

**SMITH ELECTRONICS, INC.  
ELECTROMAGNETIC COMPATIBILITY LABORATORIES**

**RADIO-FREQUENCY EMISSIONS TEST REPORT**

FOR

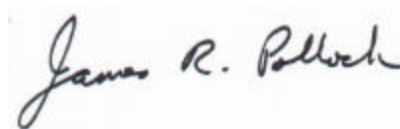
AVCOM SMT, INC

Transmitter

Model R7H-BKLINK-S

September 1, 2004

Prepared by:



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James R. Pollock

Prepared for:

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Westerville, OH 43081

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## CERTIFICATE OF COMPLIANCE

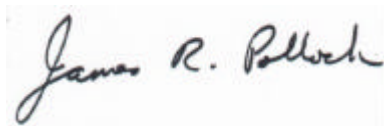
1. Manufacturer: Avcom SMT, Inc.  
213 East Broadway  
Westerville, OH 43081
2. Contact: Paul H. Wiese  
Avcom SMT, Inc.  
614/882-8176
3. Regulation: CFR47 – Part 15  
15.249
4. Measurement Method: ANSI C63.4-1992
5. EUT: Transmitter  
Model R7H-BKLINK-S
6. Type: Wireless Audio Link Transmitter
7. Tuned Frequencies 908.185MHz, 916.588 MHz, 925.145 MHz
8. Test Dates: August 23, 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-S wireless link transmitter were performed by me on August 23, 2004, and that the results of the measurements confirmed that the unit tested is capable of compliance with the above regulation.

September 1, 2004

Date



James R. Pollock, President  
Smith Electronics, Inc.

## **RADIO FREQUENCY EMISSION MEASUREMENTS**

### **OBJECTIVE:**

The transmitter emissions were measured in order to show that the emissions from the transmitters were within the requirements of FCC Part 15.249 for equipment of this type.

### **SUMMARY**

The prototype of the Avcom SMT, Inc. Model R7H-BKLINK-S wireless link transmitter has been shown to be capable of complying with those requirements of the Federal Communications Commission for an intentional radiator under Part 15.249.

The measured value closest to the appropriate limit was found at the 2<sup>nd</sup> harmonic of the highest frequency. The margin was 2.7 dB below the limit as seen in Table 4.

The transmitter has also been examined as a digital device and has been shown to meet the requirements of a Class B digital device under 15.107 and 15.109.

## TEST INFORMATION

### EQUIPMENT UNDER TEST

Model R7H BKXMT  
Wireless Audio Link Transmitter

### MANUFACTURER

Avcom SMT, Inc.  
213 East Broadway  
Westerville, OH 43081

### TEST DATES

August 23, 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 Adaptor S/N 2043A00350  
Calibrated July, 2004

Hewlett Packard Spectrum Analyzer  
Model 8503EM S/N 3536A00147  
Calibrated January, 2004

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

The R7H-BKLINK-S will be produced in two configurations. Each configuration can be set to transmit on one of two frequencies. Each configuration will transmit at a nominal frequency of 916,588 MHz. Additionally, one configuration will transmit at about 908.185 MHz and the other at about 925.145 MHz. This report indicates that the emissions of each configuration are within the limits set by 15.249.

The R7H-BKLINK-S is also a digital device and has had measurements performed to verify compliance to 15.107 and 15.109 as a Class B digital device.

## RADIATED EMISSIONS

Field strength measurements were performed on the prototype transmitter to assure that the radiated emissions were capable of compliance with the requirements of 15.249.

Measurement of the fundamental frequency was performed on the Smith Electronics, Inc., 3 meter open field test site located at 8200 Snowville Road, Brecksville, OH using the procedures of ANSI C63.4-1992. Site attenuation data pertinent to this site is on file with the FCC. A tuned dipole antenna was used with the 8593EM using peak detection.

The harmonic frequencies were measured in an area of the facility free of reflecting surfaces at a test distance of either 1 meter or 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 transmitters was made in the shielded room to determine if any emissions other than those produced by the transmitter portion of the circuitry were of concern. As can be seen in Fig. 1 covering 30 MHz to 1000 MHz, some other emissions are observed. At somewhat above 40 MHz a signal representing the 3<sup>rd</sup> harmonic of the oscillating crystal is observed. These signals are too low to be detected on the open field and are well within the limits.

A more obvious signal appears at half the transmitted signal frequency. The source of this signal in the shielded room is not obvious. This area was examined on the open field site and no signal was observed. Figure 1 is the worst case of both configurations and the three frequencies.

## CONDUCTED EMISSIONS

As the transmitter 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 system was placed on a non-conducting table in the shielded room. The system 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 is drawn on the plots for comparison. The FCC Class B limits for conducted emissions from FCC Part 15.107(b) are as follows:

| <u>Frequency</u><br><u>(MHz)</u> | <u>FCC Class B Limit (dBuV)</u><br><u>Quasi-Peak</u> | <u>FCC Class B Limit dBuV</u><br><u>Average</u> |
|----------------------------------|------------------------------------------------------|-------------------------------------------------|
| 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 typical conducted emissions detected at the LISN from the transmitter. 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-S transmitter does meet the new FCC Class B requirements.

Based on these measurements, the Avcom R7H-BKLINK-S 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-S transmitter is found to be capable of complying with the requirements of Part 15.249, 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. 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 4 at 1850 MHz, a measured value of 32.4 dBuV is added to the antenna factor (28.0 dB) and coax factor (0.4 dB) to arrive at a field strength of 60.8 dBuV/m.

$$32.4 + 28.0 + 0.4 = 60.8 \text{ dBuV/m}$$

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

$$\text{uV/m} = 10^{(60.8/20)} = 1,096 \text{ uV/m at 1 meter}$$

As the test limit at this frequency is 500 uV/m at 3 meters, the field strength could be divided by three to adjust for the distance. Conversely, the limit can be multiplied by three 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**

FUNDAMENTAL AND SPURIOUS EMISSIONS  
R7H-BKLINK-S TRANSMITTER  
LOW BOARD TUNED TO 908.185 MHz

| Nom.<br>Freq.<br>(MHz)* | Value<br>(dBuV)<br>@ Dist. | AF<br>(dB) | CL<br>(dB) | Field Strength<br>(dBuV/m) (uV/m) |        | Limit<br>(uV/m) | dB /<br>Limit |
|-------------------------|----------------------------|------------|------------|-----------------------------------|--------|-----------------|---------------|
| 908                     | 60.0 @3m                   | 29.1       | 1.7        | 90.8                              | 34,670 | 50,000          | -3.2          |
| 1816                    | 32.0 @1m                   | 27.5       | 0.4        | 59.9                              | 988    | 1,500           | -3.6          |
| 2724                    | 23.3 @1m                   | 30.0       | 0.6        | 53.9                              | 495    | 1,500           | -9.6          |
| 3632                    | 22.7 @1m                   | 32.5       | 0.7        | 55.9                              | 624    | 1,500           | -7.6          |
| 4540                    | 25.1 @1m                   | 33.0       | 0.8        | 58.9                              | 881    | 1,500           | -4.6          |
| 5778                    | 19.9 @1m                   | 36.0       | 0.9        | 56.8                              | 692    | 1,500           | -6.7          |
| 6356                    | 17.9 @1m                   | 35.5       | 1.0        | 54.4                              | 525    | 1,500           | -9.1          |
| 7264                    | 26.3 @0.5m                 | 37.0       | 1.1        | 64.4                              | 1,660  | 3,000           | -5.1          |
| 8172                    | 26.6 @0.5m                 | 38.0       | 1.2        | 65.8                              | 1,950  | 3,000           | -3.7          |
| 9082                    | 25.7 @0.5m                 | 38.5       | 1.3        | 65.5                              | 1,884  | 3,000           | -4.0          |

\* = Nominal Frequency: For actual frequency see Table 4.

AF = Antenna Factor

CL = Coax Loss Factor

Frequencies below 1 MHz were made with a peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 3 kHz video bandwidth was used to reduce the instrument noise level. The reduced video bandwidth averages the pulse modulated signal. Peak values are no more than 6 dB above the measured value.

**TABLE 2**

FUNDAMENTAL AND SPURIOUS EMISSIONS  
R7H-BKLINK-S TRANSMITTER  
LOW BOARD TUNED TO 916.588 MHz

| Nom.<br>Freq.<br>(MHz)* | Value<br>(dBuV)<br>@ Dist. | AF<br>(dB) | CL<br>(dB) | Field Strength<br>(dBuV/m) (uV/m) |        | Limit<br>(uV/m) | dB /<br>Limit |
|-------------------------|----------------------------|------------|------------|-----------------------------------|--------|-----------------|---------------|
| 916                     | 59.0 @3m                   | 29.1       | 1.7        | 89.8                              | 30,903 | 50,000          | -4.2          |
| 1832                    | 30.7 @1m                   | 27.5       | 0.4        | 58.6                              | 851    | 1,500           | -4.9          |
| 2748                    | 23.0 @1m                   | 30.0       | 0.6        | 53.6                              | 479    | 1,500           | -9.9          |
| 3660                    | 24.2 @1m                   | 32.5       | 0.7        | 57.4                              | 741    | 1,500           | -6.1          |
| 4580                    | 23.3 @1m                   | 33.0       | 0.8        | 57.1                              | 716    | 1,500           | -6.4          |
| 5496                    | 18.9 @1m                   | 36.0       | 0.9        | 55.8                              | 617    | 1,500           | -7.7          |
| 6412                    | 17.9 @1m                   | 35.5       | 1.0        | 54.4                              | 525    | 1,500           | -9.1          |
| 7328                    | 26.5 @0.5m                 | 37.0       | 1.1        | 64.6                              | 1,698  | 3,000           | -4.9          |
| 8244                    | 26.6 @0.5m                 | 38.0       | 1.2        | 65.8                              | 1,950  | 3,000           | -3.7          |
| 9160                    | 25.6 @0.5m                 | 38.5       | 1.3        | 65.4                              | 1,862  | 3,000           | -4.1          |

\* = Nominal Frequency: For actual frequency see Table 4.

AF = Antenna Factor

CL = Coax Loss Factor

Frequencies below 1 MHz were made with a peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 3 kHz video bandwidth was used to reduce the instrument noise level. The reduced video bandwidth averages the pulse-modulated signal. Peak values are no more than 6 dB above the measured value.

**TABLE 3**

FUNDAMENTAL AND SPURIOUS EMISSIONS  
R7H-BKLINK-S TRANSMITTER  
HIGH BOARD TUNED TO 916.588 MHz

| Nom.<br>Freq.<br>(MHz)* | Value<br>(dBuV)<br>@ Dist. | AF<br>(dB) | CL<br>(dB) | Field Strength<br>(dBuV/m) (uV/m) |        | Limit<br>(uV/m) | dB /<br>Limit |
|-------------------------|----------------------------|------------|------------|-----------------------------------|--------|-----------------|---------------|
| 916                     | 58.0 @3m                   | 29.1       | 1.7        | 88.8                              | 27,542 | 50,000          | -5.2          |
| 1832                    | 31.7 @1m                   | 27.5       | 0.4        | 59.6                              | 955    | 1,500           | -3.9          |
| 2748                    | 25.3 @1m                   | 30.0       | 0.6        | 55.9                              | 624    | 1,500           | -7.6          |
| 3664                    | 24.3 @1m                   | 32.5       | 0.7        | 57.5                              | 750    | 1,500           | -6.0          |
| 4580                    | 21.3 @1m                   | 33.0       | 0.8        | 55.1                              | 569    | 1,500           | -8.4          |
| 5496                    | 18.4 @1m                   | 36.0       | 0.9        | 55.3                              | 582    | 1,500           | -8.2          |
| 6412                    | 18.4 @1m                   | 35.5       | 1.0        | 54.9                              | 556    | 1,500           | -8.6          |
| 7328                    | 26.6 @0.5m                 | 37.0       | 1.1        | 64.7                              | 1,718  | 3,000           | -4.8          |
| 8244                    | 26.6 @0.5m                 | 38.0       | 1.2        | 65.8                              | 1,950  | 3,000           | -3.7          |
| 9160                    | 25.6 @0.5m                 | 38.5       | 1.3        | 65.4                              | 1,862  | 3,000           | -4.1          |

\* = Nominal Frequency: For actual frequency see Table 4.

AF = Antenna Factor

CL = Coax Loss Factor

Frequencies below 1 MHz were made with a peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 3 kHz video bandwidth was used to reduce the instrument noise level. The reduced video bandwidth averages the pulse modulated signal. Peak values are no more than 6 dB above the measured value.

**TABLE 4**

FUNDAMENTAL AND SPURIOUS EMISSIONS  
R7H-BKLINK-S TRANSMITTER  
HIGH BOARD TUNED TO 925.145 MHz

| Nom.<br>Freq.<br>(MHz)* | Value<br>(dBuV)<br>@ Dist. | AF<br>(dB) | CL<br>(dB) | Field Strength<br>(dBuV/m)      (uV/m) |        | Limit<br>(uV/m) | dB /<br>Limit |
|-------------------------|----------------------------|------------|------------|----------------------------------------|--------|-----------------|---------------|
| 925                     | 57.0 @3m                   | 29.1       | 1.7        | 87.8                                   | 24,547 | 50,000          | -6.2          |
| 1850                    | 32.4 @1m                   | 28.0       | 0.4        | 60.8                                   | 1,096  | 1,500           | -2.7          |
| 2775                    | 24.5 @1m                   | 30.0       | 0.6        | 55.1                                   | 569    | 1,500           | -8.4          |
| 3700                    | 20.2 @1m                   | 32.8       | 0.7        | 53.7                                   | 484    | 1,500           | -9.8          |
| 4625                    | 22.1 @1m                   | 33.0       | 0.8        | 55.9                                   | 624    | 1,500           | -7.6          |
| 5550                    | 17.9 @1m                   | 36.0       | 0.9        | 54.8                                   | 550    | 1,500           | -8.7          |
| 6475                    | 17.9 @1m                   | 35.5       | 1.0        | 54.4                                   | 525    | 1,500           | -9.1          |
| 7400                    | 26.8 @0.5m                 | 37.3       | 1.1        | 65.2                                   | 1,820  | 3,000           | -4.3          |
| 8325                    | 26.7 @0.5m                 | 38.2       | 1.2        | 66.1                                   | 2,018  | 3,000           | -3.4          |
| 9250                    | 25.5 @0.5m                 | 38.5       | 1.3        | 65.3                                   | 1,841  | 3,000           | -4.2          |

\* = Nominal Frequency: For actual frequency see Table 4.

AF = Antenna Factor

CL = Coax Loss Factor

Frequencies below 1 MHz were made with a peak detector. For those above 1 MHz, peak detection was used with a 1 MHz resolution bandwidth. A 3 kHz video bandwidth was used to reduce the instrument noise level. The reduced video bandwidth averages the pulse-modulated signal. Peak values are no more than 6 dB above the measured value.

**TABLE 5****NOMINAL FREQUENCY vs. ACTUAL FREQUENCY****LOW RANGE**

| NOMINAL | ACTUAL   |
|---------|----------|
| 908     | 908.185  |
| 1816    | 1816.37  |
| 2724    | 2724.555 |
| 3632    | 3632.74  |
| 4540    | 4540.925 |
| 5448    | 5449.11  |
| 6356    | 6357.295 |
| 7264    | 7265.48  |
| 8172    | 8173.665 |
| 9082    | 9081.85  |

**MID RANGE**

|      |           |
|------|-----------|
| 916  | 916.588   |
| 1832 | 1833.176  |
| 2748 | 2749.764  |
| 3664 | 3666.352  |
| 4580 | 4582.94   |
| 5496 | 5499.528  |
| 6412 | 6416.116  |
| 7328 | 7332.704  |
| 8244 | 8249.2928 |
| 9160 | 9165.88   |

**HIGH RANGE**

|      |          |
|------|----------|
| 925  | 925.145  |
| 1850 | 1850.29  |
| 2775 | 2775.435 |
| 3700 | 3700.58  |
| 4625 | 4625.725 |
| 5550 | 5550.87  |
| 6475 | 6476.015 |
| 7400 | 7401.16  |
| 8325 | 8326.305 |
| 9250 | 9251.45  |

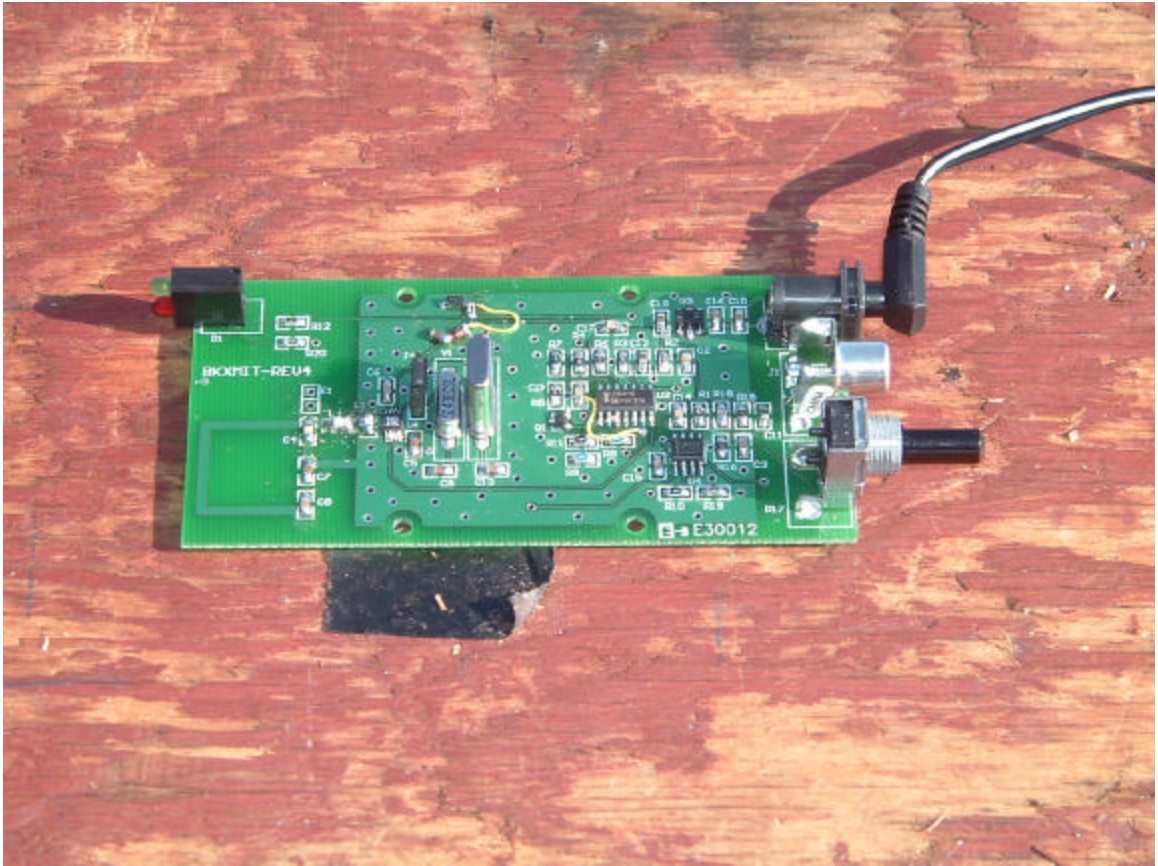


Radiated Emissions

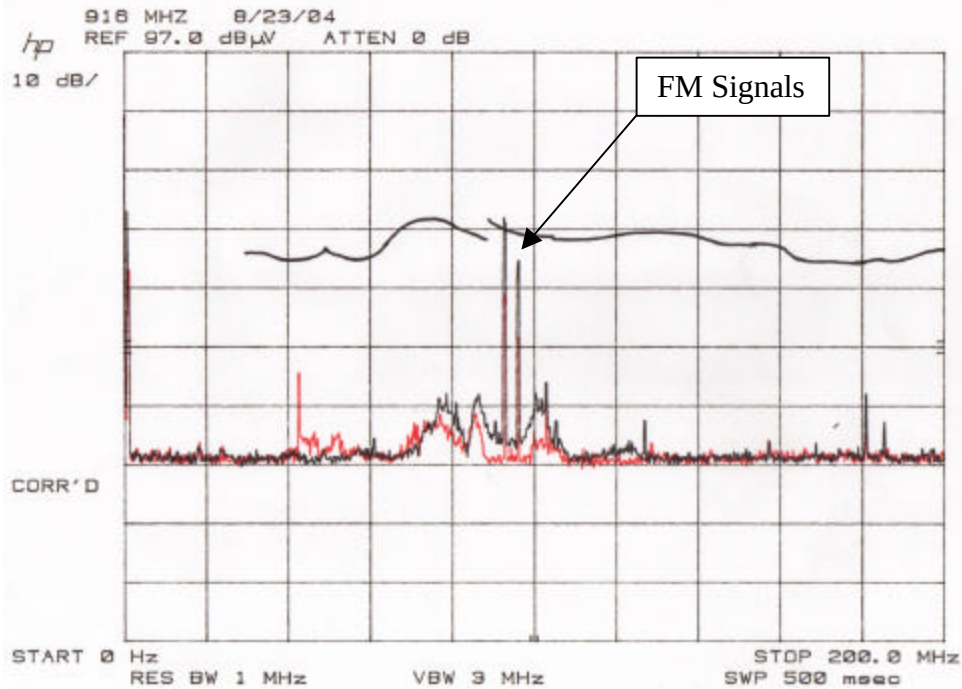


Conducted Emissions

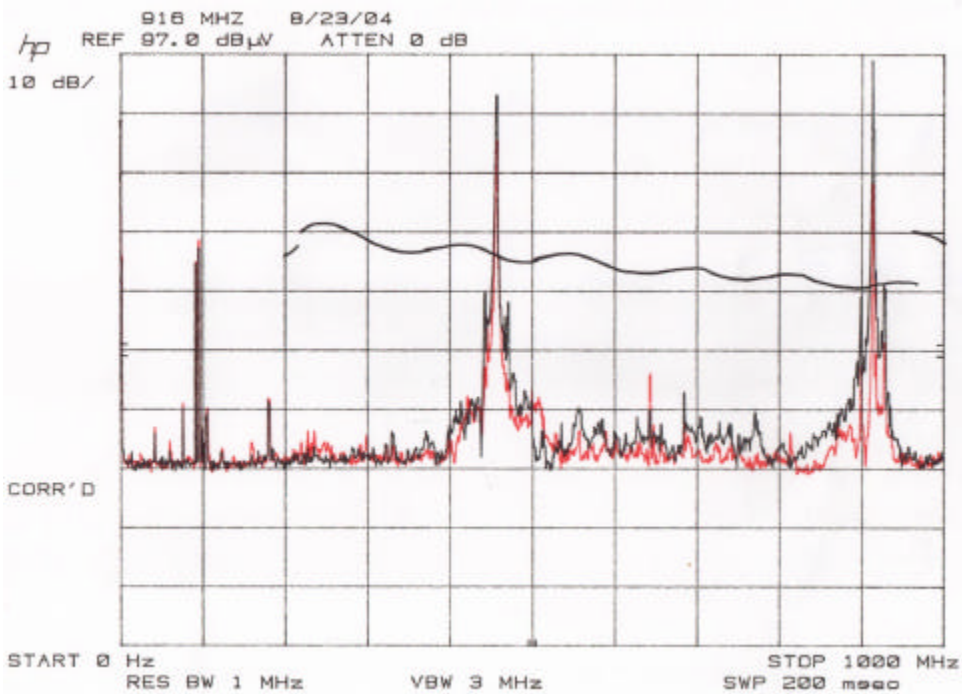
PICTORIAL 1  
R7H-BKLINK-S  
TEST SET-UP



PICTORIAL 2  
R7H-BKLINK-S  
CLOSE-UP



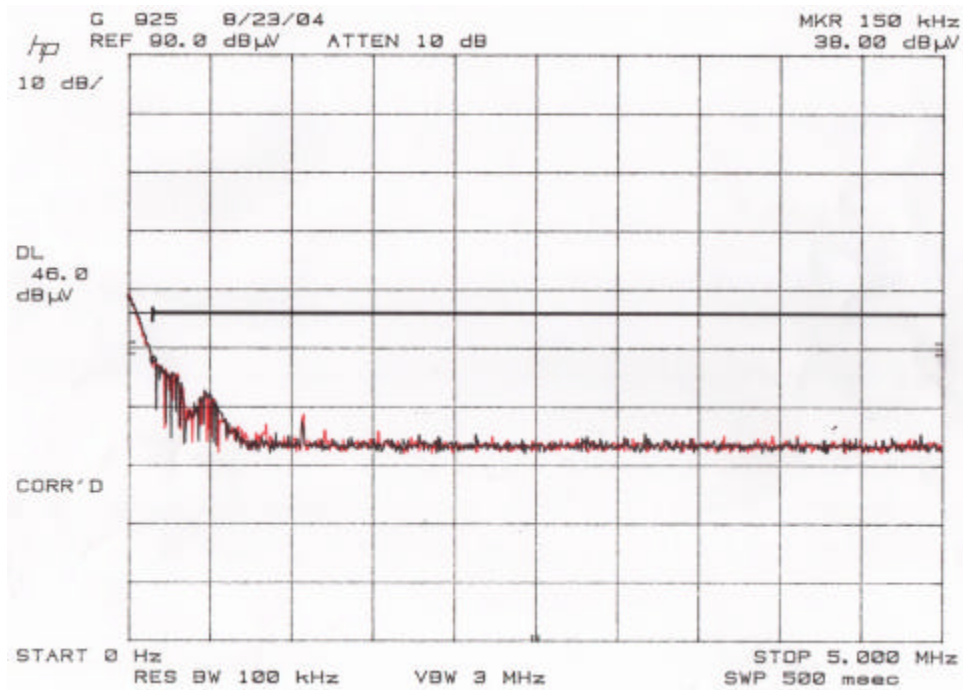
Class B  
Limit



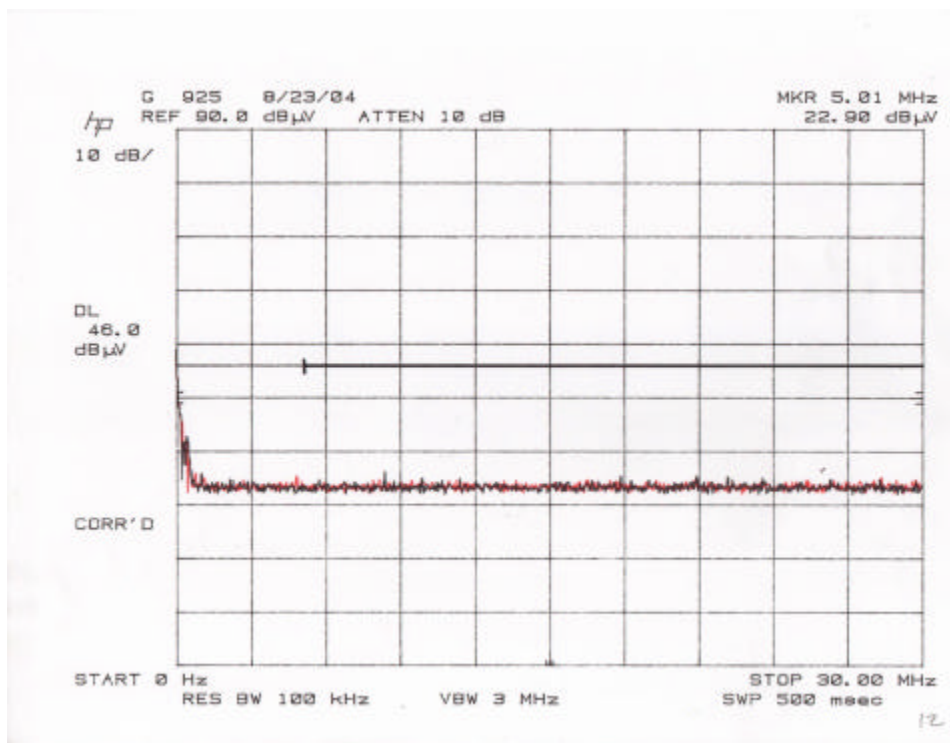
Class B  
Limit

Red = Vertical  
Black = Horizontal

Fig. 1  
Radiated Emissions  
R7H-BKLINK-S  
30 MHz – 1000 MHz



Minimum  
Average Value



Minimum  
Average Value

Red = Neutral Lead  
 Black = Hot Lead

Fig. 2  
 Conducted Emissions  
 R7H-BKLINK-S  
 150 kHz – 30 MHz