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UNITED STATES GOVERNMENT

Memorandum

TO : All Commissioners; Chief Engineer, Chief, Broadcast Bureau; Chief, Office of Plans and Policy; Chief, Cable Bureau; General Counsel

DATE: October 12, 1978

FROM : Commissioners James H. Quello and Abbott M. Washburn

SUBJECT: Measurement standard for UHF television receiver noise figure.

We were very encouraged by the Commission's affirmative action to reduce the maximum noise figure permitted for UHF television receivers from 18 db to 14 db as a first step toward an even more significant reduction. We continue to be concerned, however, that further study or deliberation will result in an unnecessary and unwarranted delay in implementation so vital to UHF comparability and progress.

One possibility for delay which can be promptly eliminated is lack of a standard for measurement of the noise figure. While we believe the industry has ample experience and expertise in such measurements, there is, perhaps, some room for complaint that the industry has no absolute measurement standard which it can be assured in advance that the Commission will accept. Therefore, our offices, in consultation with several experts in the field, prepared a draft standard that can provide the necessary assurance to the industry and, at the same time, ensure the accuracy and repeatability essential to Commission enforcement. Our proposal is attachment A.

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While we are convinced that this proposal is adequate and practical, we welcome your scrutiny and suggestions for improvement. We particularly urge the Office of Chief Engineer to review the draft and test objectively the methods suggested.

It is important, in our view, to emphasize that the obsolete standard now included in Section 15.75(b)(3) is not exclusionary. Attachment B is the pertinent section for your review. The standard merely attempts to provide a certainty to the manufacturers if they measure by any Commission accepted method. Any manufacturer has the option of developing his own method subject to Commission approval. Therefore, we believe that the Commission

can simply issue a public notice outlining an acceptable standard since it does not foreclose any other method of measurement.

This matter is scheduled for Commission action on October 19th.

James H. Quello

James H. Quello

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Attachments A&B

Attachment A.

AFT

MEASURING THE NOISE FIGURE OF A TELEVISION RECEIVER IN THE UHF CHANNELS

PROPOSED STANDARD

I. INTRODUCTION

Noise figure or noise factor is a measure of the noise performance of a receiver and as such, is a measure of the sensitivity or the ability of the receiver to extract information from the signal.

The intent of this standard is to provide a means of precisely and accurately evaluating the noise performance, particularly in the UHF television band of the television receiver. The measurement will be performed to the most practical extent possible in an effort to evaluate the noise figure of the complete television receiver.

II. GENERAL METHOD

The procedures to be used are generally classified as the Y-factor or constant Excess Noise Ratio method. The results can be obtained by calculation from a manual evaluation of Y-factor utilizing IF substitution or by means of a direct reading noise figure indicator or meter whose accuracy is commensurate with the accuracy objectives of this standard.

III. EQUIPMENT REQUIRED

The following equipment is the minimum required to perform the measurement:

A. Noise Generator:

A source of calibrated, true, random noise operating at a minimum over the frequency range from 450 to 900 MHz. Several types of noise sources are available for use in this frequency band. However, solid state noise sources are recommended due to:

1) Lack of significant impedance from the off to the on condition.
2) Negligible video transients at the output connector.
3) Low power requirements.
4) Less potential for electromagnetic interference with the receiver under test.

The noise generator should be calibrated to an overall accuracy of not worse than ±0.3 dB, and the calibration results should be traceable either to the National Bureau of Standards or a natural physical phenomena.

B. Input Transformer:

Most noise generators available commercially are provided with 50 ohm, single ended, coaxial outputs. The VSWR of the noise source should be less than 1.2.

The input transformer is required to provide a low loss, low mismatch connection to the nominal 300ohm screw terminals at the rear of the television receiver. This requires a 50 ohm unbalanced to 300 ohm balanced transformer (balun).

The loss of the transformer should be compatible with the combination of the noise figure indicator and noise source. For example, a noise figure indicator is commercially available capable of operating with noise sources whose ENR is in the range of 14.5 to 16.5 dB. Consequently, the difference between the loss of the transformer and the ENR of the source should not be less than 14.5 dB. The loss of the transformer should be calibrated to better than ±0.03 dB.

The combined VSWR of the noise source and the transformer should be less than 1.4.

C. Indicator:

The indicator can be a direct reading noise figure indicator or noise figure meter, also sometimes referred to as a System Noise Monitor, which provides a visual, direct read-out of the noise figure of the receiver under test. It can also be an intermediate frequency substitution receiver where a substitute attenuator is utilized to measure the Y-factor resulting from manual switching of the noise generator from the off to the on condition.

The use of such devices as power meters and RF voltmeters to read Y-factor directly should be avoided in order to reduce the potential for inconsistencies and uncertainties due to crest factor and detector non-linearities.

The indicator should be tuned to the intermediate frequencies of the television receiver (typically 44.5 MHz) for the 3 dB bandwidth of not less than 4 MHz and not more than 15 MHz. The bandwidth restriction is to insure measurement of the average noise figure over the pass band of the receiver.

The accuracy of the indicator should be less than ±0.5 dB in the range of noise figure from 10 to 15 dB.

D. Connections:

The noise source, as noted earlier, is connected to the receiver via the balun. The balun should be securely fastened to the receiver terminals in order to prevent inconsistencies due to losses and intermittent connections.

The indicator may be connected to the television receiver at the tester's discretion in any fashion which meets the following criteria:

- switch signal is available at the receiver's intermediate frequency to meet the minimum signal level requirements of the indicator.

- the method of connection is such that there is no significant distortion of the band pass characteristics of the receiver.

There are several methods by which these connections can be accomplished.

1) Direct capacitive coupling to the receiver IF at a low impedance point.
2) A pick-up coil assuming switch signal level is available, and it can be placed in such a manner that the signal level does not vary significantly during the measurement.
3) Direct connection to the receiver IF via a cable at the rear panel provided by the manufacturer.

Obviously the last method is the most desirable. However, it is recognized that this does impact the cost of the receiver. The other methods do require the removal of an access panel in order to achieve switch pick-up.

Attachment B

of this chapter which are manufactured after December 31, 1958.

§ 15.75 Measurement procedure.

(a) Any measurement procedure acceptable to the Commission may be used to show compliance with the requirements of this subpart. A detailed description of the proposed measurement procedure, including a list of the test equipment to be used, shall be submitted to the Commission when requesting a determination regarding the acceptability of the proposed measurement procedure.

(b) The following methods of measurement are considered acceptable procedures for certification of receivers pursuant to § 15.69:

(1) Institute of Electrical and Electronics Engineers Standard 187 (formerly 51 IRE 17S1) for radiation measurements.

(2) Institute of Electrical and Electronics Engineers Standard 213 (formerly 61 IRE 27S1) for conducted interference measurements from frequency modulated and television broadcast receivers in the range 300 kHz to 25 MHz.

(3) Institute of Electrical and Electronics Engineers Standard 190 (formerly 60 IRE 17S1) for measurement of noise figure and peak picture sensitivity of a television broadcast receiver.

(4) International Electrotechnical Commission Publication No. 106 (1959) and Supplement 106A (1962) for measurement of radiated interference from broadcast receivers. (A conversion factor of 0.1 (—20 dB) shall be applied to the measured values for comparison with the limits of § 15.63.)

NOTE: This publication and supplement may be purchased from the American National Standards Institute (formerly United States of America Standards Institute), 1430 Broadway, New York, N.Y. 10018.

(5) Electronics Industries Association Standard RS-378, dated August 1970, entitled, "Measurement of Spurious Radiation from FM and TV Broadcast Receivers in the Frequency Range of 100 to 1000 MHz—Using the EIA-Laurel Broad-Band Antenna."

(c) In the case of measurements in the field, radiation in excess of 15 μV/m at any frequency between 450 kHz and 25 MHz at the border of the property and more than 15 feet from any power line crossing this border under the control and exclusive use of the person operating or authorizing the operation of the receiver will be considered an indication of noncompliance with the radiation requirements of this subpart.

§ 15.76 Report of measurements: FM broadcast receiver.

The report of measurements for an FM broadcast receiver or the FM broadcast band in a multiband broadcast receiver shall include the following:

(a) Specific identification of the receiver that was measured including the name and address of the manufacturer, the applicant for certification (if different), the trade name (if any), the model number and the serial number (if any).

(b) The measurement procedure that was used, pursuant to § 15.75.

(c) Measurements of the level of radiated RF energy with the receiver tuned to three points, one near the top, one near the middle and one near the bottom of the tuning range 88–108 MHz. The report shall show the frequency to which the receiver was tuned and for each, the frequency and amplitude of each emission detected that is within 20 dB of the limits in § 15.63 (a). The report shall also state that the spectrum was checked from 25 to 1000 MHz for each frequency to which the receiver was tuned and that all emissions not reported were more than 20 dB below the permitted level.

(d) Measurement of the level of conducted RF energy fed back into the power line, if the receiver is operated from the power lines of a public utility system. The report shall show the frequency to which the receiver was tuned and shall state the level of conducted RF energy at 10.7 and 21.4 MHz and the frequency and amplitude of any other emission detected that is within 20 dB of the limits in § 15.63(b). The report shall also state that the spectrum was checked from 0.45 to 25 MHz and that all emissions not reported were more than 20 dB below the permitted level.

NOTE.—A report of measurements on an industry standardized reporting form will be accepted as meeting the requirements of this section. One such form will be found in EIA Consumer Products Engineering Bulletin No. 4 available from Electronic Industries Association, 2001 Eye Street NW., Washington, D.C. 20006.

§ 15.77 Report of measurements: TV receiver.

The report of measurements for a TV broadcast receiver or the TV band in a multiband broadcast receiver shall include the following:

(a) Specific identification of the receiver that was measured including the name and address of the manufacturer, the name of the applicant for certification