August 1969 Brief 69-10308

NASA TECH BRIEF

Survey of Man-Made Electrical Noise Affecting Radio Broadcasting

A survey was made to improve the present knowledge of the expected levels of unintentionally generated (man-made) noise in populated areas. Man-made noise is the chief determinant of signal quality in cities for voice broadcasting at radio frequencies extending from the HF (high frequency) to the lower UHF (ultrahigh frequency) band. The noise is characterized by a high peak-to-average power ratio and tends to be impulsive in character. Automobile ignition systems are the major sources of noise, at least in the United States. In heavily built-up areas, electrical power lines and rotating machinery also produce significant noise levels. Although man-made noise is a significant problem, good measurements of its level and distribution (both with time and location) are scarce. Much of the problem is associated with methods of making meaningful measurements over sufficiently long periods of time to establish the true characteristics of the noise. Since most measurement programs have been carried out with a particular service in mind, much of the data has little value when applied to other services. Until recently, most measurements have been made using quasi-peak detectors in standard field measuring equipment. While the values so obtained have a definite subjective relationship for AM broadcast systems, there is little evidence that such measurements apply to conventional FM broadcasting services.

In more recent measurements, the Institute for Telecommunications Sciences and Aeronomy (ITSA) and the General Electric Company (GE) used a narrow-band receiver, the output of which is fed to a group of level detectors that record the number of times given voltage levels are exceeded. The amplitude distortion of the noise is computed from this data. The average noise power can be computed from the amplitude distribution because the narrow bandwidth of the receiver makes the noise pulses essentially constant in width.

The present survey, consisting of limited noise measurements, was made to augment and verify existing data at HF and VHF and to obtain basic data at UHF. The survey was conducted in a number of carefully chosen sites in the New York City—New Jersey metropolitan area. Measurements were performed at three selected frequencies: HF at approximately 20 MHz, VHF (very high frequency) at approximately 109 MHz, and UHF at 800 MHz. The exact frequencies were determined by the absence of intentionally generated signals around the above frequencies. The noise parameters measured were true root-mean-square (rms) and weighted rms voltage from the detector output of an amplitude modulated receiver. The weighted rms values were measured because indications are that such measurements provide a true indication of the subjective effect of certain types of noise. In addition, an experiment was performed that simultaneously monitored the true rms output (and then the weighted rms output) from the AM receiver and the output from a high quality consumer FM receiver. Both dipole and directive antennas were used in the VHF and UHF measurements. The dipole allowed an equivalent noise factor (noise temperature) to be determined. The directive antennas were used to determine whether signal-noise discrimination could be obtained by virtue of directivity. Antenna positions were: horizontal

(continued overleaf)

and 45 degree elevated with horizontal polarization; and horizontal with vertical polarization. A calibrated whip antenna was used in the HF range. The calibration allowed the equivalent noise factor to be calculated.

The survey was divided into three phases. The first phase consisted of preliminary field measurements during which data collection techniques were established. The second phase was the formal field data gathering tests. The third phase consisted of the data compilation and reduction to a usable form. The results of the test show that a wide range of noise levels can be encountered in populated (urban, suburban, and rural) areas. While noise levels, in general, increase as the population density increases, the relationship appears to be weak. Noise level is more closely allied to nearness of main and secondary thoroughfares than to the number of people living in a given area. The data can be used to determine the effect of man-made noise on the reception of any radio communication. The measurement method can be used to determine man-made noise at any site.

Note:

Documentation is available from:
Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Price $3.00
Reference: TSP-10308

Patent status:

No patent action is contemplated by NASA
Source: W. B. Garner and W. T. Bisignani of
Radio Corporation of America
under contract to
Headquarters, NASA
(HQN-10290)