
Uplink	CDMA	Low	IM - 2200 - 20000	Figure 21.
Uplink	CDMA	Middle	30 – 2200	Figure 22.
Uplink	CDMA	Middle	2200 - 20000	Figure 23.
Uplink	CDMA	High	IM - In Band	Figure 24.
Uplink	CDMA	High	IM - 30 - 2200	Figure 25.
Uplink	CDMA	High	IM - 2200 - 20000	Figure 26.
Uplink	TDMA	Low	IM - In Band	Figure 27.
Uplink	TDMA	Low	IM - 30 - 2200	Figure 28.
Uplink	TDMA	Low	IM - 2200 - 20000	Figure 29.
Uplink	TDMA	Middle	30 - 2200	Figure 30.
Uplink	TDMA	Middle	2200 - 20000	Figure 31.
Uplink	TDMA	High	IM - In Band	Figure 32.
Uplink	TDMA	High	IM - 30 - 2200	Figure 33.
Uplink	TDMA	High	IM - 2200 - 20000	Figure 34.
Uplink	GSM	Low	IM - In Band	Figure 35.
Uplink	GSM	Low	IM - 30 - 2200	Figure 36.
Uplink	GSM	Low	IM - 2200 - 20000	Figure 37.
Uplink	GSM	Middle	30 - 2200	Figure 38.
Uplink	GSM	Middle	2200 - 20000	Figure 39.
Uplink	GSM	High	IM - In Band	Figure 40.
Uplink	GSM	High	IM - 30 - 2200	Figure 41.
Uplink	GSM	High	IM - 2200 - 20000	Figure 42.

Table 7.3-2: Spurious Emissions - Downlink

Configuration	Modulation	Channel	Frequency Range (MHz)	Plot Reference
Downlink	CDMA	Low	IM - In Band	Figure 43.
Downlink	CDMA	Low	IM - 30 - 2200	Figure 44.
Downlink	CDMA	Low	IM - 2200 - 20000	Figure 45.
Downlink	CDMA	Middle	30 - 2200	Figure 46.
Downlink	CDMA	Middle	2200 - 20000	Figure 47.
Downlink	CDMA	High	IM - In Band	Figure 48.
Downlink	CDMA	High	IM - 30 - 2200	Figure 49.
Downlink	CDMA	High	IM - 2200 - 20000	Figure 50.
Downlink	TDMA	Low	IM - In Band	Figure 51.
Downlink	TDMA	Low	IM - 30 - 2200	Figure 52.
Downlink	TDMA	Low	IM - 2200 - 20000	Figure 53.
Downlink	TDMA	Middle	30 - 2200	Figure 54.
Downlink	TDMA	Middle	2200 - 20000	Figure 55.
Downlink	TDMA	High	IM - In Band	Figure 56.
Downlink	TDMA	High	IM - 30 - 2200	Figure 57.
Downlink	TDMA	High	IM - 2200 - 20000	Figure 58.
Downlink	GSM	Low	IM - In Band	Figure 59.
Downlink	GSM	Low	IM - 30 - 2200	Figure 60.
Downlink	GSM	Low	IM - 2200 - 20000	Figure 61.
Downlink	GSM	Middle	30 - 2200	Figure 62.
Downlink	GSM	Middle	2200 - 20000	Figure 63.
Downlink	GSM	High	IM - In Band	Figure 64.
Downlink	GSM	High	IM - 30 - 2200	Figure 65.
Downlink	GSM	High	IM - 2200 - 20000	Figure 66.

7.4 Band-edge Compliance

7.4.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth. The center frequency was set to both the upper and lower cellular frequency block edges. Band-edge compliance was evaluated for all modulation modes.

7.4.2 Measurement Results

Band-edge plots in are listed in Table 7.4-1below and are supplied in the test report appendix 07-0090-24E-A.

Table 7.4-1: Band-edge

Configuration	Modulation	Channel	Frequency (MHz)	Plot Reference
Uplink	CDMA	Low	1851.25	Figure 67.
Uplink	CDMA	High	1868.75	Figure 68.
Uplink	TDMA	Low	1850.04	Figure 69.
Uplink	TDMA	High	1869.96	Figure 70.
Uplink	GSM	Low	1850.2	Figure 71.
Uplink	GSM	High	1869.8	Figure 72.
Downlink	CDMA	Low	1931.25	Figure 73.
Downlink	CDMA	High	1948.75	Figure 74.
Downlink	TDMA	Low	1930.04	Figure 75.
Downlink	TDMA	High	1949.96	Figure 76.
Downlink	GSM	Low	1930.2	Figure 77.
Downlink	GSM	High	1949.8	Figure 78.

7.5 Field Strength of Spurious Emissions

7.5.1 Measurement Procedure

The equipment under test is placed on the Open Area Test Site (described in section 2.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded.

The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057. A CW was used for both uplink and downlink for low, middle and high channels. The worst case emissions are reported of both uplink and downlink configurations. All emissions not reported were below the noise floor of the measurement equipment.

Results of the test are shown below in Table 7.5-1.

7.5.2 Measurement Results

Table 7.5.-1: Field Strength of Spurious Emissions

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
Uplink							
Mid Channel							
3720	-56.64	-58	H	6.66	-51.34	-13.00	38.34
High Channel							
3740	-55.75	-56	H	6.64	-49.37	-13.00	36.37
Downlink							
Low Channel							
5790	-55.45	-56	H	6.80	-48.80	-13.00	35.80
5790	-54.17	-49.8	V	6.76	-43.04	-13.00	30.04
Mid Channel							
3880	-57.34	-54.28	H	6.45	-47.83	-13.00	34.83
3880	-56.06	-54.23	V	6.38	-47.85	-13.00	34.85
5820	-56.91	-52.34	H	6.80	-45.54	-13.00	32.54
5820	-54.93	-50.78	V	6.76	-44.02	-13.00	31.02
7760	-57.39	-49.40	H	6.11	-43.29	-13.00	30.29
7760	-57.27	-59.64	V	6.15	-53.49	-13.00	40.49
High Channel							
3900	-54.79	-52.36	H	6.43	-45.93	-13.00	32.93
3900	-56.55	-59.90	V	6.35	-53.55	-13.00	40.55
5850	-57.04	-51.50	H	6.79	-44.71	-13.00	31.71
5850	-55.68	-50.00	V	6.76	-43.24	-13.00	30.24
7800	-57.82	-47.02	H	6.13	-40.89	-13.00	27.89
7800	-56.87	-57.18	V	6.17	-51.01	-13.00	38.01

Note: Non-reported harmonics were not detected above the noise floor.

7.6 Frequency Response

7.6.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Using a signal generator, both the uplink and downlink ports were driven with a CW signal. The frequency of the signal generator was sweep across the entire range of operation. Results of the test are shown below in and Figure 7.6-1 through 7.6-2.

7.6.2 Measurement Results

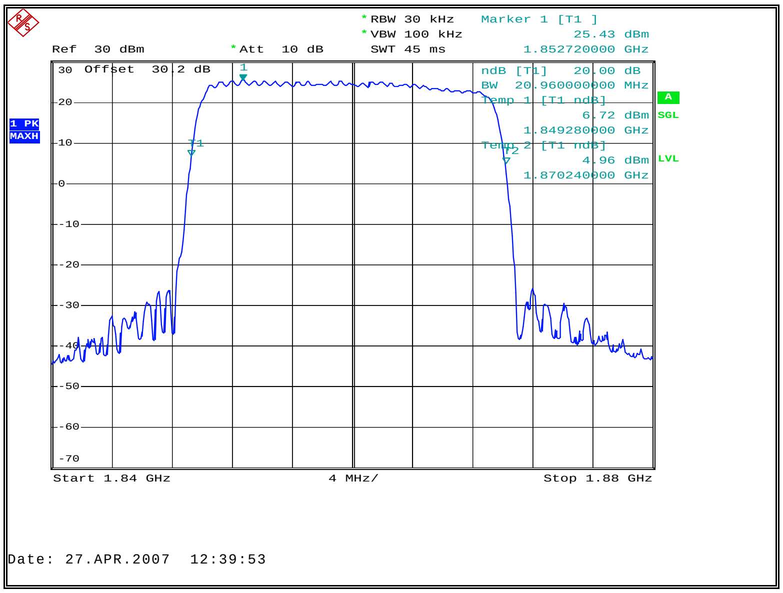

Figure 7.6-1: Frequency Response Uplink

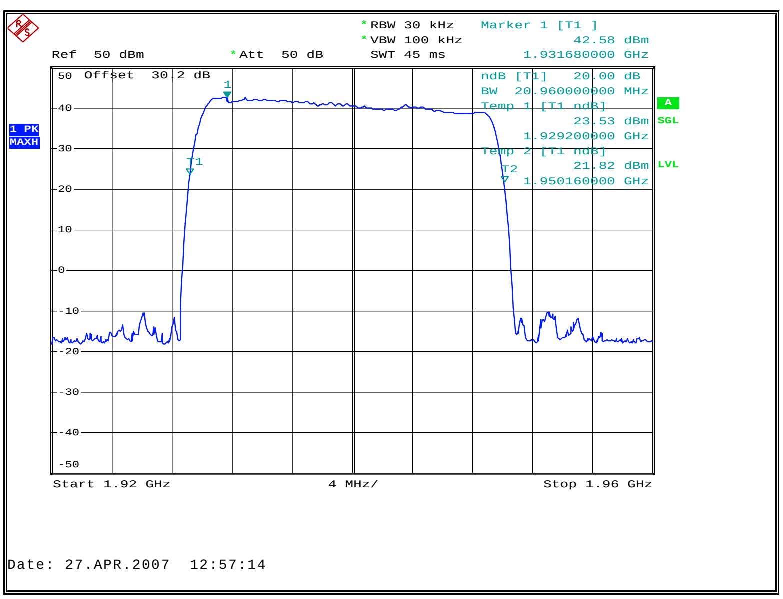

Figure 7.6-2: Frequency Response Downlink

7.7 Radiated Emissions (Unintentional Radiators) - FCC Section 15.109

7.7.1 Measurement Procedure

The equipment under test is placed on the Open Area Test Site (described in section 2.1) on a wooden table at the turntable center. For each radiated emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º to obtain a maximum peak reading on the spectrum analyzer. The radiated emissions are then measured using an EMI receiver employing a CISPR quasi-peak detector for frequencies below 1000 MHz and an Average detector function for frequencies above 1000 MHz. This repeated for both horizontal and vertical polarizations of the receive antenna.

The field strength of each radiated emission is calculated by correcting the EMI receiver level for cable loss, amplifier gain, and antenna correction factors.

Field Strength (dBuV/m) = EMI Receiver Level (dBuV) + Cable Loss (dB) – Amplifier Gain (dB) + Antenna Correction Factor (1/m)

Results of the test are shown below in Table 7.7.-1.

7.7.2 Measurement Results

Table 7.7-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
35.38		29.15	V	-11.57	---------	17.58	--------	40.0	---------	22.42
47.42		30.24	V	-16.87	---------	13.37	--------	40.0	---------	26.63
69.811		43.91	V	-20.70	---------	23.21	--------	40.0	---------	16.79
97.09		34.84	V	-14.51	---------	20.33	--------	43.5	---------	23.17
175.95		34.43	H	-15.06	---------	19.37	--------	43.5	---------	24.13
181		34.43	H	-15.32	---------	19.11	--------	43.5	---------	24.39
248		26.13	V	-11.90	---------	14.23	--------	43.5	---------	29.27
398		22.98	H	-7.54	---------	15.44	--------	46.0	---------	30.56
591.233		27.32	V	-3.95	---------	23.37	--------	46.0	---------	22.63
945		21.59	V	2.85	---------	24.44	--------	46.0	---------	21.56

Note: At frequencies >945 MHz, emissions not detected above noise floor.

7.8 Power Line Conducted Emissions - FCC Section 15.107

7.8.1 Measurement Procedure
ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.8.2 Measurement Results
Results of the test are shown below in and Tables 7.8-1.

Table 7.8-1: Conducted EMI Results

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.16	18.4	4.8	9.80	28.20	14.60	65.46	55.46	37.3	40.9
0.18	17.1	13.6	9.80	26.90	23.40	64.49	54.49	37.6	31.1
0.2	10	1.9	9.80	19.80	11.70	63.61	53.61	43.8	41.9
0.22	6.8	0.6	9.80	16.60	10.40	62.82	52.82	46.2	42.4
5.55	3	1	9.81	12.81	10.81	60.00	50.00	47.2	39.2
14.63	8.3	5.1	10.01	18.31	15.11	60.00	50.00	41.7	34.9
Line 2									
0.16	19.1	5.7	9.80	28.90	15.50	65.46	55.46	36.6	40.0
0.18	16.3	12.2	9.80	26.10	22.00	64.49	54.49	38.4	32.5
0.2	10	1	9.80	19.80	10.80	63.61	53.61	43.8	42.8
0.22	7.6	0.2	9.80	17.40	10.00	62.82	52.82	45.4	42.8
5.55	5.8	1	9.81	15.61	10.81	60.00	50.00	44.4	39.2
14.63	12.8	9.8	10.01	22.81	19.81	60.00	50.00	37.2	30.2

7.9 Frequency Stability

7.9.1 Measurement Procedure
The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the supply voltage was varied from 85% to 115% from the normal. The maximum variation of frequency was recorded.

Data was collected at the low, middle, and high frequencies for both uplink and downlink. Results of the test are shown below in Figures 7.9-1 through 7.9-6.

7.9.2 Measurement Results

The test results conclude the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block as according to CFR 47 Part 24.235.

Uplink

Frequency Stability

Mode:
Frequency (MHz): 1850
Channel:
Deviation Limit (PPM): 1.5ppm

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (VAC)
-30 C	**1850.000027**	**0.015**	100%	120.00
-20 C	**1850.000027**	**0.015**	100%	120.00
-10 C	**1850.000027**	**0.015**	100%	120.00
0 C	**1850.000028**	**0.015**	100%	120.00
10 C	**1850.000027**	**0.015**	100%	120.00
20 C	**1850.000025**	**0.014**	100%	120.00
30 C	**1850.000028**	**0.015**	100%	120.00
40 C	**1850.000027**	**0.015**	100%	120.00
50 C	**1850.000027**	**0.015**	100%	120.00
20 C	**1850.000025**	**0.014**	85%	102.00
20 C	**1850.000025**	**0.014**	115%	138.00

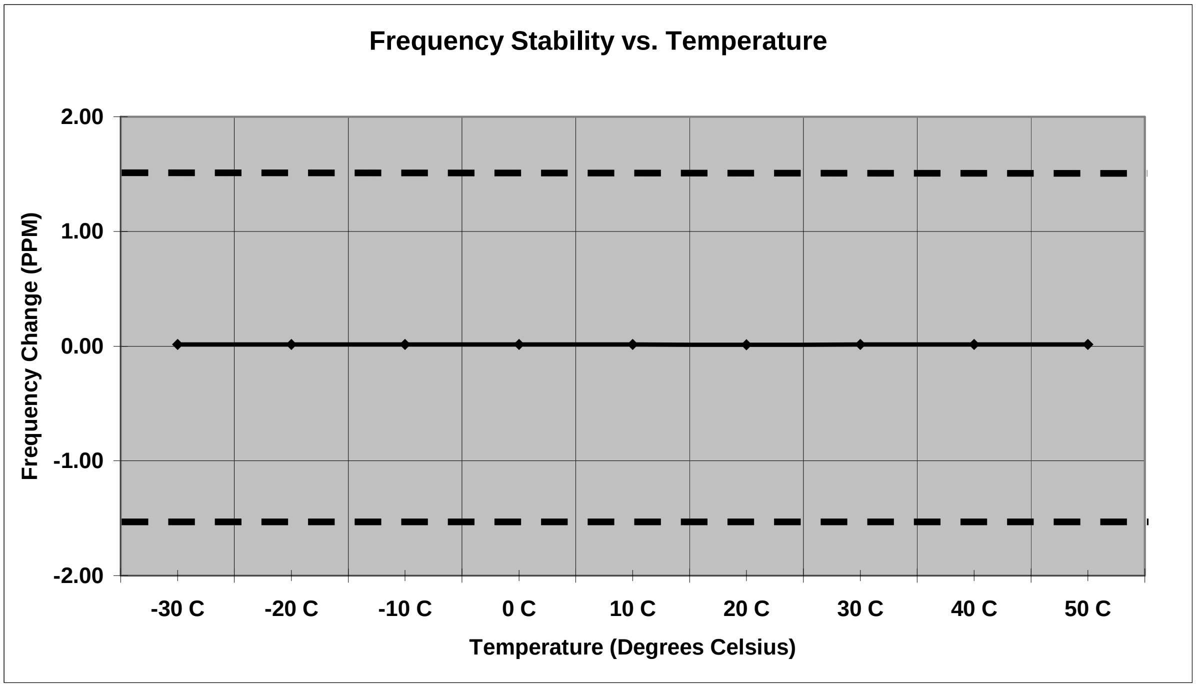

Figure 7.9-1: Frequency Stability Uplink – Low Channel

Frequency Stability

Mode: **Frequency (MHz):** 1860
Channel: **Deviation Limit (PPM):** 1.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-30 C	**1860.000029**	**0.016**	100%	120.00
-20 C	**1860.000027**	**0.015**	100%	120.00
-10 C	**1860.000029**	**0.016**	100%	120.00
0 C	**1860.000029**	**0.016**	100%	120.00
10 C	**1860.000029**	**0.016**	100%	120.00
20 C	**1860.000034**	**0.018**	100%	120.00
30 C	**1860.000028**	**0.015**	100%	120.00
40 C	**1860.000027**	**0.015**	100%	120.00
50 C	**1860.000027**	**0.015**	100%	120.00
20 C	**1860.000033**	**0.018**	85%	102.00
20 C	**1860.000033**	**0.018**	115%	138.00

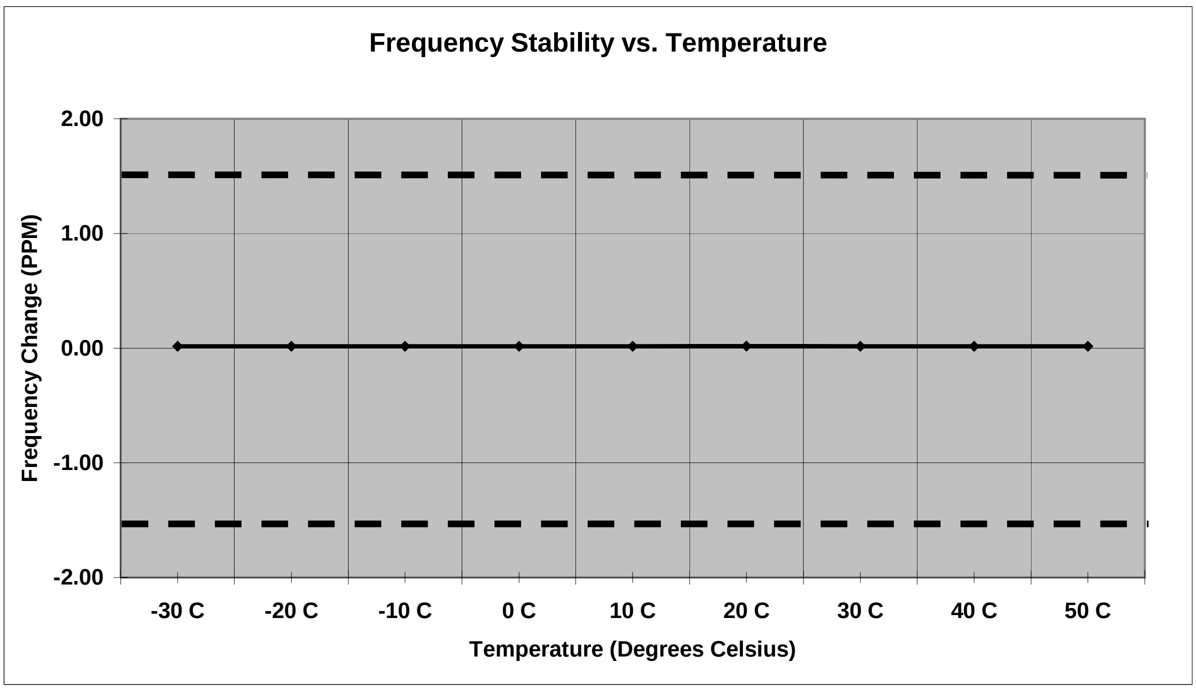

Figure 7.9-2: Frequency Stability Uplink – Middle Channel

Frequency Stability

Mode:
Channel:
Frequency (MHz): 1870
Deviation Limit (PPM): 1.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-30 C	**1870.000028**	**0.015**	100%	120.00
-20 C	**1870.000027**	**0.014**	100%	120.00
-10 C	**1870.000029**	**0.016**	100%	120.00
0 C	**1870.000029**	**0.016**	100%	120.00
10 C	**1870.000029**	**0.016**	100%	120.00
20 C	**1870.000034**	**0.018**	100%	120.00
30 C	**1870.000028**	**0.015**	100%	120.00
40 C	**1870.000027**	**0.014**	100%	120.00
50 C	**1870.000027**	**0.014**	100%	120.00
20 C	**1870.000033**	**0.018**	85%	102.00
20 C	**1870.000033**	**0.018**	115%	138.00

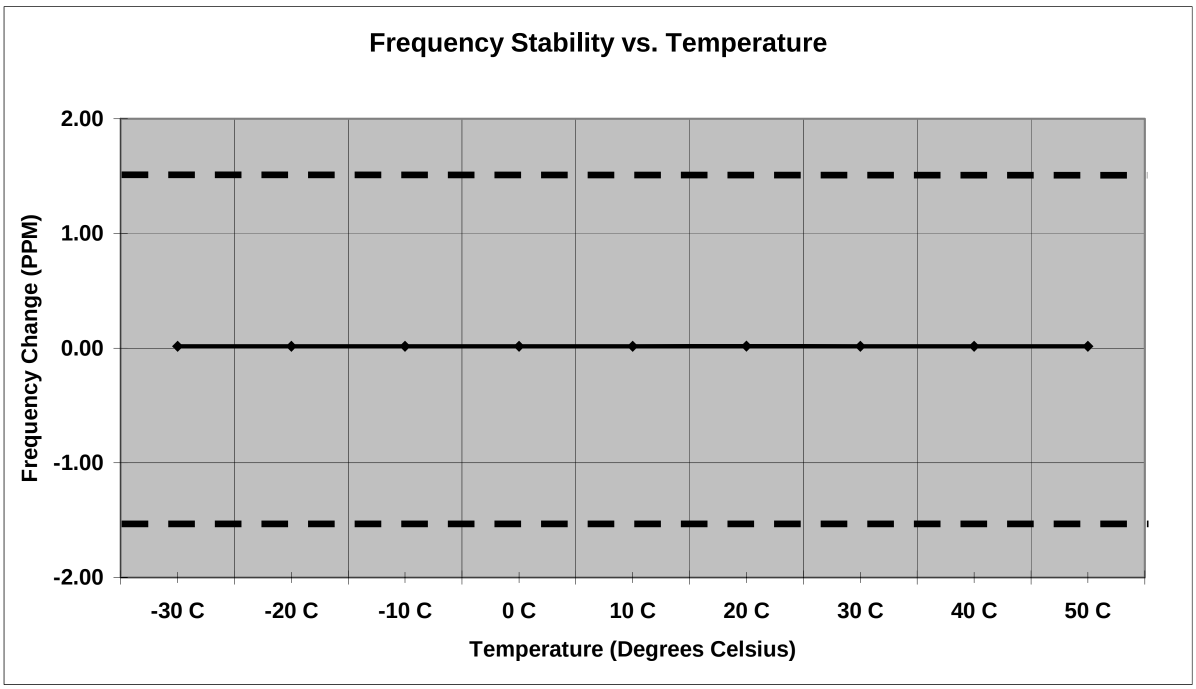

Figure 7.9-3: Frequency Stability Uplink – High Channel

Downlink

Frequency Stability

Mode: **Frequency (MHz):** 1930
Channel: **Deviation Limit (PPM):** 1.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**1930.000030**	**0.016**	100%	120.00
-20 C	**1930.000028**	**0.015**	100%	120.00
-10 C	**1930.000028**	**0.015**	100%	120.00
0 C	**1930.000030**	**0.016**	100%	120.00
10 C	**1930.000028**	**0.015**	100%	120.00
20 C	**1930.000025**	**0.013**	100%	120.00
30 C	**1930.000030**	**0.016**	100%	120.00
40 C	**1930.000028**	**0.015**	100%	120.00
50 C	**1930.000028**	**0.015**	100%	120.00
20 C	**1930.000027**	**0.014**	85%	102.00
20 C	**1930.000027**	**0.014**	100%	138.00

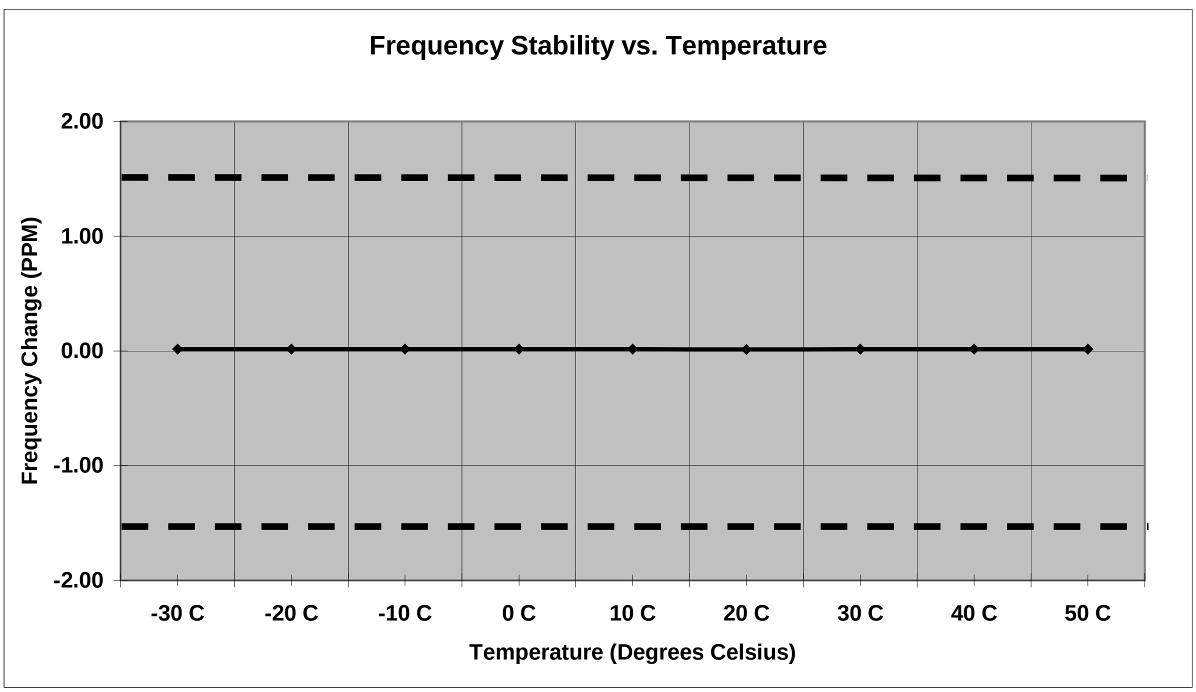

Figure 7.9-4: Frequency Stability Downlink – Low Channel

Frequency Stability

Mode:
Channel:
Frequency (MHz): 1940
Deviation Limit (PPM): 1.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**1940.000033**	**0.017**	100%	120.00
-20 C	**1940.000029**	**0.015**	100%	120.00
-10 C	**1940.000028**	**0.014**	100%	120.00
0 C	**1940.000030**	**0.015**	100%	120.00
10 C	**1940.000029**	**0.015**	100%	120.00
20 C	**1940.000042**	**0.022**	100%	120.00
30 C	**1940.000027**	**0.014**	100%	120.00
40 C	**1940.000027**	**0.014**	100%	120.00
50 C	**1940.000026**	**0.013**	100%	120.00
20 C	**1940.000041**	**0.021**	85%	102.00
20 C	**1940.000040**	**0.021**	100%	138.00

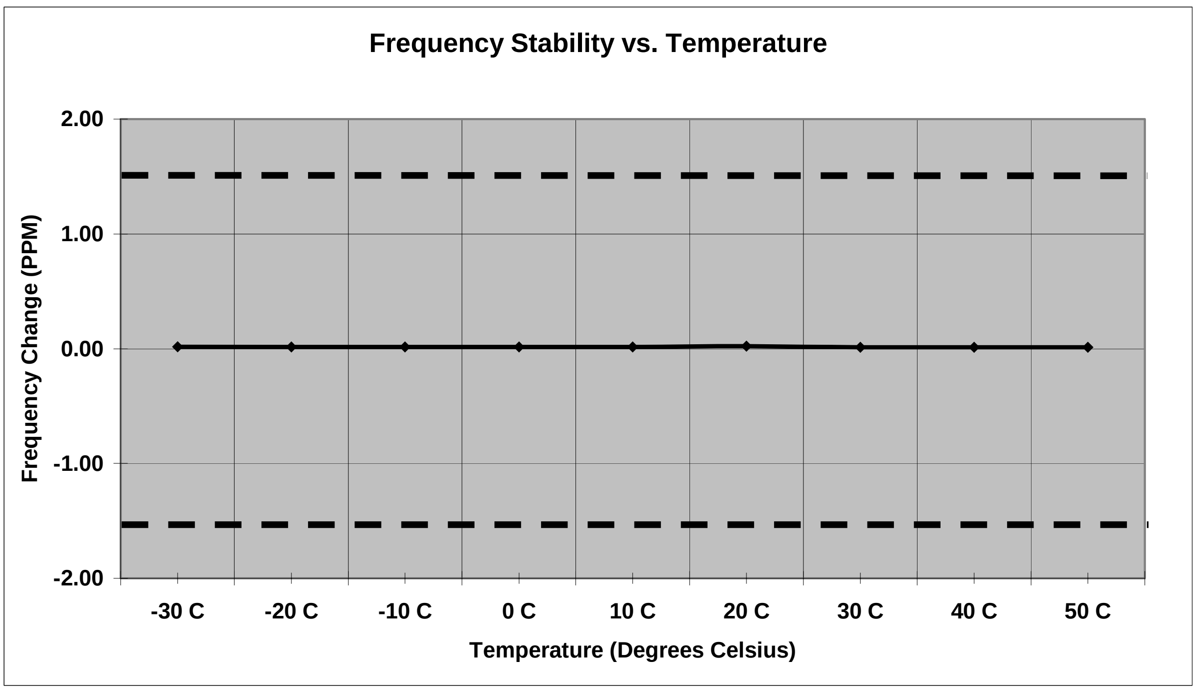

Figure 7.9-5: Frequency Stability Downlink – Middle Channel

Frequency Stability

Mode:
Channel:
Frequency (MHz): 1950
Deviation Limit (PPM): 1.5ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**1950.000033**	**0.017**	100%	120.00
-20 C	**1950.000029**	**0.015**	100%	120.00
-10 C	**1950.000028**	**0.014**	100%	120.00
0 C	**1950.000030**	**0.015**	100%	120.00
10 C	**1950.000029**	**0.015**	100%	120.00
20 C	**1950.000040**	**0.021**	100%	120.00
30 C	**1950.000027**	**0.014**	100%	120.00
40 C	**1950.000027**	**0.014**	100%	120.00
50 C	**1950.000026**	**0.013**	100%	120.00
20 C	**1950.000041**	**0.021**	85%	102.00
20 C	**1950.000040**	**0.021**	100%	138.00

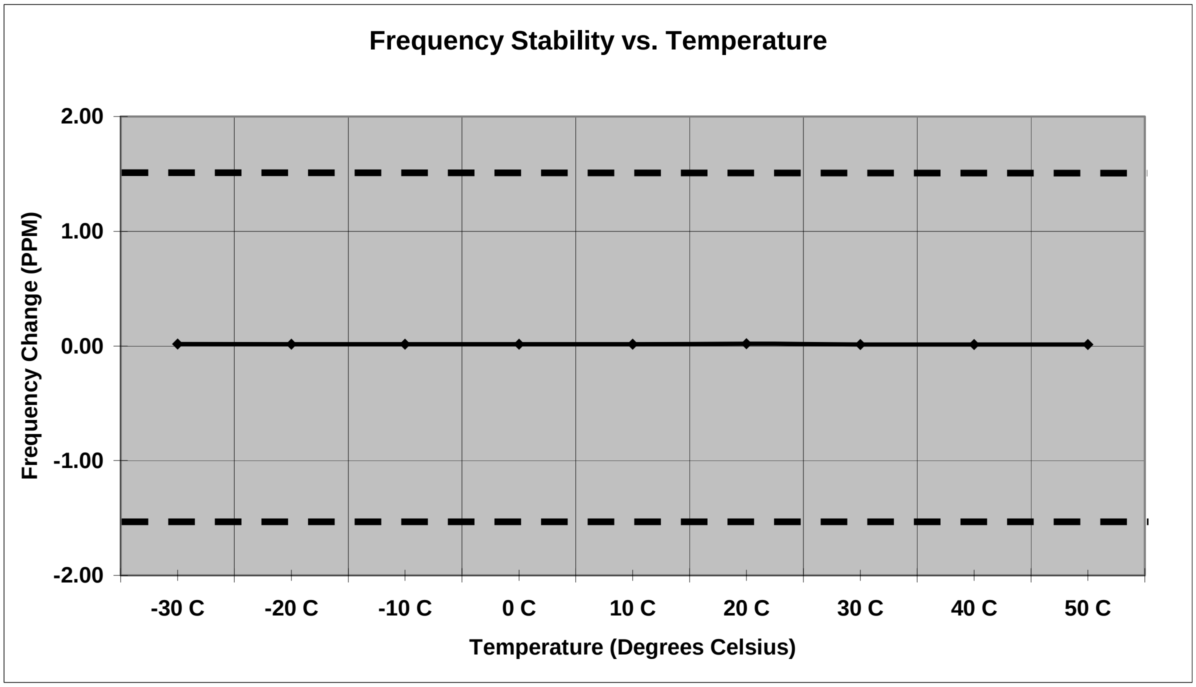

Figure 7.9-6: Frequency Stability Downlink – High Channel

END Report