Engineering and Testing for EMC and Safety Compliance

Accredited under A2LA Testing Certificate # 2653.01

FCC Certification Report

Harris Corporation
221 Jefferson Ridge Parkway
Lynchburg, VA 24501
Daryl Popowitch
Phone: (434) 455-9527

Model: Vehicular Repeater Base System (VRBS 7010)

FCC ID: OWDTR-0058-E

December 29, 2009

Standards Referenced for this Report	
Part 2: 2008	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 90: 2008	Private Land Mobile Radio Services
ANSI TIA-603-C-2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

Frequency Range	Rated Transmit Power (W) (Conducted)*	Measured Frequency Tolerance (ppm)	Emission Designator
763-775	0.25-4	1.1	8K40F1D/E (4-level C4FM; P25)

**Rated power, actual measured power in test report*

Report Prepared by Test Engineer: Daniel W. Baltzell

Document Number: 2009318

Table of Contents

Table of Tables

Table of Plots

Table of Figures

Table of Appendixes

Table of Photographs

1 General Information

The following Certification Report is prepared on behalf of **Harris Corporation** in accordance with the Federal Communications Commission. The Equipment Under Test (EUT) was the **Vehicular Repeater Base System (VRBS 7010), FCC ID: OWDTR-0058-E**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with the applicable FCC Rules and Regulations in CFR 47. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia, 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.2 Related Submittal(s)/Grant(s)

This is an original application.

2 Tested System Details

The test sample was received on December 17, 2009. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable. The radio is offered with two lengths of cables to an antenna. The conducted power ranges from 0.5 to 3 W.

Table 2-1: Test System Details

Model Tested	Vehicular Repeater Base System (VRBS 7010)
Frequency Band	763-775 MHz
Modulation Type	P25 C4FM
Channel Step Size	6.25 kHz
Channel Bandwidth	12.5 kHz
Primary Power	13.8 VDC battery operated
Rated Transmitter Output Power	Continually variable 0.25-4 W
Duty Cycle	100% maximum

Table 2-2: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Vehicular Repeater Base System	Harris Corporation	VRBS 7010	RU-017933-010	OWDTR-0058-E	19360

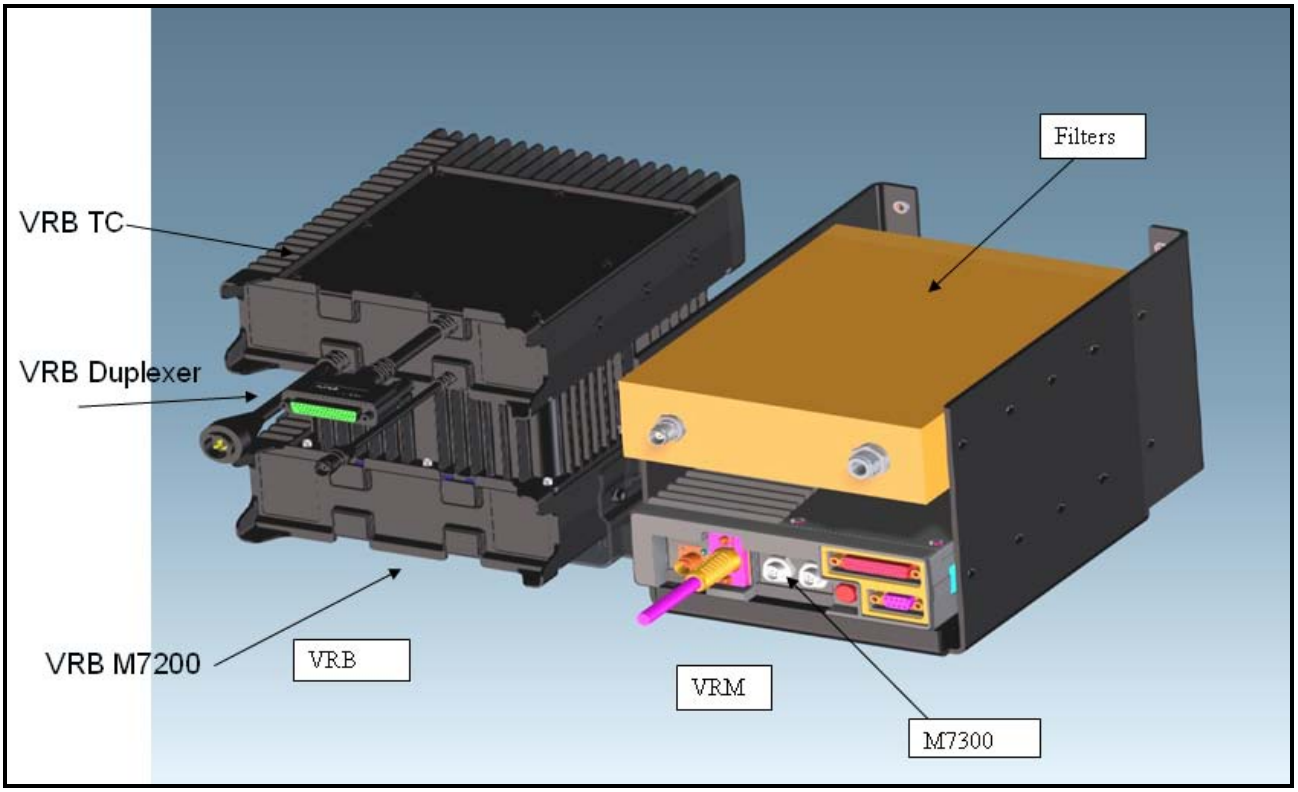
Table 2-3: Ports and Cabling (EUT)

Port	Type	Quantity	Length (m)	Shield
RF In/Out	TNC	1	4.5/4.6	Yes
I/O	RS-232	1	1.65	Yes
Power	Unshielded	1	2.3	No

Table 2-4: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Notebook Computer	Hewlett Packard	Mini 1000	N/A	N/A	N/A
Antenna	PCTEL	700/800 MHz, Black Low Profile, Roof Mount, 3 dB	AN-225001-004	N/A	N/A
USB Serial Interface Cable	N/A	DB-9	N/A	N/A	N/A
Power Supply	Hewlett Packard	6291A	1928A05866	N/A	900773
M7300/M5300	Harris Corporation	MAMW-8DMXX	RU144750-061/3636B-0051	OWDTR-0051-E	19361

Figure 2-1: Configuration of Tested System



3 FCC Rules and Regulations Part 2 §2.1033(c)(8) Voltages and Currents Through The Final Amplifying Stage

Nominal DC Voltage: 13.8 VDC
Current: 6 A

4 FCC Rules and Regulations Part 90 §90.1215(a) and Part 2 §2.1046(a): Peak Output Power

4.1 Test Procedure

ANSI TIA-603-2004, section 2.2.1.

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

4.2 Test Data

Table 4-1: RF Power Output: Carrier Output Power – NBOTP

Frequency (MHz)	Full Duplex Version RF Power Measured (Watt)*
763	4.0
769	4.1
775	4.0

* Measurement accuracy: +/-.02 dB (logarithmic mode)

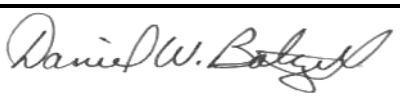
Table 4-2: RF Power Output (Rated Power)

Rated Power
4 W

Table 4-3: Test Equipment for Testing RF Power Output - Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	11/13/10
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	11/18/10
901396	MCE Weinschel	48-40-34	Attenuator, 40 dB, DC-18 GHz, 100 W	93453	12/3/10

Test Personnel:

Daniel W. Baltzell		December 17, 2009
Test Engineer	Signature	Date Of Tests

5 FCC Rules and Regulations Part 2 §2.1051: Spurious Emissions at Antenna Terminals; Part 90 §90.210: Emissions Masks

5.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.13.

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer. The device uses digital modulation modulated to its maximum extent using a pseudo random data sequence of 9600 bps for NBOTP (Narrow Band OpenSky Trunking Protocol) mode.

5.2 Test Data

Frequency range of measurement per Part 2.1057: 9 kHz to 10xFc.

Limit: P(dBm) – (43 + 10xLOG P(W))

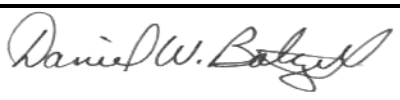
The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

No emissions were found to be within 20 dB of the limit; therefore, no data is listed.

Table 5-1: Test Equipment for Testing Conducted Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9 kHz - 12.8 GHz)	3826A00144	11/23/10
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	12/3/10
901132	Par Electronics	806-902 (25W)	UHF Notch Filter	N/A	3/10/12

Test Personnel:

Daniel W. Baltzell		December 17, 2009
Test Engineer	Signature	Date Of Tests

6 FCC Rules and Regulations Part 90 §90.543(a): Emission Limitations: ACCP Requirements

Transmitters designed to operate in the 763-775 MHz and 794-806 MHz frequency bands must meet the emission limitations of this section.

6.1 Test Procedure

Device with digital modulation: modulated to its maximum extent using a pseudo-random data sequence – 9600 bps.

For a Portable transmitter designed to operate with a 12.5 kHz channel bandwidth, the ACP shall be in accordance with the values in the following table:

Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Maximum ACP Relative (dBc)
(+/-)9.375	6.25	-40
(+/-)15.625	6.25	-60
(+/-)21.875	6.25	-60
(+/-)37.5	25	-60
(+/-)62.5	25	-65
(+/-)87.5	25	-65
(+/-)150	100	-65
(+/-)250	100	-65
(+/-)350	100	-65
>400 kHz to 12 MHz	30(s)	-75
12 MHz to paired receive band	30(s)	-75
In the paired receive band	30(s)	-100

FCC Rules and Regulations Part 90 §90.543(b)

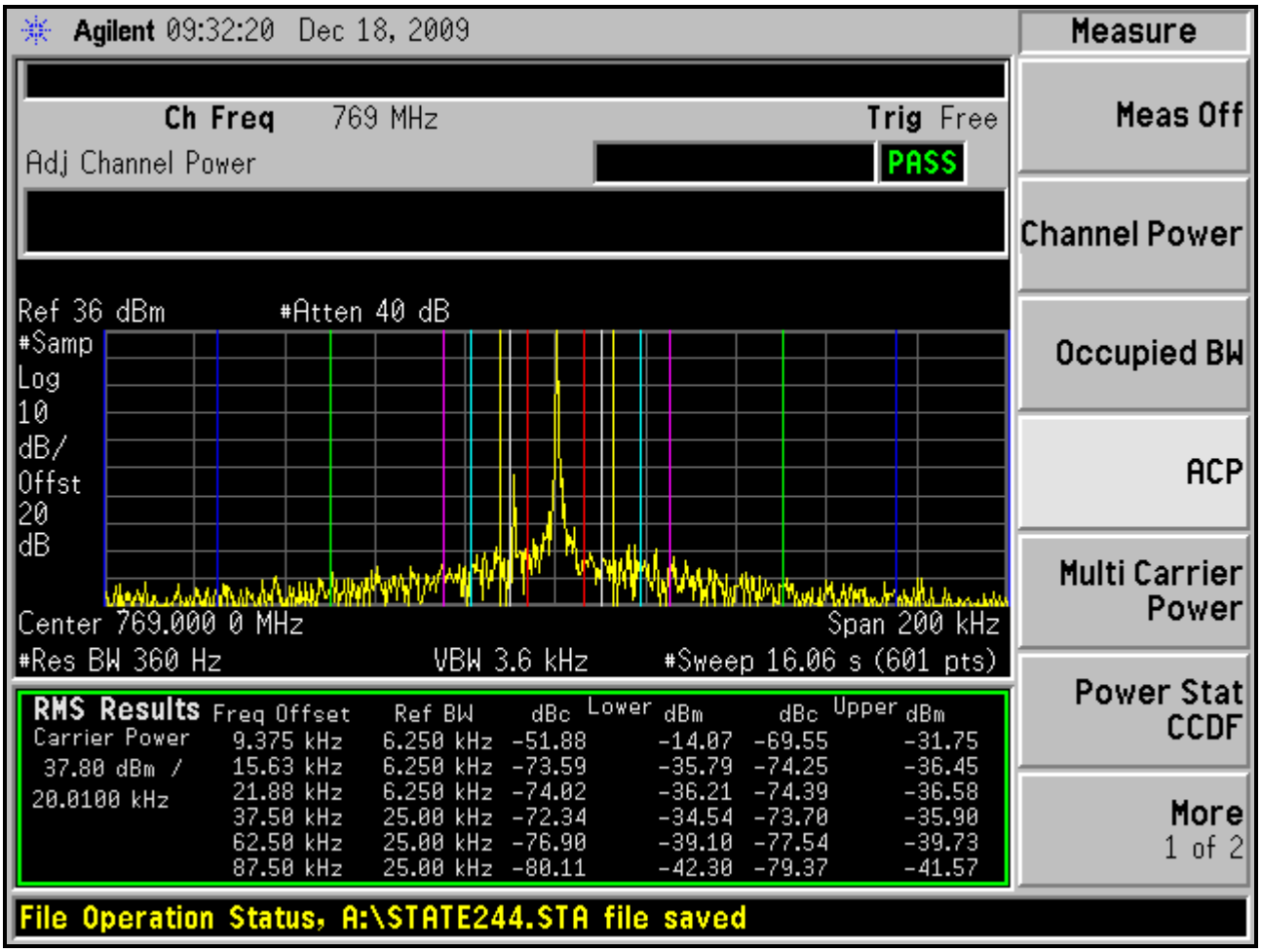
Setting Reference Level - Part 90 §90.543(b)(1): Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth to the channel size. Set the frequency offset of the measurement to zero and adjust the center frequency of the spectrum analyzer to give the power level in the measurement bandwidth. Record this power as the reference power level.

Measuring the power level at the frequency offset <600 kHz - Part 90 §90.543(b)(2): Using a spectrum analyzer capable of adjacent channel power (ACP) measurements, set the measurement bandwidth as shown in table. Measure ACP in dBm. These measurements are made at maximum power. Calculate the coupled power by subtracting the measurements made in this step from the reference power level. The absolute ACP values must be less than the values given in the table for each condition.

Measuring the power level at the frequency offset >600 kHz - Part 90 §90.543(b)(3): Set the spectrum analyzer to 30 kHz resolution bandwidth, 1 MHz video bandwidth and sample detection mode. Sweep +/-6 MHz from the carrier frequency. Set the reference level to the RMS value of the transmitter power and note the power. The response at frequencies >600 kHz must be less than the values listed in the table.

6.2 Test Data

Plot 6-1: Adjacent Channel Power to 87.5 kHz; 769 MHz



Plot 6-2: Adjacent Channel Power from 150 kHz to 350 kHz; 769 MHz

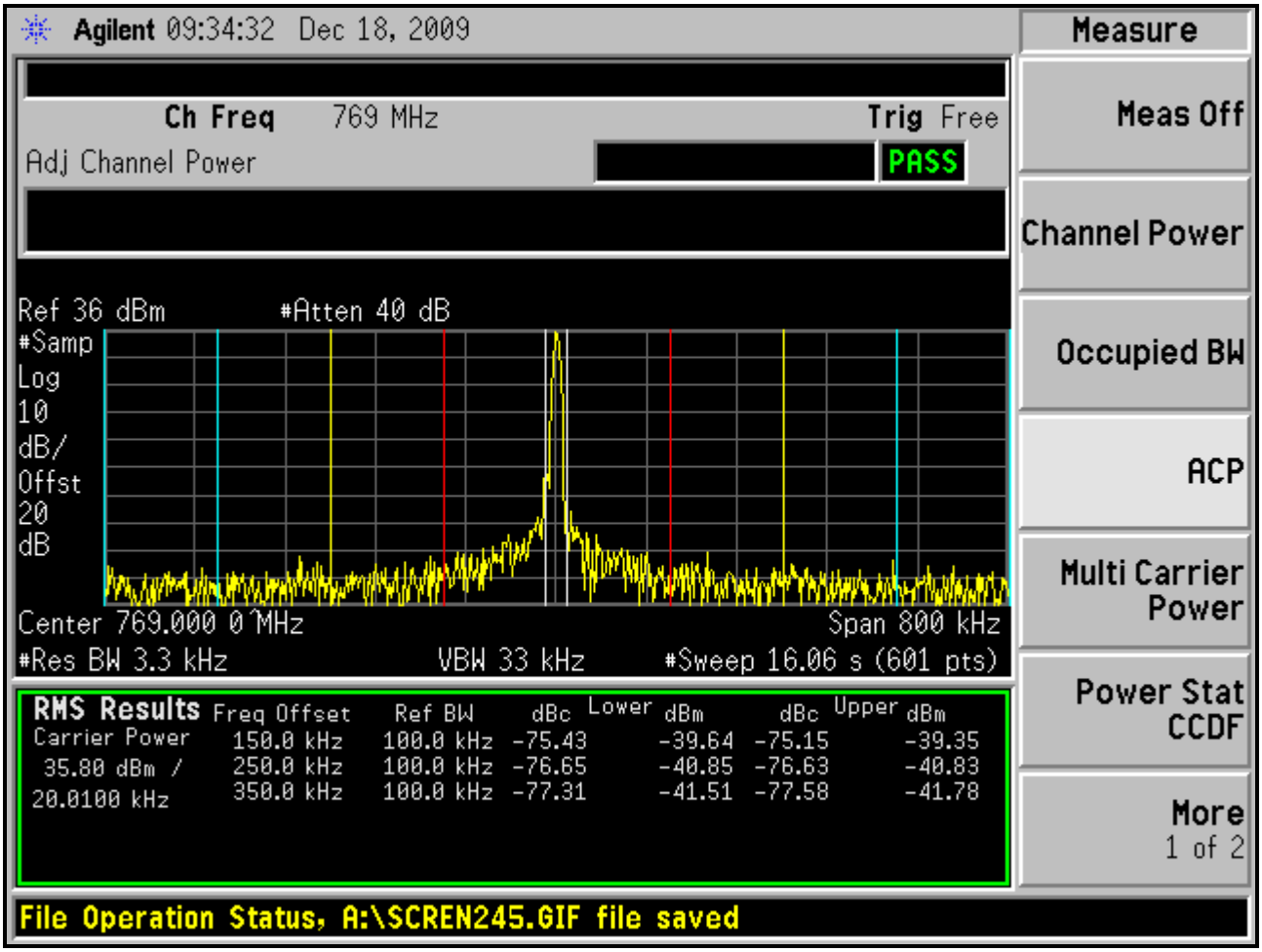


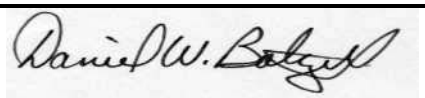
Table 6-1: Adjacent Channel Power – 400 kHz through Receive Band; 769 MHz

Offset from Center Frequency (kHz)	Measurement BW (kHz)	Max ACP (dBc)	Max ACP (dBc)
>400 to 12 MHz	30(s)	-75	-85.6
12 MHz to receive band	30(s)	-75	-96.2
In receive band	30(s)	-100	-104.3

Table 6-2: Test Equipment for Testing ACCP Requirements

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	11/10/10
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	12/3/10

Test Personnel:

Dan Baltzell		December 18, 2009
Test Engineer	Signature	Date Of Tests

7 FCC Rules and Regulations Part 90 §90.210(g) and Part 2 §2.1053(a): Field Strength of Spurious Radiation

7.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.12.

The EUT was tested in both duplex and non-duplex configurations.

The device uses digital modulation modulated to its maximum extent using a pseudo-random data sequence of 9600 bps for NBOTP (Narrow Band OpenSky Trunking Protocol) mode.

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This maximized signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna was further corrected to a half wave dipole.

7.2 Test Data

7.2.1 CFR 47 Part 90.210 Requirements

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Limit: P(dBm) – (43 + 10xLOG P(W))

Table 7-1: Field Strength of Spurious Radiation: 769 MHz

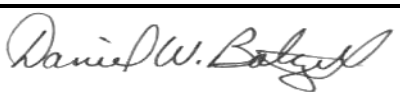
Limit = 43 + 10 log (36) = 49 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to transmit Antenna (dB)	Antenna Gain (dBd)	EIRP (dBc)	Margin (dB)
1538	66.5	-31.5	12.8	6.6	73.8	-24.8
2307	34.3	-62.1	16.6	7.3	107.4	-58.4
3076	60.8	-32.3	16.7	7.2	77.8	-28.8
3845	54.2	-32.3	16.8	7.0	78.1	-29.1
4614	50.9	-32.4	16.6	9.1	75.9	-26.9
5383	39.7	-41.2	16.8	8.5	85.6	-36.6
6152	34.8	-45.5	17.3	9.0	89.8	-40.8
6921	31.9	-47.1	17.5	9.6	91.1	-42.1
7690	31.5	-43.2	17.8	9.4	87.6	-38.6

Table 7-2: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9 kHz - 12.8 GHz)	3826A00144	11/23/10
900928	Hewlett Packard	83752A	Synthesized Sweeper, (0.01 - 20 GHz)	3610A00866	2/9/10
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	12/12/10
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	6/14/10
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	6/14/10
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	6/14/10
901262	ETS	3160-9	Double ridged Guide Antenna (1 - 18 GHz)	6748	5/1/11
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	10/19/10
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS-09302008	RF cable, 20'	NA	10/19/10
901517	Insulated Wire Inc.	KPS-1503-360-KPS-09302008	RF cable 36"	NA	10/19/10
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 30dB gain	N/A	3/4/10

Test Personnel:

Daniel W. Baltzell		December 23, 2009
Test Engineer	Signature	Date Of Test

8 FCC Rules and Regulation Part 2.1055: Frequency Stability; Part 90.213, 90.539: Frequency Stability; Part 80.209: Frequency Stability

8.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +60°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

§ 90.539 Frequency Stability

Transmitters designed to operate in 769–775 MHz and 799–805 MHz frequency bands must meet the frequency stability requirements in this section.
(a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.
(b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.
(c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).
(d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.
(e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

The EUT was tested while the AFC was not locked, therefore, the limit is 1.5 ppm. The worst-case deviation was found to be 1.1 ppm.

8.2 Test Data

Table 8-1: Temperature Frequency Stability – 769 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	769.0008223	1.07
-20	769.0007398	0.96
-10	769.0007245	0.94
0	769.0007543	0.98
10	769.0006865	0.89
20 (reference)	769.0004637	0.60
30	769.0002993	0.39
40	769.0002065	0.27
50	769.0000667	0.09
60	769.0000301	0.04

Result: The EUT is compliant.

8.2.1 Frequency Stability/Voltage Variation

Table 8-2: Frequency Stability/Voltage Variation – 769 MHz

Voltage (VDC)	Measured Frequency (MHz)	ppm
11.73	769.000703	0.91
13.8	769.000702	0.91
15.87	769.000699	0.91

Table 8-3: Test Equipment Used For Testing Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	7/23/10
901300	Agilent Technologies	53131A	Frequency Counter	MY40001345	6/18/10
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	12/3/10

Test Personnel:

Daniel Baltzell		December 18, 2009
EMC Test Engineer	Signature	Date Of Test

9 FCC Rules and Regulations Part 2 §2.202: Necessary Bandwidth and Emission Bandwidth

Type of Emission: F9W
Digital Voice and Data: 9600 BPS

Calculations:

P25 – 9600 bps:
Calculation:
Data rate in bps (R) = 9600
Peak deviation of carrier (D) = 1800
$Bn = [9600/\log_2(4) + 2 (1800) (1) = 8.400$ kHz
Emission designator: 8K40F1D, 8K40F1E

10 Conclusion

The data in this measurement report shows that the **Harris Corporation** Model **Vehicular Repeater Base System (VRBS 7010), FCC ID: OWDTR-0058-E,** complies with all the applicable requirements of FCC Parts 90, 15 and 2.