NEBRASKA CENTER FOR EXCELLENCE IN ELECTRONICS
4740 Discovery Drive
Lincoln, NE 68521
402-472-5880

ACCREDITED
Certificate Number 1953-01

Test Report

Company: Radiotronix, Inc.
207 Industrial Blvd.
Moore, OK 73160
Contact: Tom Marks

Product: Suretalk RF Base-station
FCC ID: Q7V-3F0002RDTX

Test Report No: R042303-01-02

APPROVED BY: Steve Cass
General Manager

Doug Kramer
Test Engineer

Date: 21 September 2004
Total Pages: 20

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1.0 Summary of test results

1.1 Test Results

Test	Test Specification	Results
CFR 47, FCC Part 15.203	Part 15.203	Complies
CFR 47, FCC Part 15.207	Part 15.207	Complies
CFR 47, FCC Part 15.209	Part 15.209, Class B	Complies
CFR 47, FCC Part 15.249	Part 15.249	Complies

1.2 Test Methods

1.2.1 Conducted Emissions

Measurements of conducted emissions were not performed, as the EUT does not tie into any mains networks. The EUT is intended for automobile use and powered by battery. Modifications were made to the base station portion of the EUT to allow for an AC/DC adapter in order to facilitate testing.

1.2.2 Radiated Emissions

Compliance to CFR 47 Parts 15.209 and 15.249 was tested in accordance with the methods of ANSI/IEEE C63.4, 2001. Several configurations were examined the results presented represent a worst-case scenario. The EUT was placed on a wooden table approximately 80cm high and centered on a 4m diameter turntable. The table was rotated to maximize emissions. All measurements were taken at a distance of 3m from the EUT.

2.0 Description

2.1 Equipment under test

The Suretalk RF Base-Station is an automobile mounted digital transceiver and analog receiver for use with the Suretalk RF microphone belt-pack. The Base-Station is mounted in a law enforcement vehicle for use in receiving audio signal from the microphone. The digital transceiver is for channel selection and control for the FM audio coming from the belt-pack.

2.1.1 Identification: Suretalk RF Base-Station

2.1.2 EUT tested dates: 27 May and 21 September 2004

2.1.3 Manufacturer: Radiotronix, Inc.

2.1.4 Serial number: BSFCCTEST1

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC registered lab. This site has been fully described in a report submitted to the FCC, and accepted in a letter dated May 4, 2001. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 46 ± 4%
Temperature of 21 ± 3° Celsius

2.3 Special equipment or setup

The device was modified to enable the transmitter to be active continuously and to have operator selectable frequency control. The antennas were oriented in a position so that emissions would be maximized; intended orientation is at 45° from vertical.

3.0 Test equipment used

Serial #	*Manufacturer*	*Model*	*Description*	*Last cal.*
1647	EMCO	3142B	Biconilog antenna	10-Nov-03
6416	EMCO	3115	DRG Horn	17-Sep-03*
100037	Rohde & Schwarz	ESIB26	EMI Test Receiver	08-Jun-04
082001/003	Rohde & Schwarz	TS-PR18	Preamplifier	N/A
2575	Rohde & Schwarz	ES-K1	Software v1.60	N/A

*Not used for testing after cal. date expiration

4.0 Detailed Results

Radiated emissions measurements were made by first using a spectrum analyzer getting a rough signal spectrum, any points were then measured using a CISPR 16 compliant receiver with the following bandwidth setting:

30MHz - 1GHz: 120kHz IF bandwidth, 60kHz steps
Above 1GHz: 1MHz IF bandwidth, 500kHz steps

Conducted measurements were made using a CISPR 16 compliant receiver with the IF bandwidth set to 9kHz taking 5kHz steps through the range 150kHz to 30MHz.
All results shown are corrected to incorporate cables losses, antenna factors, and any amplification.

4.1 FCC Part 15.203 unique connector for antenna

The antenna for the transceiver portion is a helix antenna that is connected via a reverse SMA connection. The antenna for the receiver portion of the device is the other matched antenna. See Figures 2 and 5.

4.2 FCC Part 15.207 Conducted Emissions

Measurements of conducted emissions were not performed, as the EUT does not tie into any mains networks. The EUT is intended for automobile use and powered by battery. Modifications were made to the base station portion of the EUT to allow for an AC/DC adapter in order to facilitate testing.

4.3 FCC Part 15.209 Radiated Emissions

The EUT was found to not produce any emissions within 15dB of the Class 'B' limits. The test setup can be seen in Figures 3 and 4. More information on the radiated emissions can be found in Section 4.4. The transmitter was not active for these measurements.

4.4 FCC Part 15.249 Radiated Emissions

The EUT was tested with the transmitter continuously operating and when the receivers are "listening". Values, as measured with peak and quasi-peak (QP) detectors (30MHz –1GHz) or peak and average detectors (above 1GHz) are shown in Appendix B. No QP emissions were detected above the limits.

An average correction factor (AV) of –9.1dB was applied to the measurements above 1GHz. The averaging factor was calculated by the following:

$$AverageFactor(AV) = 20\log(\frac{35}{100}) = -9.1dB$$

Where 35msec is the longest duration of any pulse train (Figure 6) in a 100msec period, per the coding specifications for this system. The use of this factor is denoted by a '*' in the tables in Appendix B.

Appendix A

Test setup photos

Figure 1 EUT configured for use with belt-pack in place

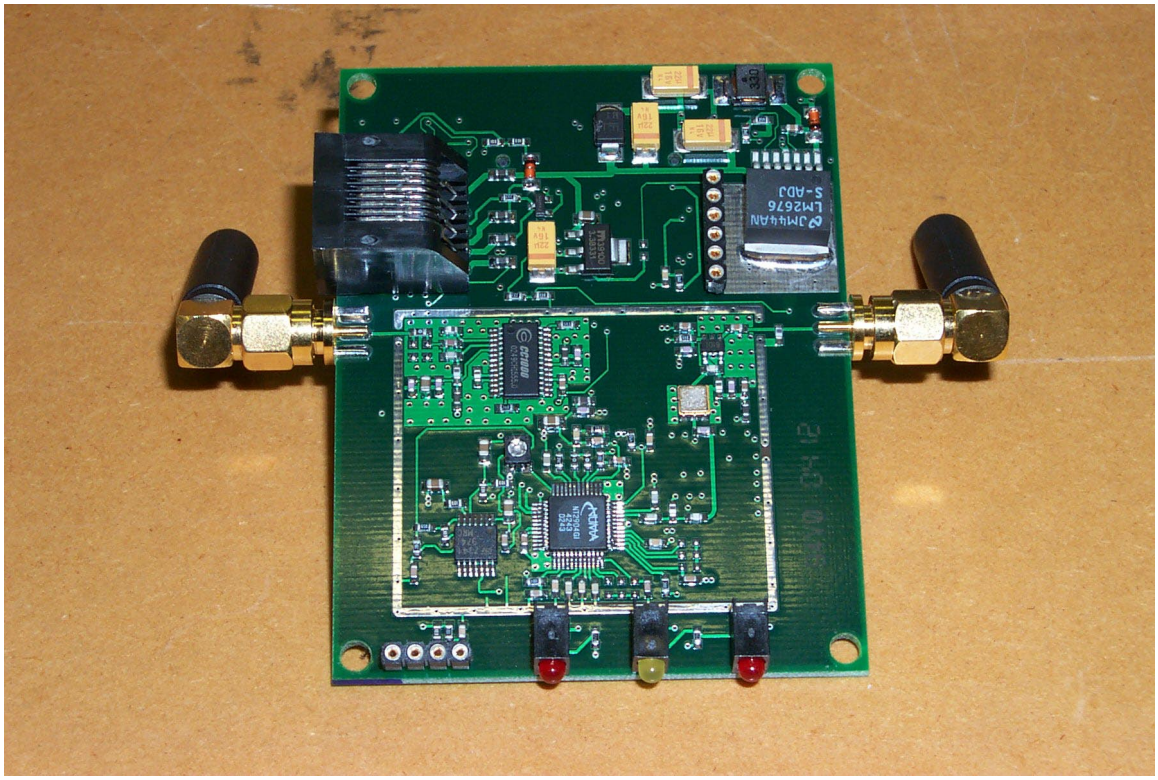


Figure 2 EUT antenna mounts

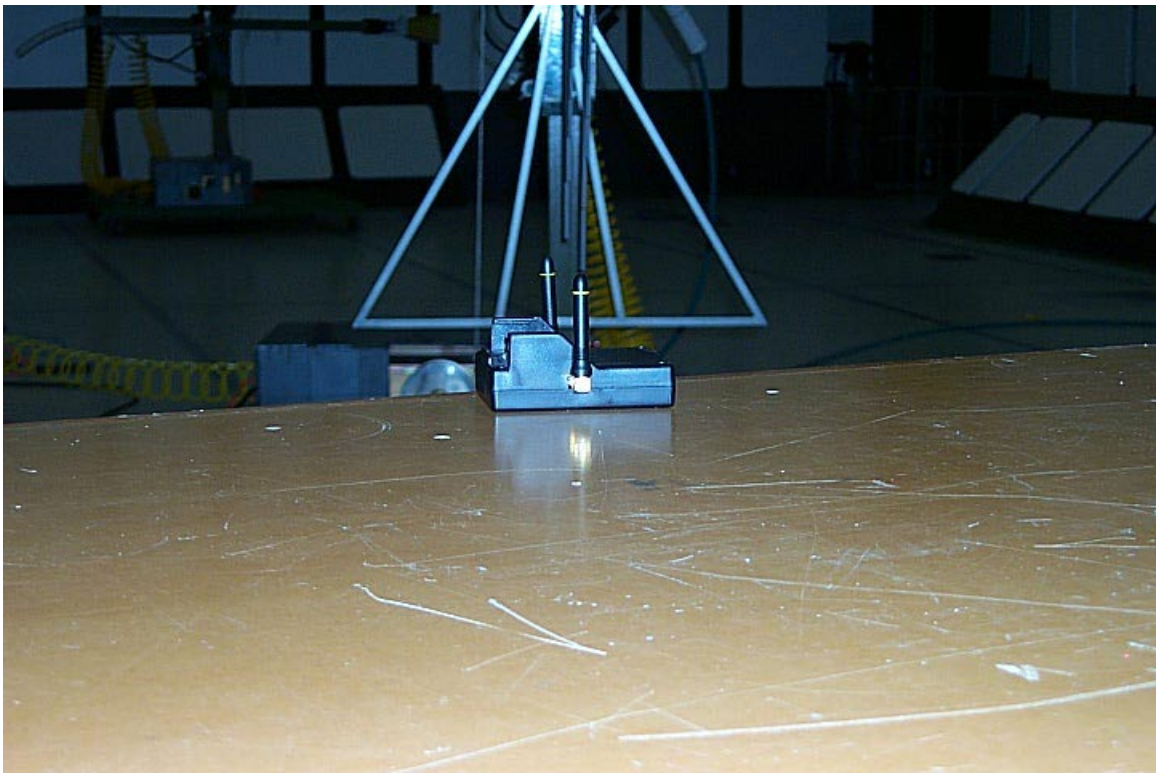


Figure 3 Test setup

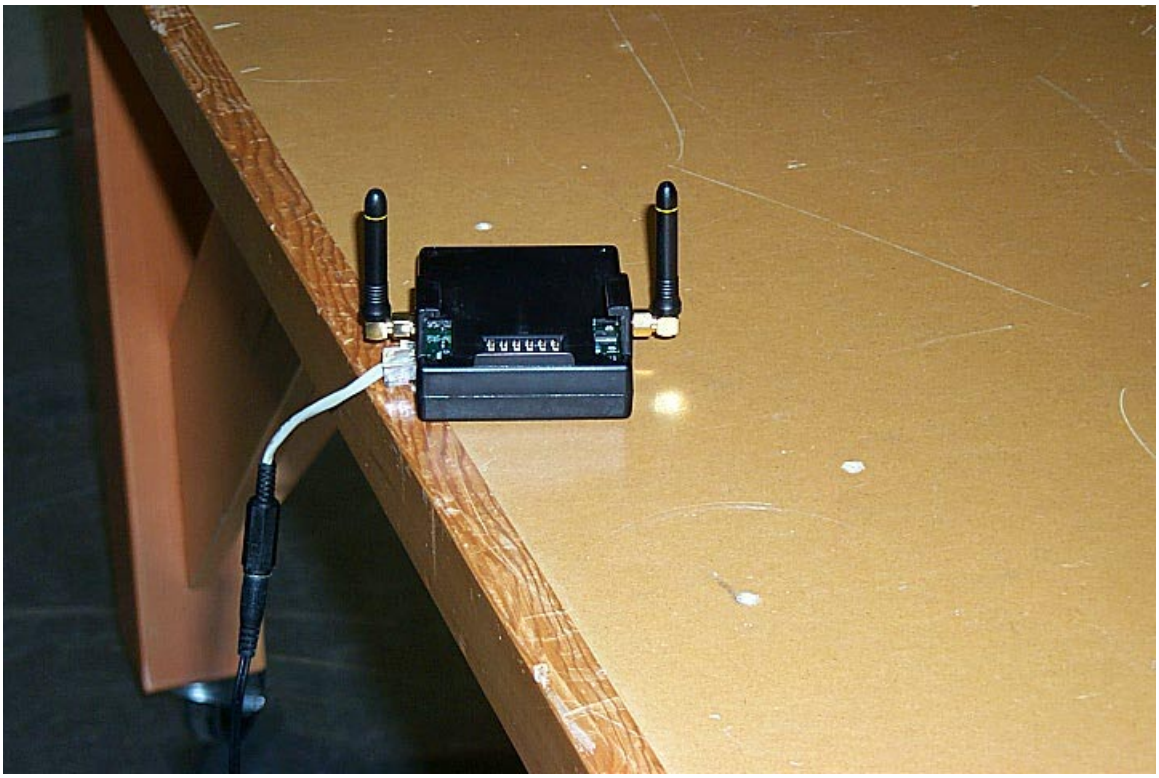


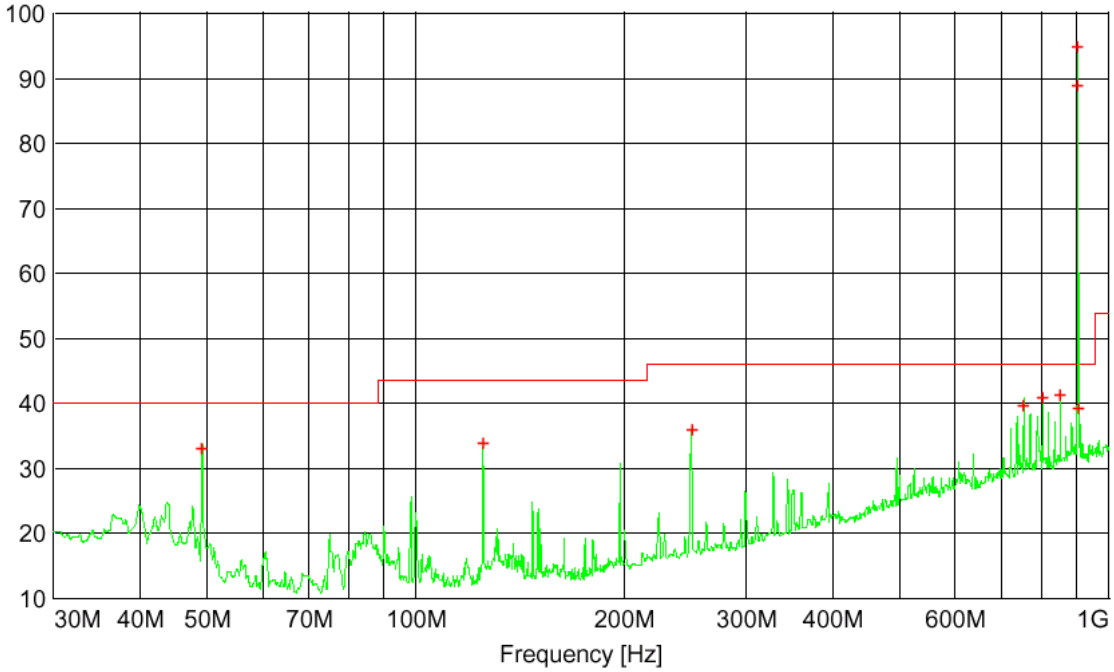
Figure 4 Test setup

Figure 5 Antenna connectors (reverse SMA)

Appendix B

Emissions plots and tables

Channel 1, 903.3623MHz



PEAK (120kHz RBW)

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
49.140000	33.19	22.77	40.0	6.8	102.0	88	VERT
124.980000	34.00	25.15	43.5	9.5	101.0	88	VERT
250.020000	35.97	21.27	46.0	10.0	162.0	164	VERT
754.560000	39.86	14.56	46.0	6.1	115.0	127	HORI
803.640000	40.95	14.95	46.0	5.1	109.0	129	HORI
851.940000	41.35	14.13	46.0	4.7	99.0	291	HORI
902.040000	95.00	67.10	93.9	-1.1	100.0	134	HORI
902.100000	88.77	60.88	93.9	5.13	100.0	265	HORI
906.420000	39.08	11.37	93.9	54.82	100.0	134	HORI

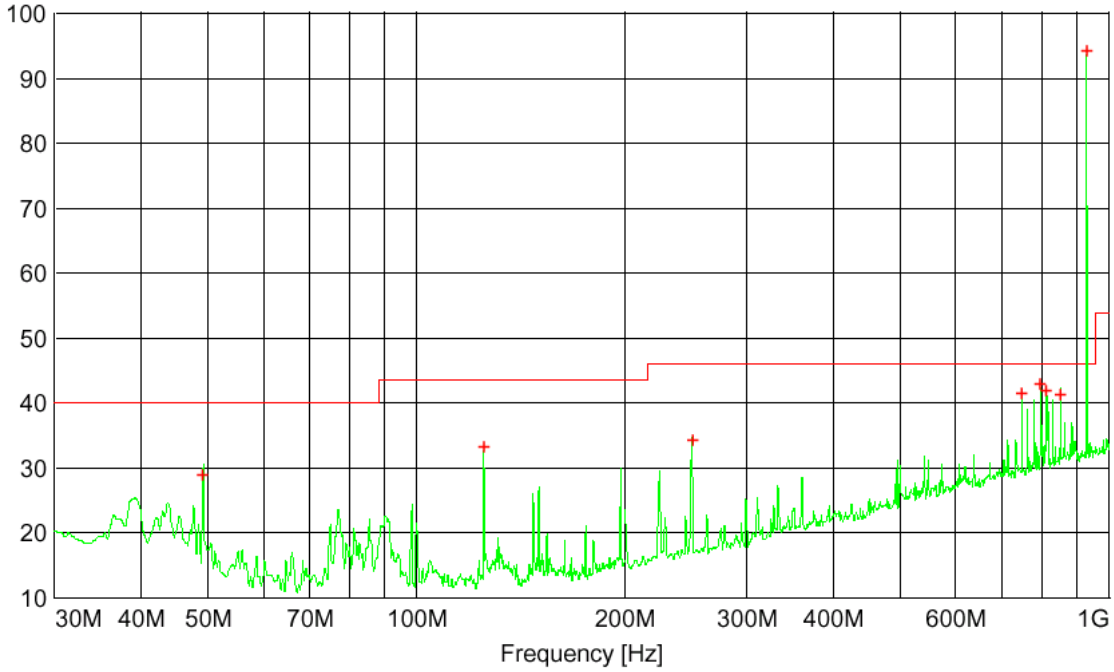
AVERAGE (1MHz RBW) *factor applied, Path Corrected Level + AV (AV = -9.1)

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1804.0000	45.38*	51.96	53.9	8.52	106.0	287	HORI
1812.0000	43.27*	49.78	53.9	10.63	106.0	272	VERT
2707.0000	42.76*	44.25	53.9	11.14	119.0	282	HORI
3608.0000	42.82*	41.02	53.9	11.08	115.0	282	HORI
4510.0000	38.26*	33.85	53.9	15.64	119.0	283	HORI
9142.5000	29.02*	15.80	53.9	24.88	100.0	170	VERT

PEAK (1MHz RBW)

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1804.0000	55.48	52.95	73.9	18.42	106.0	287	HORI
1812.0000	53.67	51.09	73.9	20.23	106.0	272	VERT
2707.0000	57.47	49.85	73.9	36.43	119.0	282	HORI
3608.0000	54.60	43.70	73.9	19.30	115.0	282	HORI
4510.0000	51.65	38.14	73.9	22.25	119.0	283	HORI
9142.5000	51.53	29.21	73.9	22.37	100.0	170	VERT

Channel 20, 927.6664MHz



PEAK (120kHz RBW)

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
49.140000	28.94	18.53	40.0	11.1	100.0	39	VERT
124.980000	33.21	24.36	43.5	10.3	100.0	346	VERT
250.020000	34.48	19.78	46.0	11.5	162.0	33	VERT
747.600000	41.53	16.20	46.0	4.5	115.0	132	HORI
796.800000	42.86	16.96	46.0	3.1	102.0	127	HORI
811.800000	41.95	15.81	46.0	4.1	109.0	127	HORI
851.940000	41.28	14.06	46.0	4.7	100.0	155	HORI
927.840000	94.21	66.77	93.9	-0.31	98.0	263	HORI

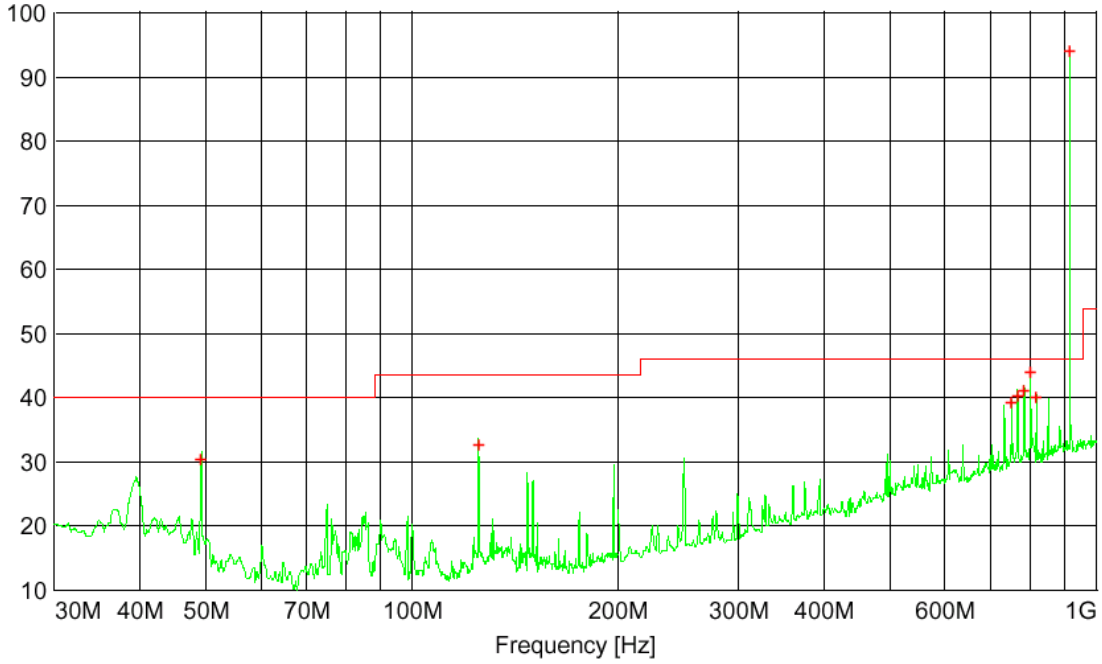
AVERAGE (1MHz RBW) *factor applied, Path Corrected Level + AV

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1850.000	45.01*	51.25	53.9	8.89	106.0	87	VERT
1856.000	46.86*	53.08	53.9	7.04	106.0	137	HORI
2784.500	50.42*	51.55	53.9	3.48	100.0	137	HORI
3711.500	48.21*	46.18	53.9	5.69	107.0	123	HORI
4639.500	39.48*	34.47	53.9	14.42	119.0	127	HORI
5567.500	35.30*	26.46	53.9	18.60	119.0	127	HORI
9112.500	29.15*	15.86	53.9	24.75	100.0	359	VERT

PEAK (1MHz RBW)

Frequency MHz	Corrected Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1850.000	55.27	52.41	73.9	18.63	106.0	87	VERT
1856.000	58.12	55.23	73.9	15.78	106.0	137	HORI
2784.500	65.08	57.12	73.9	8.82	100.0	137	HORI
3711.500	59.12	47.98	73.9	14.70	107.0	123	HORI
4639.500	52.50	38.39	73.9	21.40	119.0	127	HORI
5567.500	51.67	33.73	73.9	22.23	119.0	127	HORI
9112.500	51.60	29.21	73.9	22.30	100.0	359	VERT

Channel 10, 914.9233MHz



PEAK (120kHz RBW)

Frequency MHz	Corr. Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
49.140000	30.43	20.01	40.0	9.6	106.0	136	VERT
124.980000	32.56	23.71	43.5	10.9	100.0	255	VERT
751.080000	39.09	13.79	46.0	6.9	100.0	85	HORI
767.460000	40.19	14.43	46.0	5.8	101.0	127	HORI
783.780000	41.12	15.25	46.0	4.9	100.0	110	HORI
800.160000	43.98	17.98	46.0	2.0	100.0	122	HORI
816.540000	40.09	13.86	46.0	5.9	99.0	87	HORI
914.940000	94.05	66.40	93.9	-0.15	101.0	253	HORI

AVERAGE (1MHz RBW) *factor applied, Path Corrected Level + AV

Frequency MHz	Corr. Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1830.000000	48.31*	54.70	53.9	6.40	100.0	91	VERT
5715.000000	23.89*	13.93	53.9	30.01	281.0	75	VERT
5807.500000	23.84*	13.46	53.9	30.06	299.0	28	VERT
8715.500000	28.40*	16.03	53.9	25.50	149.0	115	HORI
9064.000000	29.01*	15.83	53.9	24.89	201.0	260	VERT

PEAK (1MHz RBW)

Frequency MHz	Corr. Level dBµV/m	RA dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
1830.000000	58.20	55.49	73.9	15.70	100.0	91	VERT
5715.000000	46.78	27.71	73.9	27.12	281.0	75	VERT
5807.500000	46.17	26.69	73.9	27.73	299.0	28	VERT
8715.500000	51.18	29.71	73.9	22.72	149.0	115	HORI
9064.000000	52.12	29.84	73.9	21.78	201.0	260	VERT

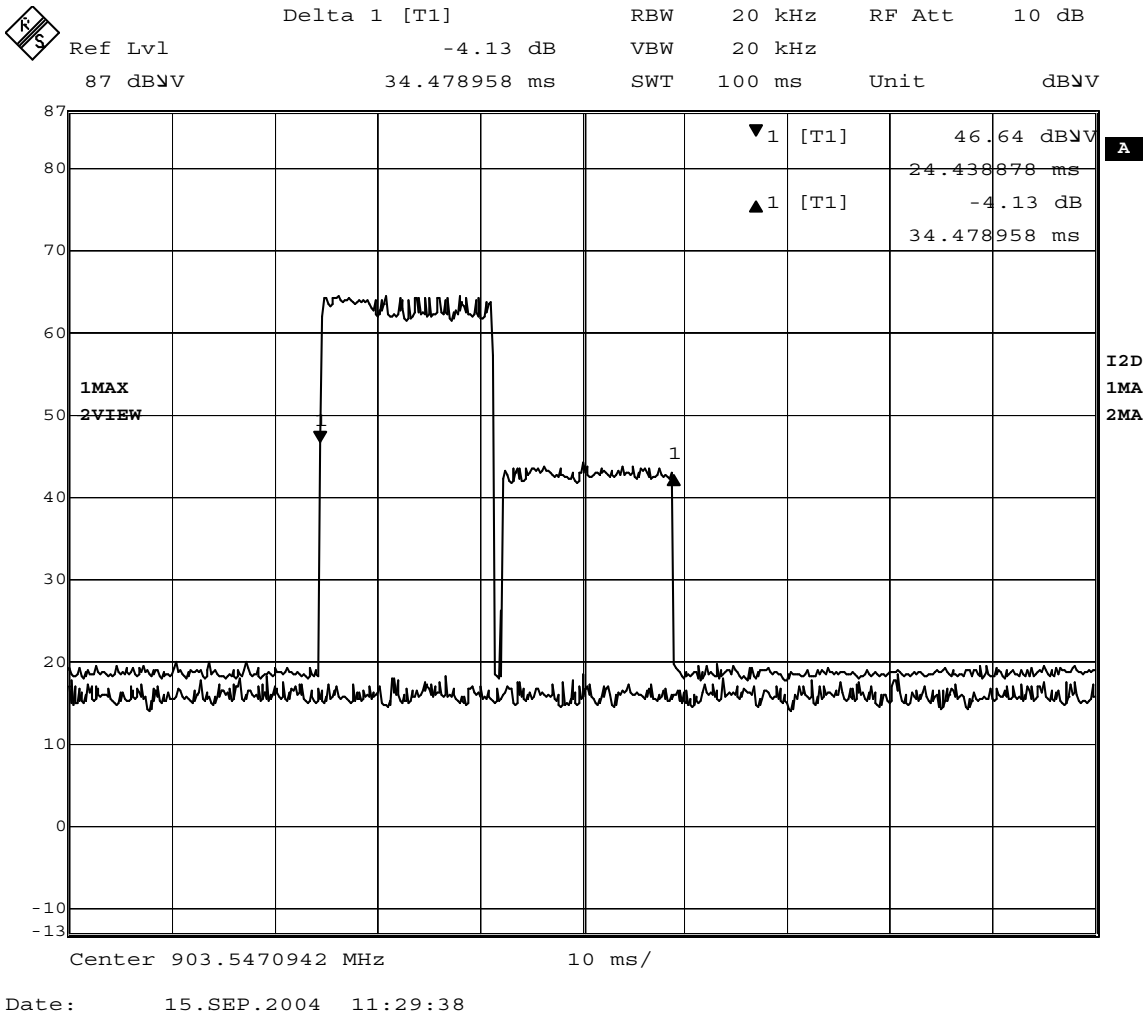


Figure 6 Digital transmissions

Maximum duty cycle, shown is transmission from base and response from belt-pack. Total time was used to determine average factor. The RF messages (both microphone and base-station) are fixed-length with a 9-byte preamble, 13-byte payload, and 1-byte CRC. The total transmission time is ~19.1msec. There will be some variation in this as the OS will activate and deactivate the transmitter; an estimate of 35msec allows plenty of margin for that.

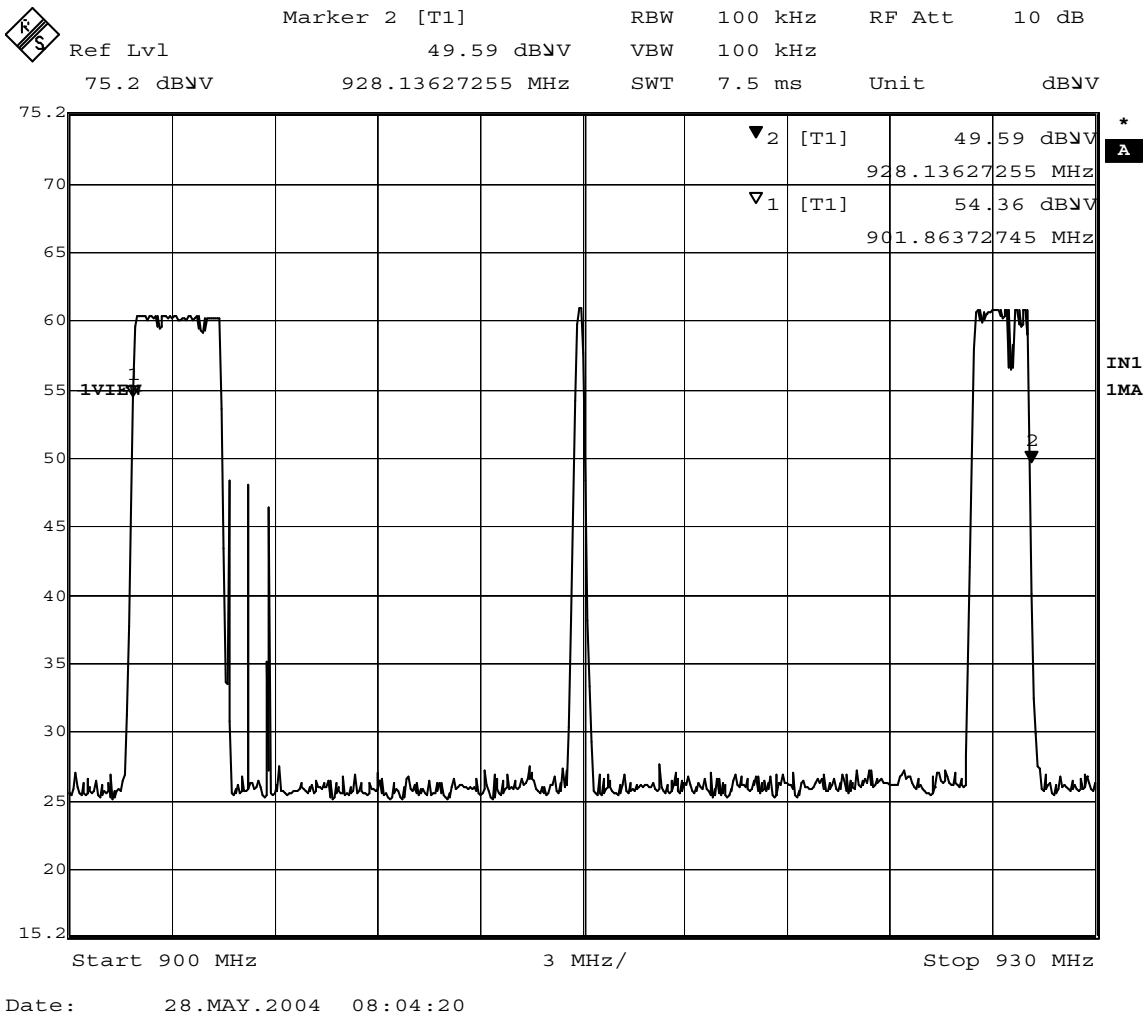


Figure 7 Frequency range of operation (NOTE: lower 2 and upper most channels have been removed in order to maintain 902-928MHz band). Levels not corrected for signal path. Spectrum analyzer set for MAX-HOLD

When a path correction factor of 27.5dB is added to the results shown in Figure 7, the resulting field strength is approximately 89.5dBµV/m.

Figure 8 is the results multiple scans using a quasi-peak detector over the course of 11-hours with the unit in normal operation. Figure 9 is the same configuration over a 15-minute period.

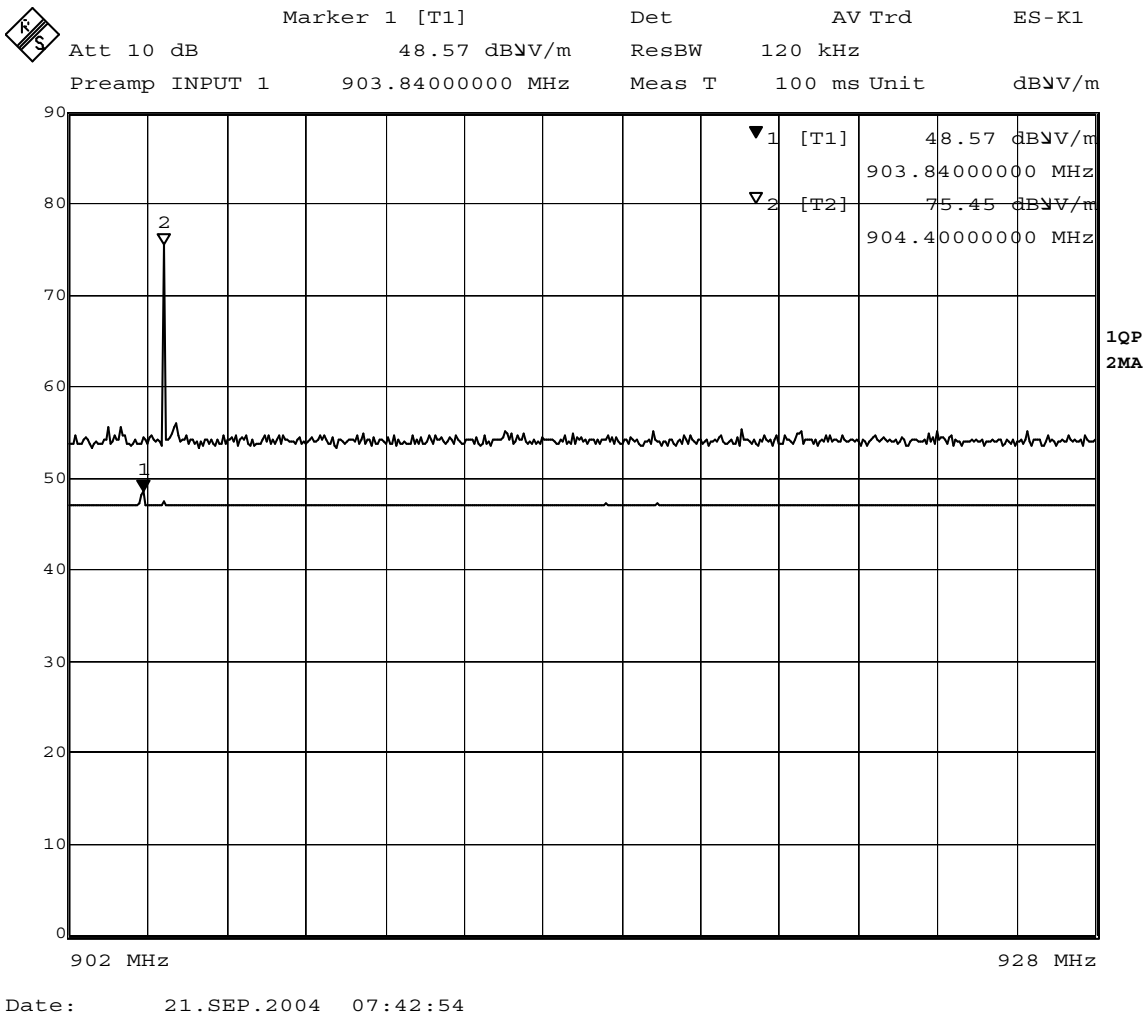


Figure 8 10-hours of observation. Trace 2 is PEAK, Trace 1 is QUASI-PEAK, both traces set to MAX-HOLD

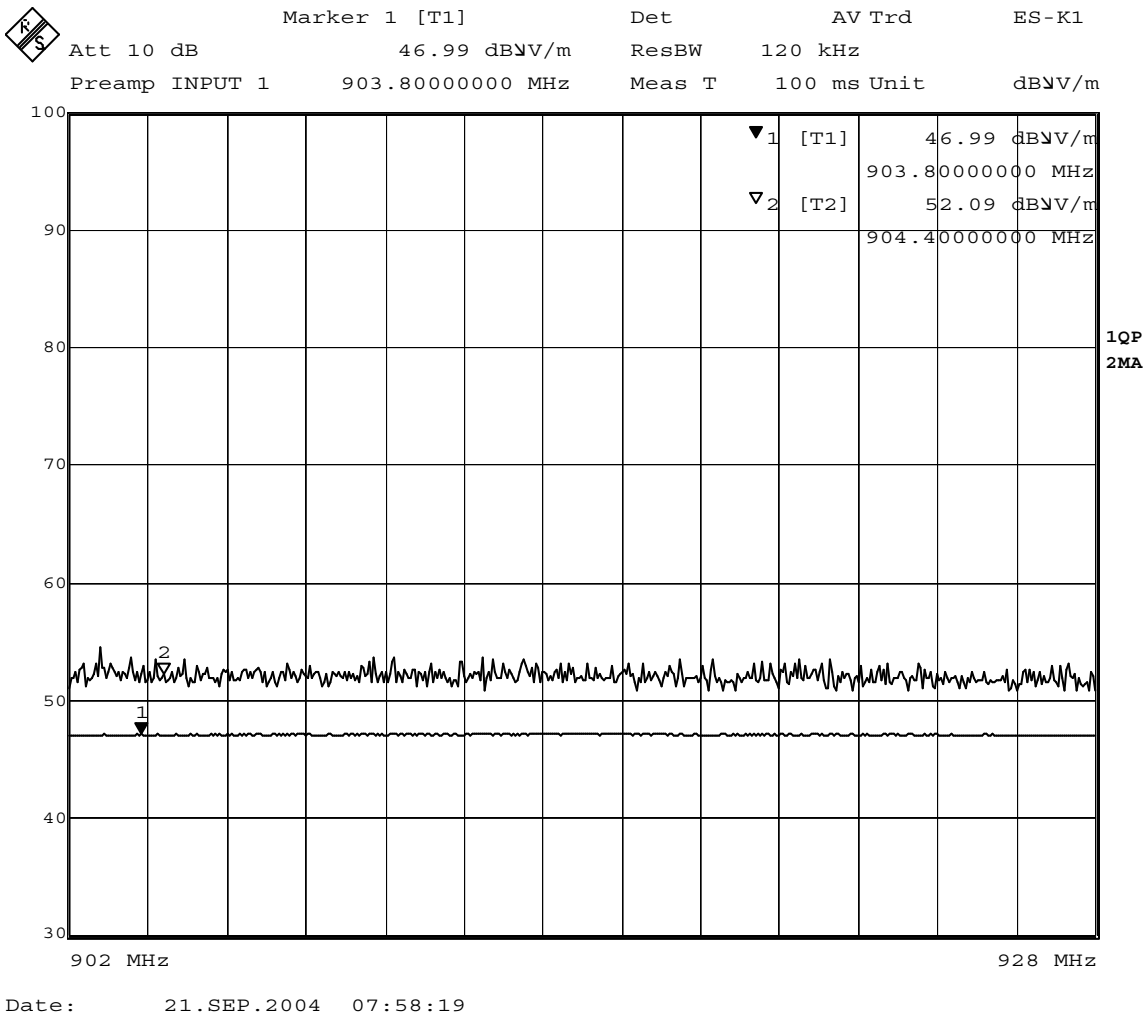
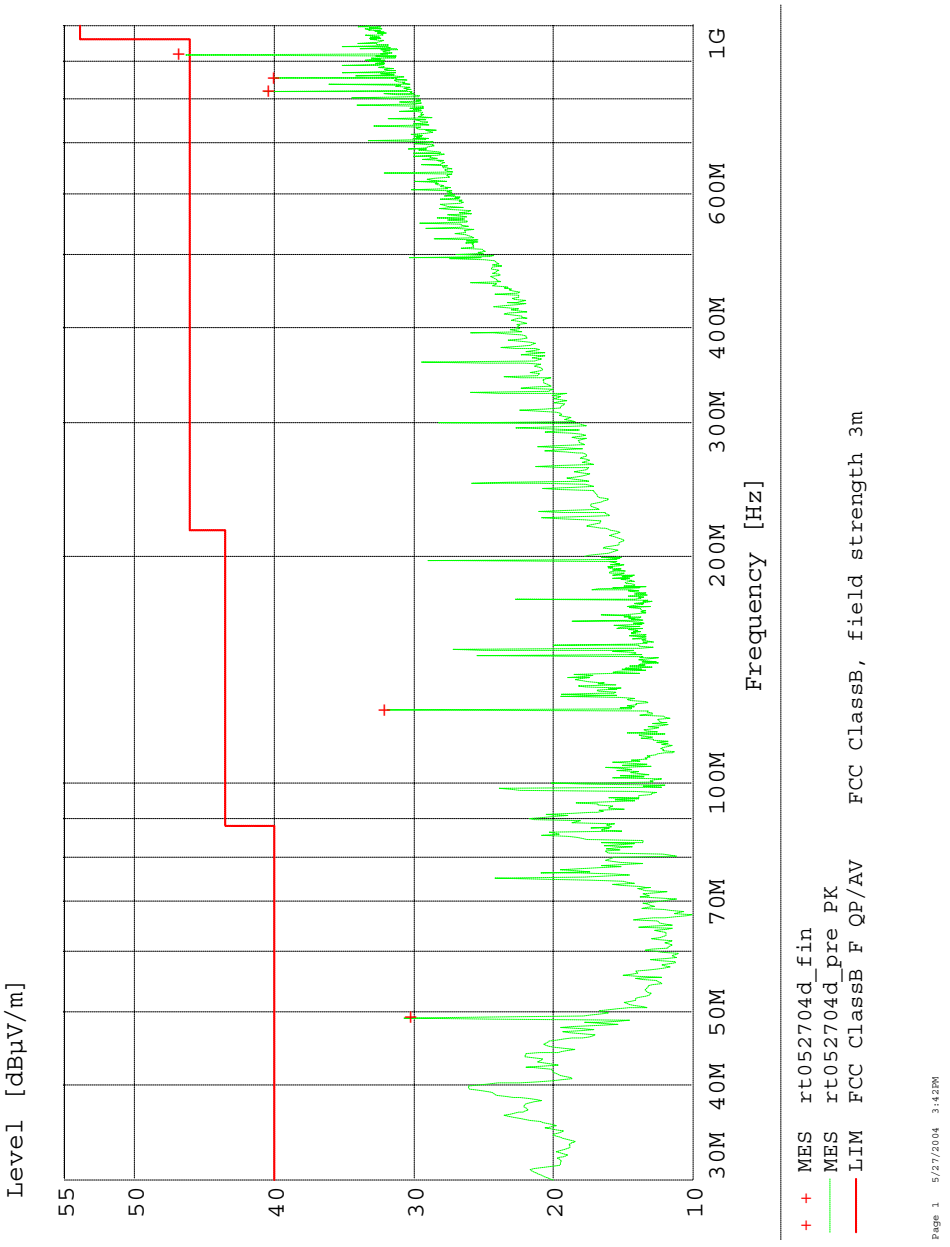


Figure 9 15-minutes of observation. Trace 2 is PEAK, Trace 1 is QUASI-PEAK, both traces set to MAX-HOLD

With a Quasi-Peak detector, no emissions were found in excess of the limit during normal operations.

ANALOG AND DIGITAL RECEIVERS FOR AUTOMOBILE INSTALLATION



QUASI-PEAK

Frequency MHz	Level dBµV/m	Measured dBµV	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
49.140000	30.44	20.03	40.0	9.6	100.0	39	VERT
124.980000	32.34	23.49	43.5	11.2	100.0	267	VERT
819.180000	40.67	14.39	46.0	5.3	99.0	329	HORI
851.940000	40.29	13.06	46.0	5.7	101.0	356	HORI
914.760000	47.10	19.45	46.0	-1.1	100.0	268	HORI

Appendix C

Sample calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBµV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBµV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m