

SIRIUS SATELLITE RADIO

REMOTE RADIATOR VEHICLE TESTING
UNIVERSITY OF MICHIGAN

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DISCUSSION OF TESTING AND RESULTS

Satellite radio products function to receive satellite radio channels, decode the modulation on the satellite signal and modulate the recovered base band signal onto a carrier in the FM radio band for reception by the FM radio in the vehicle. The remote radiator concept provides for better coupling to the car radio of the modulated FM signal from the satellite receiver.

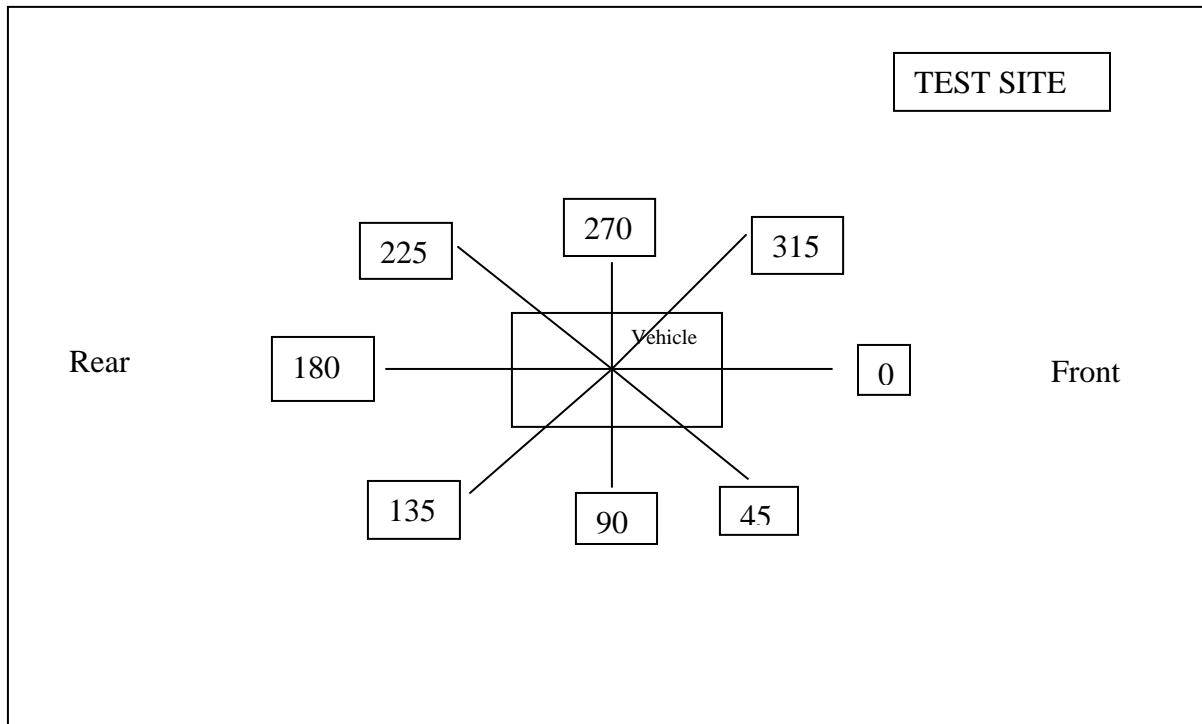
These tests were implemented to gather data on a remote radiator configuration with Sirius Satellite radio products. The data was taken on 8 radials with 3 different vehicles at a distance of 3 meters from the closest point of the vehicle.

In situ testing was performed for three vehicles based on the following vehicle sizes; small, medium, and large. The selected vehicles were: Accura SX, Honda Accord, and a Nissan Quest. The above vehicles have window mount antennas and the remote antenna was located adjacent to the window antenna in each case. Three frequencies in the FM band were measured; one near the low end (88 MHz), middle, (98 MHz) and high end (108 MHz) of the band in both horizontal and vertical polarizations.

A 4th test was performed with the remote radiator located vertically along the right side of the windshield to simulate coupling to a fender mounted car radio antenna. All specified arrangements for locating and attaching the remote radiator relative to car radio antenna were investigated.

The results show that the remote radiator produces levels about 15 dB or more below the FCC Section 15.239 limits when measured 3 meters from the perimeter of the vehicle. In the tables that follow, Kg is the correction factor for preamp gain and cable loss and Ka is the antenna factor for the measurement antenna.

Below is a diagram of the radial arrangement for measurements as laid out on the test site showing their position relative to the vehicle position. Measurement were made using an antenna and mast moved to each marked location. Antenna height was varied from 1 to 4 meters at each location.



Acura RSX w/ Rear Glass Antenna

Radial Angle	88 MHz (dBuV)		98 MHz (dBuV)		108 MHz (dBuV)	
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
0	39	37.3	35.4	32.7	30.9	23.8
45	40.8	42	36.9	32.1	24.4	28.8
90	30.4	28.9	38.8	29.8	31.5	29.4
135	28.4	29.3	37.6	27.3	26.1	31.1
180	34.8	36.7	37.6	40.3	29.9	27
225	35.7	40.1	42.1	38.2	26	30.6
270	30.4	30.3	36.7	33.5	28.9	28.1
315	30.4	26.6	38.2	34.6	27.4	23
Max dBuV	40.8	42	42.1	40.3	31.5	31.1
Max dBuV/m	28.5	29.7	30.4	28.6	21.1	20.7
Limit Margin	-19.5	-18.3	-17.6	-19.4	-26.9	-27.3

42.1	Max Reading (dBuV)
30.4	Max Output (dBuV/m)
-17.6	Min Margin (dB)

Range and BICON calibration			
	Kg	Ka	Corr
88	20.2	7.9	-12.3
98	20	8.3	-11.7
108	19.4	9	-10.4



Nissan Quest w/ Side Glass Diversity

Radial Angle	88 MHz (dBuV)		98 MHz (dBuV)		108 MHz (dBuV)	
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
0	30.9	32.4	42.6	32.7	30.1	26.2
45	30.9	33.5	39.7	33	27.9	28.6
90	35.4	36.3	36.7	36.1	29.7	29.1
135	29.1	29.4	34.7	32.8	28.8	28.5
180	28.6	30.5	36.8	36.8	23.7	25.4
225	30.6	35.3	41.4	39.3	26.3	27.3
270	31.7	33.7	37.9	33.9	28.1	30.7
315	29.2	32.4	36.1	40.6	28.3	28.1
Max dBuV	35.4	36.3	42.6	40.6	30.1	30.7
Max dBuV/m	23.1	24	30.9	28.9	19.7	20.3
Limit Margin	-24.9	-24	-17.1	-19.1	-28.3	-27.7

42.6	Max Reading (dBuV)
30.9	Max Output (dBuV/m)
-17.1	Min Margin (dB)

Range and BICON calibration			
	Kg	Ka	Corr
88	20.2	7.9	-12.3
98	20	8.3	-11.7
108	19.4	9	-10.4



Honda Accord with Rear Glass Antenna Remote Radiator Mounted Along Rear Antenna

Radial Angle	88 MHz (dBuV)		98 MHz (dBuV)		108 MHz (dBuV)	
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
0	35.3	31.5	44.2	39.7	32.8	28.5
45	38.1	40.2	38.8	38.5	30.5	27.5
90	39	36.2	40.9	43.6	31.4	30.1
135	30.5	27.6	41.9	39.2	25.5	35
180	37.4	38.3	40.5	37.8	33.9	26.8
225	31.4	34	38.9	41.1	29.5	26.9
270	36.5	38.1	40.1	43.9	29.3	36.7
315	36.5	34.7	39.7	37.9	29.7	28.1
Max dBuV	39	40.2	44.2	43.9	33.9	36.7
Max dBuV/m	26.7	27.9	32.5	32.2	23.5	26.3
Limit Margin	-21.3	-20.1	-15.5	-15.8	-24.5	-21.7

44.2

Max Reading (dBuV)

32.5

Max Output (dBuV/m)

-15.5

Min Margin (dB)

Range and BICON calibration			
	Kg	Ka	Corr
88	20.2	7.9	-12.3
98	20	8.3	-11.7
108	19.4	9	-10.4



Honda Accord with Rear Glass Antenna Remote Radiator Mounted Along A-pillar

Radial Angle	88 MHz (dBuV)		98 MHz (dBuV)		108 MHz (dBuV)	
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
0	37.5	34.5	40.6	36.4	33.9	25.1
45	37.5	29.1	36.4	30.7	35.1	27.1
90	30.3	29.6	38.9	32.5	31.8	34
135	29.1	33.1	37.7	35.9	30.5	41.4
180	40.5	41.7	39.6	40.4	30.5	26.7
225	32.5	30.3	39.7	40.2	27.9	27.1
270	37.6	36.7	36.7	37.3	28.4	30.5
315	28.8	34.6	37.8	34.7	34.7	29.9
Max dBuV	40.5	41.7	40.6	40.4	35.1	41.4
Max dBuV/m	28.2	29.4	28.9	28.7	24.7	31
Limit Margin	-19.8	-18.6	-19.1	-19.3	-23.3	-17

41.7	Max Reading (dBuV)
31	Max Output (dBuV/m)
-17	Min Margin (dB)

Range and BICON calibration			
	Kg	Ka	Corr
88	20.2	7.9	-12.3
98	20	8.3	-11.7
108	19.4	9	-10.4



TEST SITE PHOTOS

