SMITH ELECTRONICS, INC.
ELECTROMAGNETIC COMPATIBILITY LABORATORIES

RADIO-FREQUENCY EMISSIONS TEST REPORT

FOR

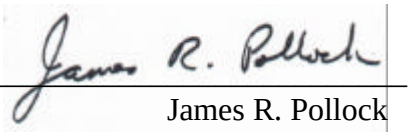
AVCOM SMT, INC

Receiver

Model R7H-BKLINK-R

September 21, 2004

Prepared by:



James R. Pollock

Prepared for:

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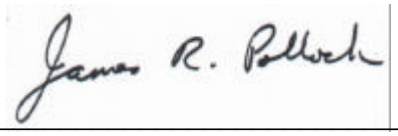
TABLE OF CONTENTS

CERTIFICATE OF COMPLIANCE

1.	Manufacturer:	Avcom SMT, Inc. 213 East Broadway Westerville, OH 43081
2.	Contact:	Paul H. Wiese Avcom SMT, Inc. 614/882-8176
3.	Regulation:	CFR47 – Part 15 15.107, 15.109
4.	Measurement Method:	ANSI C63.4-1992
5.	EUT:	Receiver Model R7H-BKLINK-R
6.	Type:	Wireless Audio Link Receiver
7.	Tuned Frequencies	907.744 MHz, 916.36352 MHz, 924.7488 MHz
8.	Test Dates:	June 15 – 17, 2004
9.	Test Location	Smith Electronics, Inc. Test Lab and Open Field Site 8200 Snowville Rd. Brecksville, OH

10. Statement of Compliance:

I hereby certify that measurements of radio frequency emissions from the Avcom SMT, Inc. Model R7H-BKLINK-R wireless link receiver were performed by me on June 15 to 17, 2004, and that the results of the measurements confirmed that the unit tested is capable of compliance with the above regulation.



September 21, 2004
Date

James R. Pollock, President
Smith Electronics, Inc.

RADIO FREQUENCY EMISSION MEASUREMENTS

OBJECTIVE:

The receiver emissions were measured in order to show that the emissions from the receivers were within the requirements of FCC Parts 15.107 and 15.109 for equipment of this type.

SUMMARY

The prototype of the Avcom SMT, Inc. Model R7H-BKLINK-R wireless link receiver has been shown to be capable of complying with those requirements of the Federal Communications Commission for an intentional radiator under Parts 15.107 and 15.109.

All measured radiated emissions appear to be more than 17 dB below the 15.109 limits. The conducted measurements were also well suppressed, being about 10 dB or more below the new 15.107 limits. As the antenna is part of the circuit board and no provision for an external antenna is available, Part 15.111 measurements were not performed.

TEST INFORMATION

EQUIPMENT UNDER TEST	Model R7H BKLINK-R Wireless Audio Link Receiver
MANUFACTURER	Avcom SMT, Inc. 213 East Broadway Westerville, OH 43081
TEST DATES	June 15 – 17, 2004
TEST LABORATORY	Smith Electronics, Inc. 8200 Snowville Rd. Brecksville, OH 44141 (440)526-4386
MEASUREMENT EQUIPMENT	Hewlett-Packard Spectrum Analyzer 8568B with: 85650A RF Section S/N 2216A02120 85662A Display Section S/N 2152A03686 85650A Quasi-Peak Adapter S/N 2043A00350 Calibrated July, 2004 Hewlett Packard Spectrum Analyzer Model 8503EM S/N 3536A00147 Calibrated January, 2004 Singer Instrumentation EMI Receiver SN: 0366-06168 Calibrated June, 2003
ANTENNAS	EMCO Biconical Model 3104 Frequency Range 20 – 200 MHz EMCO Log-Periodic Model 3146 Frequency Range 200 – 1000 MHz Stoddart Tuned Dipole Model 91598-2 Frequency Range 400 – 1000 MHz EMCO Double Ridged Guide Horn Model 3115 Frequency Range 1 – 18 GHz
MISCELLANEOUS	Hewlett-Packard Preamplifier Model 8447D S/N 1937A03103 12.2 m RG-214/U coaxial cable 0.6 m RG-214/U coaxial cable

TEST REPORT

INTRODUCTION

The Model R7H-BKLINK-R receiver (EUT), manufactured by Avcom SMT, Inc. (Avcom) is part of a system specifically designed for receiving the short-range transmissions of audio signals from a companion transmitter. The audio is transmitted using pulse-width modulation and picked up by the receiver to be fed to a powered remote speaker.

The R7H-BKLINK-R will be produced in two configurations. Each configuration can be set to receive on one of two frequencies. Each configuration will receive at a frequency of 916,36352 MHz. Additionally, one configuration will also receive at 907.744 MHz and the other at about 924.7488 MHz. This report indicates that the emissions of each configuration are within the limits set by 15.107 and 15.109.

RADIATED EMISSIONS

Field strength measurements were performed on the prototype receiver to assure that the radiated emissions were capable of compliance with the requirements of 15.109.

As the LO emissions could not be detected at the three meter test distance, the receiver was moved to a 1 meter distance. The LO emissions were measured using the Singer receiver and the tuned dipole antenna. The procedures of ANSI C63.4-1992 were followed except that the test antenna was not varied in elevation.

The harmonic frequencies were measured in an area of the facility free of reflecting surfaces at a test distance of 0.5 meters. A double ridged wave guide antenna and the 8593EM spectrum analyzer were used for these measurements.

Measurements were made at the two frequencies for each configuration. As both configurations were tested, all three frequencies used were measured. This includes one at the low end of the band, one at the high end and two measurements in the middle of the band. Results of the measurements are found in Tables 1 through 4.

Each of the four tables contains the measured data from one of the test frequencies. To save space in the tables, nominal test frequencies were used to the nearest MHz. Table 5 lists each of the actual test frequencies and the nominal frequency used to designate that frequency.

A scan of the emissions from the receivers was made in the shielded room to determine if any emissions other than those produced by the receiver portion of the circuitry were of concern. As can be seen in Fig. 1, covering 30 MHz to 1000 MHz, the only emissions observed are the LO signal and the ambient emissions. As no emissions other than the LO were observed below 1000 MHz, no open field measurements were made in this frequency range.

. Figure 1 is the worst case of both configurations and the three frequencies.

CONDUCTED EMISSIONS

As the receiver is powered from the AC line using a Tamura 212AS09012, 9 VDC power-pack, conducted emissions were required to be measured to the limits of 15.107.

The conducted emissions measurements were performed in the shielded room. AC power (120 VAC 60 Hz) was supplied to the system from a filtered source and passed through 50 uH LISNs (Line Impedance Stabilization Network). The conducted emissions are measured on both the AC hot and AC neutral lines relative to safety ground. The LISNs are constructed according to ANSI C63.4-1992 Fig. 2. The detected emissions were recorded on a plotter from a spectrum analyzer with the detector function set to peak mode. The spectrum analyzer bandwidth is set to the CISPR 6 dB bandwidth of 9 kHz.

Conducted emissions were measured at the 50 Ohm termination points of the LISN with the system's power cord plugged directly into the LISN AC output. The power cord was bundled to about 1 meter in length. The receiver was placed on a non-conducting table in the shielded room. The EUT was positioned 0.4 m from the room wall, which served as the ground plane. It was at least 0.8 m from other conducting planes. The detected emissions were recorded on a plotter from the spectrum analyzer. The lowest FCC Class B average limit (46 dBuV) is drawn on the plots for comparison. The new FCC Class B limits for conducted emissions from FCC Part 15.107(b) are as follows:

Frequency (MHz)	FCC Class B Limit (dBuV) Quasi-Peak	FCC Class B Limit dBuV Average
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5.0	56	46
5.0 – 30	60	50

Figure 2 shows the worst case conducted emissions detected at the LISN from the receiver. Data for both hot and neutral sides of the line are overlaid on each plot. In reviewing the data plots it is evident that the R7H-BKLINK-R receiver does meet the new FCC Class B requirements.

Based on these measurements, the Avcom R7H-BKLINK-R is in compliance with FCC Part 15.107(b) for suppression of conducted emissions.

CONCLUSIONS

Based upon the measurements made and reported herein, the Avcom R7H-BKLINK-R receiver is found to be capable of complying with the requirements of Parts 15.107 and 15.109 of the FCC Rules and Regulations when operated in a manner consistent with its intended use and purpose.

METHOD OF CALCULATION

Signal strength readings were made in units of dBuV from the spectrum analyzer or receiver. To these values an antenna factor in dB and a coax loss factor in dB were added to arrive at a field strength in dBuV/m at the measurement distance. This value is converted to field strength in uV/m and compared to the limit corrected for distance. An inverse distance correction factor was used to convert limit values from one distance to another.

SAMPLE CALCULATION

From Table 1 at 1814 MHz, a measured value of 21.2 dBuV is added to the antenna factor (27.5 dB) and coax factor (0.4 dB) to arrive at a field strength of 49.1 dBuV/m.

$$21.2 + 27.5 + 0.4 = 49.1 \text{ dBuV/m}$$

To convert dBuV/m to uV/m use the following equation:

$$\text{uV/m} = 10^{(49.1/20)} = 285 \text{ uV/m at 0.5 meter}$$

As the test limit at this frequency is 500 uV/m at 3 meters, the field strength in uV/m could be divided by six to adjust for the distance. Conversely, the limit can be multiplied by six for the adjustment. For the purposes of this report, the limit values have been multiplied to account for the different distances. For the 1 meter measurement distance, the limit was multiplied by three. For the 0.5 meter distance, the limit was multiplied by six to adjust to the equivalent 3 meter distance.

TABLE 1

LOCAL OSCILLATOR AND SPURIOUS EMISSIONS
RH-BKLINK-R RECEIVER
LOW BOARD TUNED TO 907.744 MHz
LO = 906.74944

Nom. Freq. (MHz)*	Value (dBuV) @ Dist.	AF (dB)	CL (dB)	Field Strength (dBuV/m)	(uV/m)	Limit (uV/m)	dB / Limit
907	6.0 @1m	29.1	1.7	36.8	69.2	600	-18.7
1813	21.2 @0.5m	27.5	0.4	49.1	285	3000	-20.4
2720	17.3 @0.5m	30.0	0.6	47.9	248	3000	-21.6
3627	17.6 @0.5m	32.5	0.7	50.8	347	3000	-18.7
4534	17.3 @0.5m	33.0	0.8	51.1	359	3000	-18.4

* = Nominal Frequency: For actual frequency see Table 5
AF = Antenna Factor
CL = Coax Loss Factor

Frequencies below 1 MHz were made with a quasi-peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 1 kHz video bandwidth was used to reduce the instrument noise level. The oscillator signal is CW and the reduced VBW does not affect the signal level.

TABLE 2

LOCAL OSCILLATOR AND SPURIOUS EMISSIONS
RH-BKLINK-R RECEIVER
LOW BOARD TUNED TO 916.3635 MHz
LO = 915.3638

Nom. Freq. (MHz)*	Value (dBuV) @ Dist.	AF (dB)	CL (dB)	Field Strength (dBuV/m)	(uV/m)	Limit (uV/m)	dB / Limit
915	7.0 @1m	29.1	1.7	37.8	77.6	600	-17.8
1831	20.8 @0.5m	27.6	0.4	48.8	275	3000	-20.7
2746	17.4 @0.5m	30.0	0.6	48.0	251	3000	-21.5
3661	17.5 @0.5m	32.7	0.7	50.9	351	3000	-18.6
4577	17.3 @0.5m	33.0	0.8	51.1	359	3000	-18.4

* = Nominal Frequency: For actual frequency see Table 5
AF = Antenna Factor
CL = Coax Loss Factor

Frequencies below 1 MHz were made with a quasi-peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 1 kHz video bandwidth was used to reduce the instrument noise level. The oscillator signal is CW and the reduced VBW does not affect the signal level.

TABLE 3

LOCAL OSCILLATOR AND SPURIOUS EMISSIONS
RH-BKLINK-R RECEIVER
HIGH BOARD TUNED TO 916.3635 MHz
LO = 915.36384

Nom. Freq. (MHz)*	Value (dBuV) @ Dist.	AF (dB)	CL (dB)	Field Strength (dBuV/m)	(uV/m)	Limit (uV/m)	dB / Limit
915	7.0 @1m	29.1	1.7	37.8	77.6	600	-17.8
1831	2.32 @0.5m	27.6	0.4	50.3	327	3000	-19.2
2746	17.4 @0.5m	30.0	0.6	48.0	251	3000	-21.5
3661	17.4 @0.5m	32.7	0.7	50.8	347	3000	-18.7
4577	17.3 @0.5m	33.0	0.8	51.1	359	3000	-18.4

* = Nominal Frequency: For actual frequency see Table 5
AF = Antenna Factor
CL = Coax Loss Factor

Frequencies below 1 MHz were made with a quasi-peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 1 kHz video bandwidth was used to reduce the instrument noise level. The oscillator signal is CW and the reduced VBW does not affect the signal level.

TABLE 4

LOCAL OSCILLATOR AND SPURIOUS EMISSIONS
RH-BKLINK-R RECEIVER
BOARD TUNED TO 924.7488 MHz
LO = 923.74914

Nom. Freq. (MHz)*	Value (dBuV) @ Dist.	AF (dB)	CL (dB)	Field Strength (dBuV/m)	(uV/m)	Limit (uV/m)	dB / Limit
924	7.0 @1m	29.1	1.7	37.8	77.6	600	-17.8
1849	23.0 @0.5m	27.8	0.4	51.2	363	3000	-18.3
2771	17.3 @0.5m	30.1	0.6	48.0	251	3000	-21.5
3695	17.6 @0.5m	32.8	0.7	51.1	359	3000	-18.4
4619	17.3 @0.5m	33.0	0.8	51.1	359	3000	-18.4

* = Nominal Frequency: For actual frequency see Table 5
AF = Antenna Factor
CL = Coax Loss Factor

Frequencies below 1 MHz were made with a quasi-peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 1 kHz video bandwidth was used to reduce the instrument noise level. The oscillator signal is CW and the reduced VBW does not affect the signal level.

TABLE 5

NOMINAL FREQUENCY vs. ACTUAL FREQUENCY

LOW RANGE

NOMINAL	ACTUAL
907	906.74944
1813	1813.49888
2720	2720.24832
3627	3626.99776
4534	4533.7472

MID RANGE

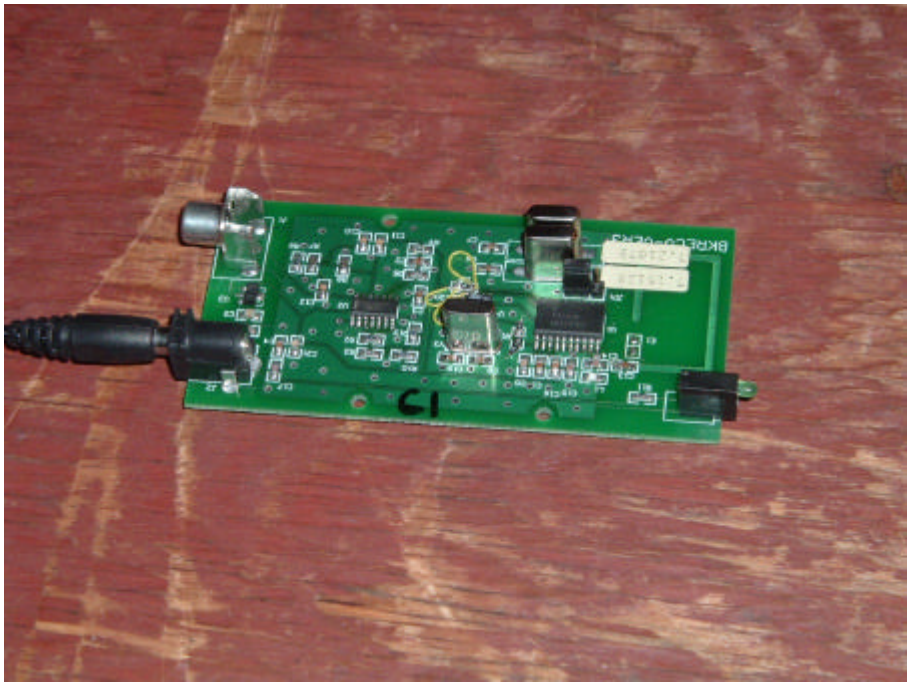
915	915.36384
1831	1830.72768
2746	2746.09159
3661	3661.45536
4577	4576.8192

HIGH RANGE

924	923.74914
1849	1849.49828
2771	2771.24742
3695	3694.99656
4619	4618.7457

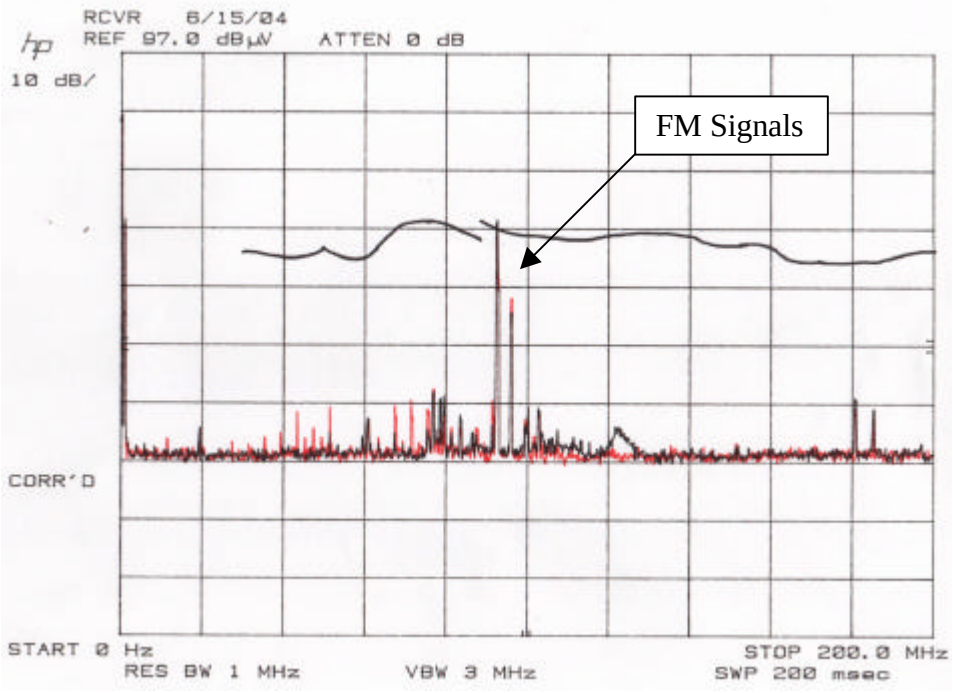
Pictorial 1
R7H-BKLINK-R
Radiated Emissions Test Set-up

Conducted Emissions Test Set-Up

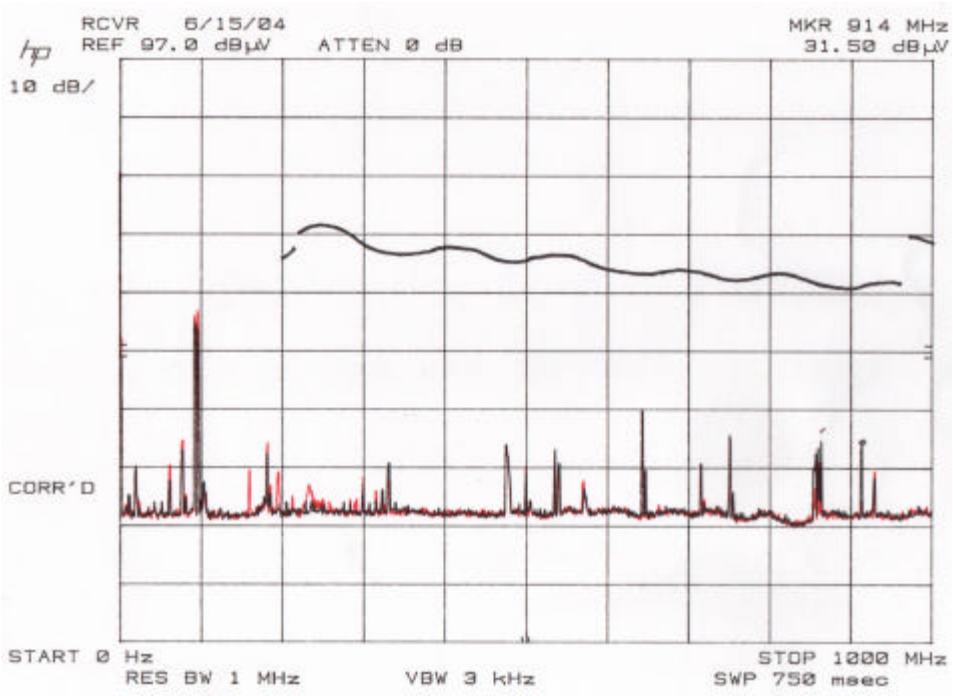


Close Up of Receiver Board

Pictorial 2
R7H-BKLINK-R
Conducted Set-Up
and Close Up



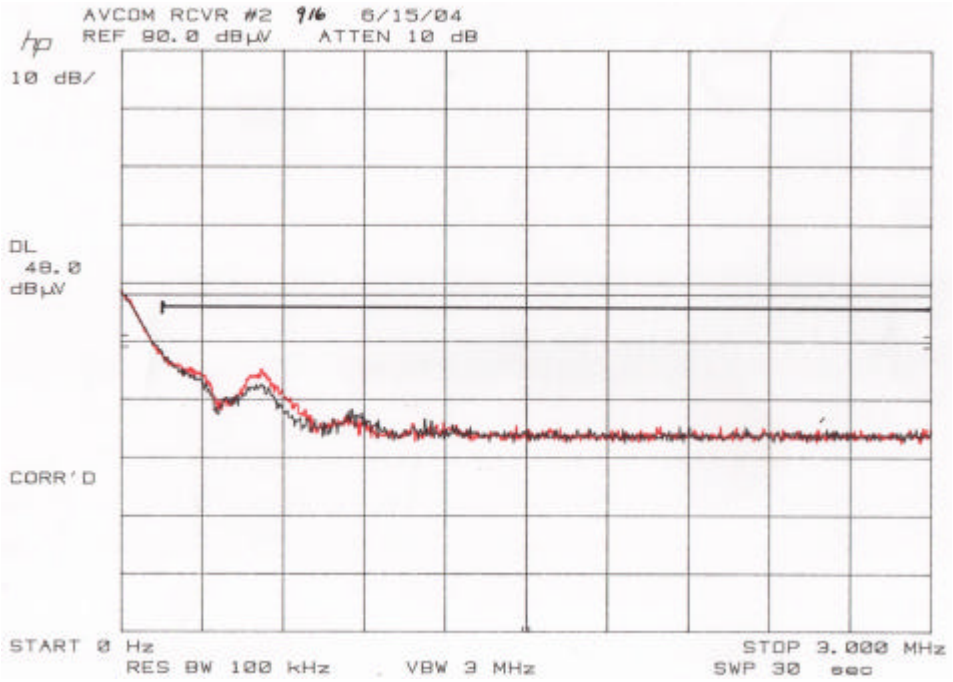
Limit



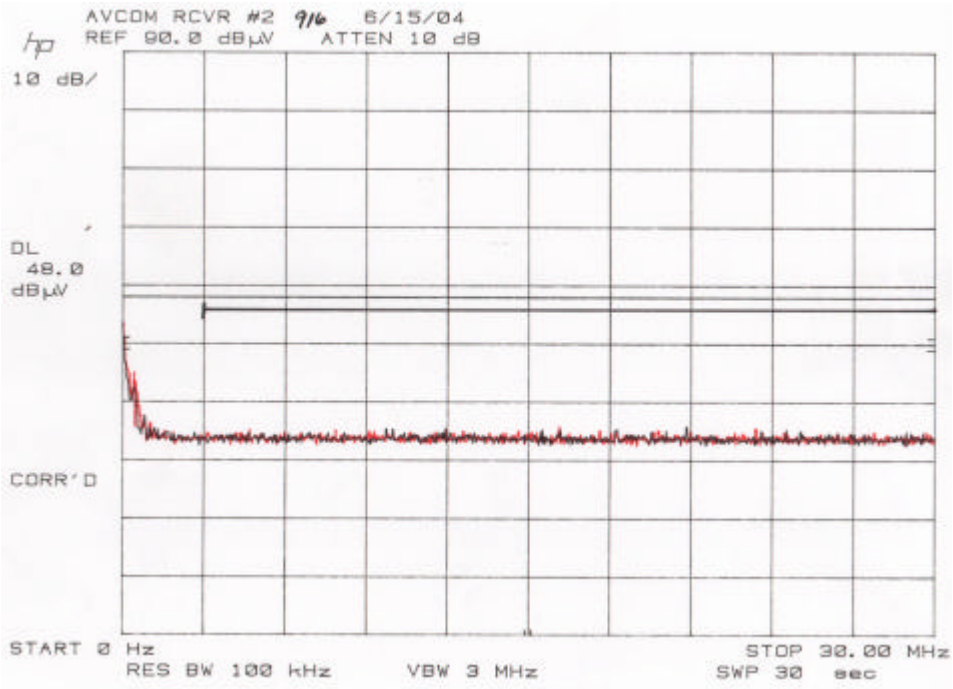
Limit

Black = Horizontal
Red = Vertical

Fig. 1
TYPICAL RADIATED EMISSIONS
R7H-BKLINK-R
30 MHz – 1000 MHz



46 dBu Limit



46 dBu Limit

Black = Hot Lead
Red = Neutral Lead

Fig. 2
TYPICAL CONDUCTED EMISSIONS
R7H-BKLINK-R
150 kHz – 30 MHz