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A MEASUREMENT METHOD OF ELECTROMAGNETIC SMOG

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INTRODUCTION

One of the major problems in the design of a communication system which is to serve a large area is the rf noise or "electromagnetic smog". The signal which was interfered by "smog" is difficult to be recovered. It causes severe cost and power penalties. The smog is changing every moment, and also it depends on the activities of man closely. It is useful to investigate the characteristics of EM-Smog for the communication systems which are located in or around the city, especialy for the earth station of satellite data communications at VHF.

One method to measure rf noise in the city is use of the mobile receiving system. But it can not measure simultaneously the over all rf noise environment. Another method is to set many ground measurment systems. This needs much cost. The measurement by the aircraft is most attractive because it can measure the over all city noise simultaneously in a short time. But it also costs much in Japan.

Same measurment can be done if the high sensitivity receiving system with a high gain and sharp beam antenna is set on the top of the hill near the city, as show in Fig. 1.

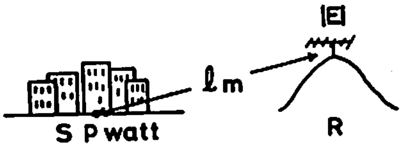

Fig. 1 Location of Measurement System.

This report presents the results by the last method. By rotating the sharp beam antenna, the distribution pattern of noise sources is also determined.

SYSTEM CONFIGURATION

Two kinds of systems are used for measurement. One is for the measurement of noise amplitude distribution at 135 MHz and the other is for the measurement of noise source distribution at 300 MHz. The system configurations are almost same, except the ability of antenna rotation for 300 MHz system. The block diagram is shown in Fig. 2. The characteristics or parameters are in Table 1.

Electric Field Strength Meter preceded by low noise amplifire is used for receiver. IF band width is 80 KHz, and the detected average noise envelope voltage proportional to meter deflection is digitized with sampling time interval 19.6 usec. 20000 data elements are proceeded by Mini computer.

MEASUREMENT RESULTS

Three typical apd curves as shown in Fig. 3 were obtained by measurements at 135 MHz during Dec. 27, 1977 to Mar. 11, 1978. Because of impulsive noise by running cars near the site, curves have the tail in the low percentage portion. It is not too far to surpose that the portion fitting Rayleigh dis-

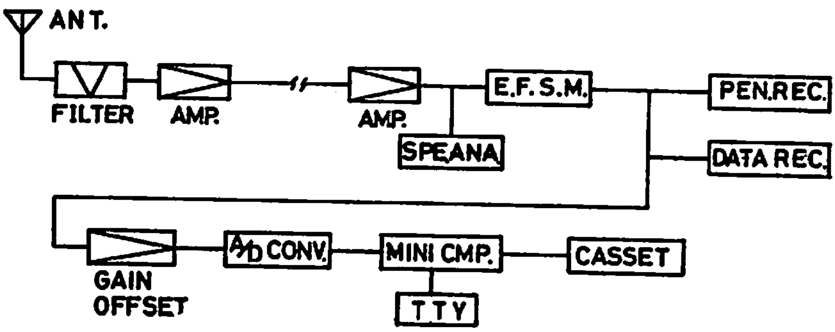

Fig. 2 Measurement System.

Table 1

Antenna : 6 elements cross Yagi
4 stacks, G=16 dB(iso)
elev.8, azi.105
Pre. Amp. : G=49dB, NF=2.0
Filter : f_0=135.6 MHz
B=2.4 MHz
Insert. Loss=0.2 dB
E.F.S.M. : ANRITSU 512A
IF B=80 KHz
Time Const.
Charge & discharge
less than 2.5 usec
A/D Convt. : DATEL ADC-EH 8D-2
Mini Computer : HP 2100A

tribution depends on the rf Gaussian noise which consists of sky noise, ground noise and composite city noise, or EM-Smog.

Mean of 50 % values is 0.46 uV at the antenna output.

By measurement at 300 MHz rotating the antenna beam, the noise source distribution pattern was obtained as Fig. 4. The peak values directs to the center of the city. The another peak on the opposite side is supposed by the reflection of penthouse on the EE building.

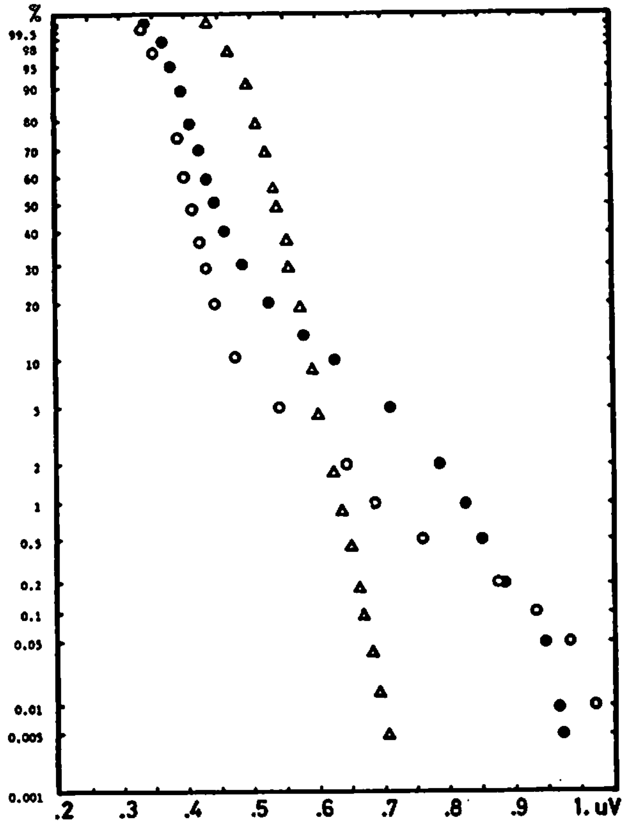

Fig. 3 Three Typical apd Curves.

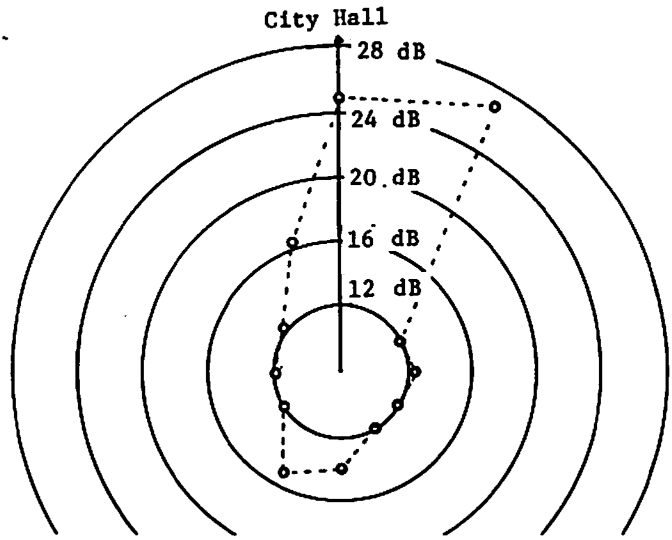

Fig. 4 An Example of Noise Source Distribution

CONCLUSION

By using the system which is composed of a high gain antenna with sharp beam and a high sensitivity receiver, and which is settled on the top of a hill near the city, the over all rf city noise, or electromagnetic smog at VHF can be measured. By rotating the antenna, noise source distribution can be measured.

Measurements have been done at 135 MHz and 300 MHz near by Sendai city. The noise level at 135 MHz was 12 dB above kTB and the effective external noise figure is 16.3. The distribution pattern of noise source was measured roughly.

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