



IEEE Recommended Practice for Measurement of 8-VSB Digital Television Transmission Mask Compliance for the USA

RF Standards Committee G-2.2

Sponsored by the
IEEE Broadcast Technology Society

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Approved 27 March 2008
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Abstract: This recommended practice provides a standardized body of theory, techniques, and procedures for measuring the spectral characteristics of 8-VSB transmitters used for terrestrial transmission of digital television (DTV) in the frequency range near their assigned channels. Essential characteristics are specified and measurement procedures are given that ensure that all parties will obtain comparable results.

Keywords: 8-VSB, 8-VSB emissions, 500 kHz sub-band, adjacent channel, ATSC digital TV standard, average filter attenuation modeling, band-stop filter, DTV, DTV emissions, FCC emissions compliance, DTV emissions measurement procedure, DTV emissions measurement theory, digital signal intermodulation, emission mask, LPTV DTV transmitter, noise-floor correction, noise bandwidth, pilot frequency offset, simple emission mask, spectrum analyzer, stringent emission mask

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Introduction

This introduction is not part of IEEE Std 1631-2008, IEEE Recommended Practice for Measurement of 8-VSB Digital Transmission Mask Compliance for the USA.

Overview

This recommended practice presents the theory, requirements, and techniques required to obtain accurate and consistent measurements of 8-VSB DTV emissions in the transmitter's adjacent channels. It is intended to provide manufacturers, installers, TV station personnel and other concerned parties with a standardized body of information for the purpose of determining whether DTV transmission systems are in compliance with the specifications prescribed in the FCC rules. Although the practices within this document apply specifically to the FCC's rules in the United States, the background theory and the measurement techniques apply to 8-VSB DTV emissions worldwide.

History

A digital television (DTV) standard was developed for the United States by the Advanced Television Standards Committee (ATSC). In the late 1990s, the FCC adopted the ATSC's transmission standards by incorporation (i.e., the ATSC's standards are referred to in the FCC's rules) but adopted its own regulations for DTV transmitter out-of-channel emissions performance.

Subsequently, in 2002, discussions between the IEEE Broadcast Technology Society (BTS) and the ATSC resulted in the BTS agreeing to provide assistance to develop the methodology required to measure DTV signals. A major driver of the BTS's participation was instances where significantly different results were obtained when measuring the same transmitter. At that time, it was unclear whether the primary problem was variations in the measurement techniques or in the test equipment. The impact was that there was little certainty whether a given transmitter was in complete compliance with the FCC's rules. Thus, it was important for the BTS to define instrument performance and to codify measurement protocols so that comparable results could be obtained by all parties. A Project Authorization Request (PAR) was sponsored by the IEEE BTS to start the project, and the RF Standards Committee G-2.2 was identified as the working group to investigate and develop the necessary information.

The in-channel spectrum of the 8-VSB DTV signal is similar to other digitally modulated radio-frequency (RF) signals. However, the FCC's out-of-channel emission requirements are very severe and are couched in language specific to DTV. This, coupled with the fact that the techniques required to measure the spectrum of a digitally modulated transmitter are unfamiliar to the broadcast industry, caused significant variations in the results obtained by various observers. Therefore, it was determined by the BTS RF Standards Committee that its initial project would be to develop an 8-VSB emissions measurement recommended practice. The project turned out to be much more difficult than originally thought, and it has evolved over the past 5 years with significant effort by a dedicated group of individuals. Two factors made developing the document difficult. The first is that FCC's requirements are very rigorous, pushing the performance of available test equipment to its limits. The second, to obtain that performance, required that the test equipment be carefully configured so the document had to provide sufficient, suitably worded instruction for those unfamiliar with the equipment's operation.

The committee collected the necessary background theory and then evaluated the methods and the suitability of the test equipment available for making the measurements. After several field trials and an informal poll of industry members concerning the acceptability of various techniques, a direct measurement technique requiring the use of a band stop filter in the RF sample path was selected as the primary method.

Field tests of the consistency of measurements made by different models of test equipment as well as of the clarity and understandability of the document's language were made. A verification report was created that documents the measurements made at two transmitters with multiple instruments. This report documents that the goals outlined by this recommended practice were essentially achieved. This report is available from the BTS G-2.2 RF Standards Committee.

The measurement of harmonic emissions was initially included in this document. However, significant obstacles prevented reaching closure on an acceptable and practical means of measuring the harmonics of both existing and future transmitters. These obstacles included issues caused by moding of harmonic energy in the transmission line (or wave guide) and associated RF directional coupler characteristics. It was, therefore, decided to proceed with the adjacent channel portion of the emissions document for the industry's use, whereas the harmonic problem is further considered. It is hoped that as the harmonic emissions measurement problem is resolved, a future amendment can be incorporated into this document.

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1. Scope

This recommended practice provides a standardized body of theory, techniques, and procedures for measuring the spectral characteristics of 8-VSB transmitters used for terrestrial transmission of digital television (DTV) in the frequency range near their assigned channels. Essential characteristics are specified and measurement procedures are given that ensure that all parties will obtain comparable results. The theory and techniques presented are applicable to *all* 8-VSB transmitters. However, the specification and interpretation of these measurements is primarily focused on DTV transmitters used within the United States of America.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

FCC regulations for DTV within 47CFR§73 Subpart E-Television Broadcast Stations¹:

FCC 47CFR§73.606(a)

FCC 47CFR§73.622(g)

FCC 47CFR§73.682(a)^{1 2}

FCC 47CFR§73.682(d)

FCC regulations for LPTV DTV Broadcast Stations within 47CFR§74 Subpart G-Low Power TV, TV Translator, and TV Booster Stations:

FCC 47CFR§74.794(a)

FCC 47CFR§74.794(b)

FCC Public Notice DA-05-1321A1, May 10, 2005, "OET Clarifies Emission Mask Measurement for DTV Transmitters."

3. Definitions

For the purposes of this document, the following terms and definitions apply. The glossary in Annex C and *The Authoritative Dictionary of IEEE Standards Terms* [B5]³ should be referenced for terms not defined in this clause.

3.1 band power measurement (also called channel power): A measurement system included in most measurement instruments that automatically measures the total average power of the signal(s) present within a frequency range selected by the user.

3.2 channel: The nominal specified range of frequencies assigned to each 6 MHz television channel in North America.

NOTE—See 4.2.⁴

3.3 channel edge: The upper or lower edge of the 6-MHz-wide channel occupied by the 8-VSB signal from a DTV transmitter.

3.4 channel filter: A band-pass filter typically used at the output of a DTV transmitter to limit its out-of-channel emissions. *Syn.*: **emissions mask filter**.

NOTE—See Figure 21 or Figure 22.

3.5 dB_{DTV}: An amplitude measure of spectral details of an 8-VSB signal where the amplitude of the noise-like signal is either *measured* across a 500 kHz range of frequencies or *normalized* to a 500 kHz bandwidth, and then expressed as a logarithmic ratio to the total average power of the 8-VSB signal within its 6 MHz channel.

NOTE—See 4.4.

¹ All FCC regulations and public notices are available from the FCC's Web site at www.fcc.gov.

² The ATSC standard is available from the ATSC Web site at www.atsc.org.

³ The numbers in brackets correspond to those of the bibliography in Annex D.

⁴ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

3.6 emissions: All electromagnetic signals emanating from the transmitter via its antenna transmission line. Emissions include the *desired* fundamental signal itself plus all *undesired* electromagnetic signals at frequencies not within the transmitter's assigned channel, including, but not limited to, adjacent channel (or channel) signals, harmonic signals, subharmonic signals, and spurious responses.

3.7 emissions mask filter: A band-pass filter typically used at the output of a DTV transmitter to limit its out-of-channel emissions. *Syn.*: **channel filter**.

NOTE—See Figure 21 or Figure 22.

3.8 frequency response: The variation of a transmitter's actual amplitude response at a given frequency with respect to its ideal response; typically expressed in decibels. In the 8-VSB DTV transmitter, the ideal response is a flat mid-band amplitude response with two root-raised cosine transition regions at the channel edges. (adapted from the ATSC Digital Television Standard, Part 2 [B1])

3.9 F_{Symbol} : The approximately 10.762, 238 MHz rate that data *symbols* are transmitted in the 8-VSB system. (adapted from the ATSC Digital Television Standard, Part 2 [B1])

NOTE—See 4.3.

3.10 head or signal head: The flat, central portion of the 8-VSB signal.

3.11 head-shoulder intercept (HSI) or 8-VSB HSI: A measure of a device's intermodulation performance when handling an 8-VSB signal. The 8-VSB HSI is the total average signal amplitude that would (by extrapolation) cause the signal's channel edge shoulder to be equal in amplitude to the signal's head.

NOTE—See Annex A.

3.12 near-channel: A loosely defined range of frequencies near the 8-VSB DTV transmitter's assigned channel (e.g., within approximately a dozen megahertz of the channel's center frequency).

3.13 noise bandwidth: An attribute of either a filter or a signal. It is the bandwidth of an idealized (i.e., rectangular-shaped) response that has the same peak amplitude response and passes the same noise power as the actual filter or signal; also referred to as equivalent noise bandwidth.

NOTE—See 6.1.1.

3.14 pilot frequency: The frequency of the 8-VSB signal's pilot carrier.

NOTE—See 4.2 and Figure 2.

3.15 out-of-channel emissions: Any emission that the 8-VSB DTV transmitter produces outside of its channel.

NOTE—See 4.6.

3.16 sampling device: A directional coupler or attenuator used to obtain a portion of the transmitted signal for use by the measurement instrument. The sampling device is typically placed in the transmission line (e.g., the coaxial cable or the waveguide) connecting the transmitter to its load (normally the antenna). When a directional coupler is used, it selectively provides a sample of the signal traveling from the transmitter toward its load while rejecting the signal reflected from the load.

NOTE—See 4.5 and 5.4.2.

3.17 shoulder: The “shelf” of third-order intermodulation products in the frequency range immediately beyond the transmitter’s assigned channel. Since it is primarily caused by third-order intermodulation, its amplitude increases three times faster than the total 8-VSB signal’s power. Its amplitude is generally measured with respect to the amplitude of the head or flat portion of the 8-VSB spectrum. This is the most critical area in a transmitter’s out-of-band emissions because the transmitter’s channel filter is often ineffective near the edge of the transmitter’s channel.

NOTE—See 6.2.2 and Figure 1.

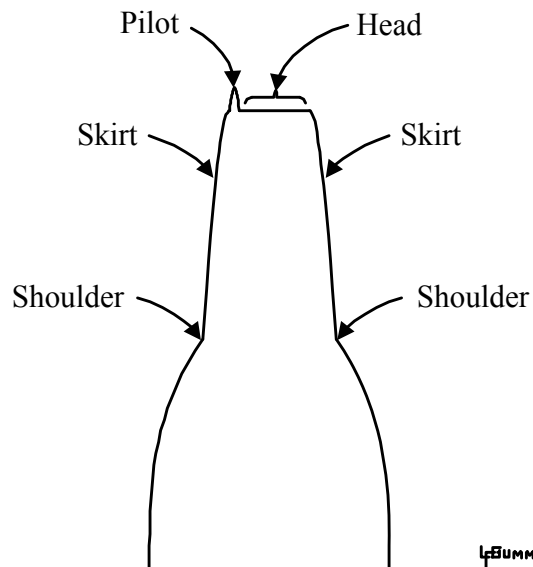


Figure 1—Parts of the 8-VSB signal

3.18 slope attenuation factor: When dealing with a channel filter’s attenuation versus frequency characteristic expressed in decibels, portions of the curve between two frequencies may be modeled as a linear slope. The slope attenuation factor is the difference, in decibels, between the midpoint attenuation of that slope and the *average* attenuation computed over the entire slope.

NOTE—See 6.3.2.4.

3.19 sub-band: One of 24, 500 kHz wide frequency bands in the 6 MHz channel directly above and directly below the 8-VSB DTV transmitter’s channel. They are numbered in a sequence of ± 1 to ± 12 , with 1 being directly adjacent and 12 being the farthest from the channel edge. Positive numbers are assigned to the sub-bands *above* the transmitter’s channel and negative numbers to those *below*.

NOTE—See Figure 6.

3.20 sweet spot or sweet spot amplitude: The 8-VSB signal amplitude at the measurement instrument’s input mixer that maximizes the measurement instrument’s dynamic range.

NOTE—See 6.2.4, 6.2.5, and 6.2.6.

3.21 third-order intercept (TOI or IP3): When two signals of equal amplitude and nearly the same frequency are applied to an active device’s input, spurious intermodulation products caused by the device’s third-order nonlinearities may be generated. If the two signals are separated by ΔF , one spurious

of interest product will appear at a frequency ΔF above the frequency of the higher signal and another at ΔF below the frequency of the lower signal. Over a considerable range of input amplitudes, the amplitude of each spurious product increases 3 dB for each 1 dB increase in *both* of the two input signals' amplitude. The device's third-order intercept (i.e., its TOI or its IP3) is, by extrapolation, the signal amplitude at which the individual spurious products are equal in amplitude to the individual input signals. This value is never found by direct measurement because the 3:1 relationship between spurious product amplitude and the signal's amplitude (known as being "well behaved") fails well before the intercept amplitude is reached.

NOTE—See 6.2.2 and Figure 13.

4. 8-VSB signal characteristics

4.1 General

In the USA, DTV transmission is specified by the FCC. The critical emissions standards, the subject of this recommended practice, are wholly specified by the FCC itself, whereas the detailed specification of the 8-VSB signal itself is specified by the FCC by reference to the ATSC's standard [FCC 47CFR§73.682(d)].⁵ For the reader's convenience, the applicable portions of both the FCC's regulations and the ATSC's standards are repeated here. Although correct at the time of writing, this information may have been superseded and should not be considered authoritative. The reader is urged to reference the source documents, especially the FCC's DTV emissions rules, to ensure that the correct FCC rules are applied to the measured values.

4.2 Pilot frequency

The 8-VSB pilot is normally 309.441 kHz above the lower edge of the channel assigned to the DTV transmitter, except when the DTV transmitter is required by the FCC to offset its pilot frequency in order to minimize interference caused to a lower adjacent channel analog TV station. In that case, the pilot frequency is required to be 5.082,138 MHz (± 3 Hz) above the visual carrier of the analog station [FCC 47CFR§73.622(g)].⁶

The exact pilot frequency of an offset 8-VSB transmitter is thus dependent on the frequency of the analog transmitter. Because the nominal frequencies of some analog stations are offset 10 kHz lower in frequency, whereas others are offset 10 kHz higher [FCC 47CFR§73.606(a)],⁷ the pilot frequency of an upper adjacent channel 8-VSB transmitter will be about 12.697 kHz, 22.697 kHz, or 32.697 kHz *higher* than nominal. Operating with an offset makes it more difficult for a DTV transmitter to meet the emissions mask. A quantitative analysis of this problem is given in Annex B.

4.3 Frequency response

The ideal frequency response of an 8-VSB transmitter is shown in Figure 2 [the ATSC Digital Television Standard, Part 2 [B1]; FCC 47CFR§73.682(a)1].⁸

⁵ Information on references can be found in Clause 2.

⁶ Specifies exceptions to the standard pilot frequency.

⁷ Specifies the use of 10 kHz offsets for some analog TV channels.

⁸ Specifies a 6 MHz channel for television use.

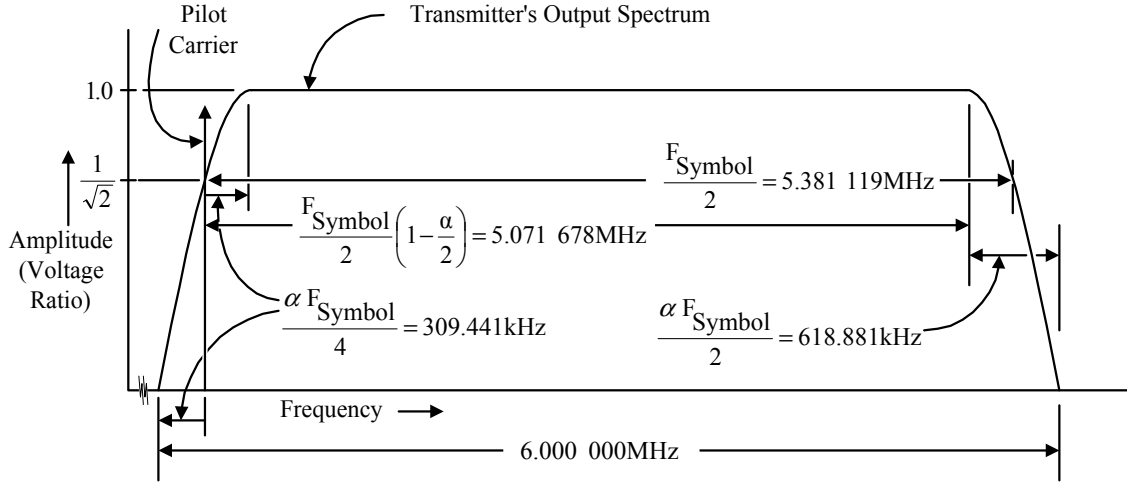


Figure 2—Ideal transmitter output spectrum

This curve may be expressed in equations as in Equation (1):

$$H(F) = \begin{cases} 0 & 0 < F \leq \left(F_{Pilot} - \frac{F_{Symbol}\alpha}{4} \right) \\ \sin \left[\frac{\pi \left(F - F_{Pilot} + \frac{F_{Symbol}\alpha}{4} \right)}{F_{Symbol}\alpha} \right] & \left(F_{Pilot} - \frac{F_{Symbol}\alpha}{4} \right) < F \leq \left(F_{Pilot} + \frac{F_{Symbol}\alpha}{4} \right) \\ 1 & \left(F_{Pilot} + \frac{F_{Symbol}\alpha}{4} \right) < F \leq \left(F_{Pilot} + \frac{F_{Symbol}}{2} \left(1 - \frac{\alpha}{2} \right) \right) \\ \sin \left[\frac{\pi \left(\frac{F_{Symbol}}{4} (2 + \alpha) - F + F_{Pilot} \right)}{F_{Symbol}\alpha} \right] & \left(F_{Pilot} + \frac{F_{Symbol}}{2} \left(1 - \frac{\alpha}{2} \right) \right) < F \leq \left(F_{Pilot} + \frac{F_{Symbol}}{2} \left(1 + \frac{\alpha}{2} \right) \right) \\ 0 & \left(F_{Pilot} + \frac{F_{Symbol}}{2} \left(1 + \frac{\alpha}{2} \right) \right) < F < \infty \end{cases} \quad (1)$$

where as in Equation (2) and Equation (3):

$$F_{\text{Symbol}} = 4.5(684/286)10^6 \text{ or } 5(1539/715)10^6 \approx 10.762\,238 \text{ MHz } (\pm 30 \text{ Hz})$$

(the ATSC Digital Television Standard, Part 2 [B1]) (2)

$$\alpha = [2(6.000\,000 \text{ MHz})/F_{\text{Symbol}}] - 1 \approx 0.1150097 \quad (3)$$

4.4 Units for 8-VSB emissions amplitude measurements

The FCC specifies the attenuation of emissions in terms of measurements made with a 500 kHz reference bandwidth, expressed in decibels with respect to the *total* power transmitted in the transmitter's 6 MHz channel (including the pilot's power). Because of this quantity's complexity and its use in all measurements and regulations, it is given a special designation, dB_{DTV}, in this document.

NOTE—The amplitude of a measurement at a single frequency may also be expressed in dB_{DTV}. With the exception of the pilot signal, the 8-VSB signal is noise-like. Therefore, measured amplitudes vary directly with the measurement bandwidth. To express an amplitude measurement in dB_{DTV}, first scale that amplitude to a 500 kHz noise bandwidth using the procedure given in 6.1.1. Then divide that result by the transmitter's total average power measured within its channel and express the result in decibels. For amplitudes measured in dBm, measure the amplitude across a 500 kHz band or adjust the amplitude to a 500 kHz equivalent bandwidth using the procedure in 6.1.1 and then subtract the total average 8-VSB signal power (in dBm) to obtain the amplitude in dB_{DTV}.

4.5 Source of signal to be measured

The FCC specifies that emissions are to be measured on a signal derived from the transmitter's output at a point beyond any filters that may be employed [FCC 47CFR§73.622(h)]. Typically, a coupler or sampling device to obtain this signal is inserted in the transmission line (coaxial cable or waveguide) between the transmitter (including the mask filter) and its load or antenna. During measurement, the transmitter may be operated into either an antenna or a dummy load; the dummy load is preferred, as it minimizes possible problems with off-air signal ingress. As an option, the sampling device can be a simple attenuator of the correct impedance and one that can accommodate the transmitter's output power. Regardless of type, to make measurements possible, the sampling device should provide the measurement instrument with a signal of the appropriate amplitude. (See 6.3.2.1.)

To enable accurate measurements of adjacent near-channel emissions, the sampling device should exhibit no more than a 0.5 dB peak-to-peak flatness error over a minimum range of 18 MHz centered at the transmitter's output channel. The sampling device should exhibit at least 18 dB of return loss over the 18 MHz range centered at the transmitter's output channel. (See 5.4.1.) The cables and connectors used to make connections between the sampling device and the test instrument should avoid the generation of passive intermodulation (PIM) distortion.

NOTE—Any frequency selectivity provided by any element in the transmission path leading to the antenna *after* the signal is delivered to the sampling device at the output of the transmitter's channel filter, is excluded from consideration by the FCC's regulations [FCC 47CFR§73.622(h)].

4.6 Out-of-channel emissions

4.6.1 General

In the USA, the FCC has specified different emission masks for different types of 8-VSB DTV transmitters.

One mask is specified for full-service digital TV transmitters. Two other masks are specified for digital LPTV transmitters, Class A digital transmitters and digital TV translators; one mask is termed “Simple” and the other “Stringent.” The conditions imposed by the licensing process and the FCC’s regulations should be consulted to determine which mask is appropriate for a given digital transmitter.

4.6.2 Full-service DTV transmitter emissions mask

Full-service transmitters should meet the following out-of-channel emissions requirements [FCC 47CFR§73.622(h)]:

- a) In the range between one half the width of the resolution bandwidth filter used and 500 kHz from the channel edge, as shown in Equation (4):

$$\text{Emissions} \leq -47 \text{ dB}_{\text{DTV}} \quad (4)$$

- b) More than 6 MHz from the channel edge, as shown in Equation (5):

$$\text{Emissions} \leq -110 \text{ dB}_{\text{DTV}} \quad (5)$$

- c) At any frequency between 500 kHz and 6 MHz from the channel edge, as shown in Equation (6):

$$\text{Emissions} \leq -(11.5(|\Delta F| - 0.5) + 47) \text{ dB}_{\text{DTV}} \quad (6)$$

where

ΔF is the frequency difference, in megahertz, from the channel edge

These requirements are shown graphically in Figure 3.

8-VSB Full Service Transmitter Emission Limits

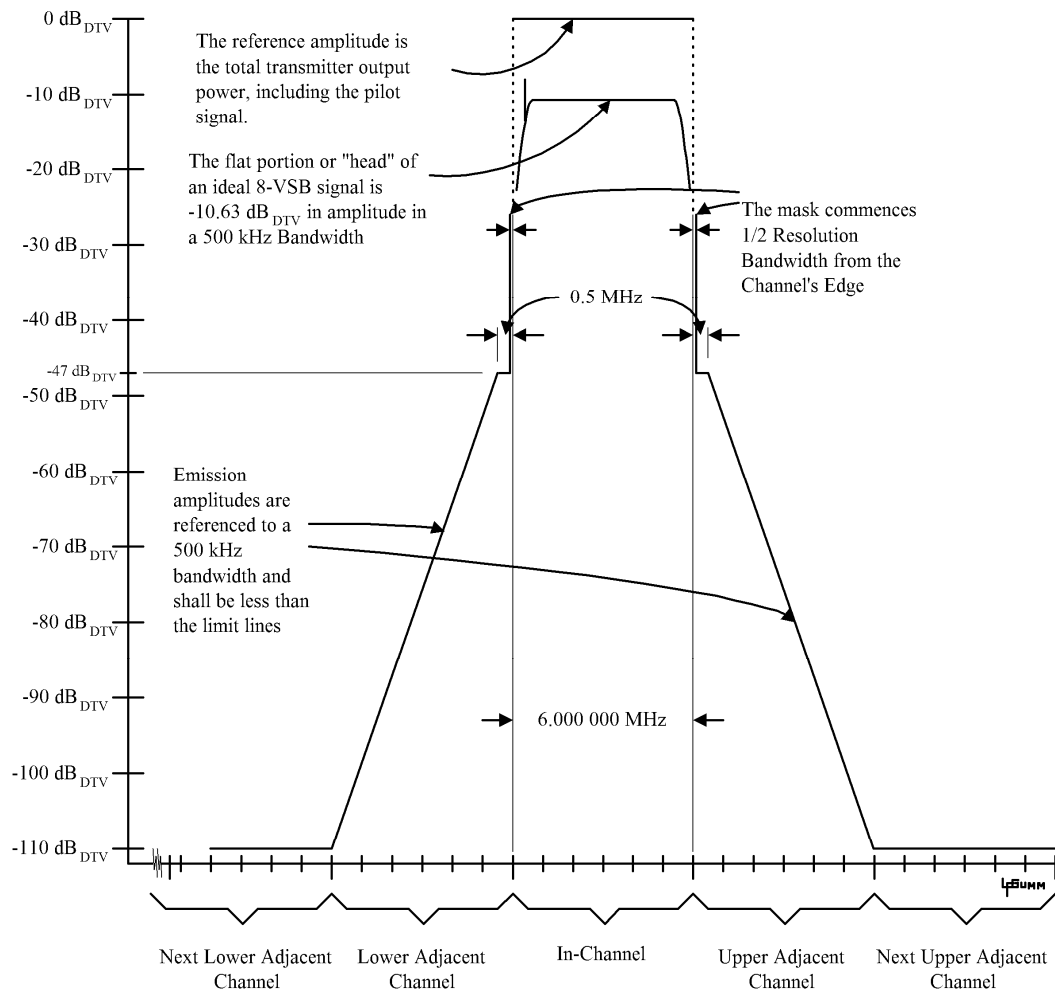


Figure 3—Emissions requirements for full-service 8-VSB transmitters

4.6.3 Stringent emissions mask for LPTV DTV transmitters

Certain 8-VSB TV transmitters licensed for LPTV or translator service should meet the following out-of-channel emissions requirements [FCC 47CFR§74.794(a)]:

- In the range between one half the width of the resolution bandwidth filter used and 500 kHz from the channel edge, as shown in Equation (7):

$$\text{Emissions} \leq -47 \text{ dB}_{\text{DTV}} \quad (7)$$

- More than 3 MHz from the channel edge, as shown in Equation (8):

$$\text{Emissions} \leq -76 \text{ dB}_{\text{DTV}} \quad (8)$$

IEEE Recommended Practice for Measurement of 8-VSB Digital Television Mask Transmission Compliance for the USA

- c) At any frequency between 500 kHz and 3 MHz from the channel edge, as shown in Equation (9):

$$\text{Emissions} \leq -(11.5(|\Delta F| - 0.5) + 47) \text{ dB}_{\text{DTV}} \quad (9)$$

where

ΔF is the frequency difference, in megahertz, from the channel edge

NOTE—The FCC requires that the attenuation between the power amplifier's output terminals and the transmitter's output shall be verified for low-power transmitters operating on certain channels. (See 4.7.)

These requirements are shown graphically in Figure 4..

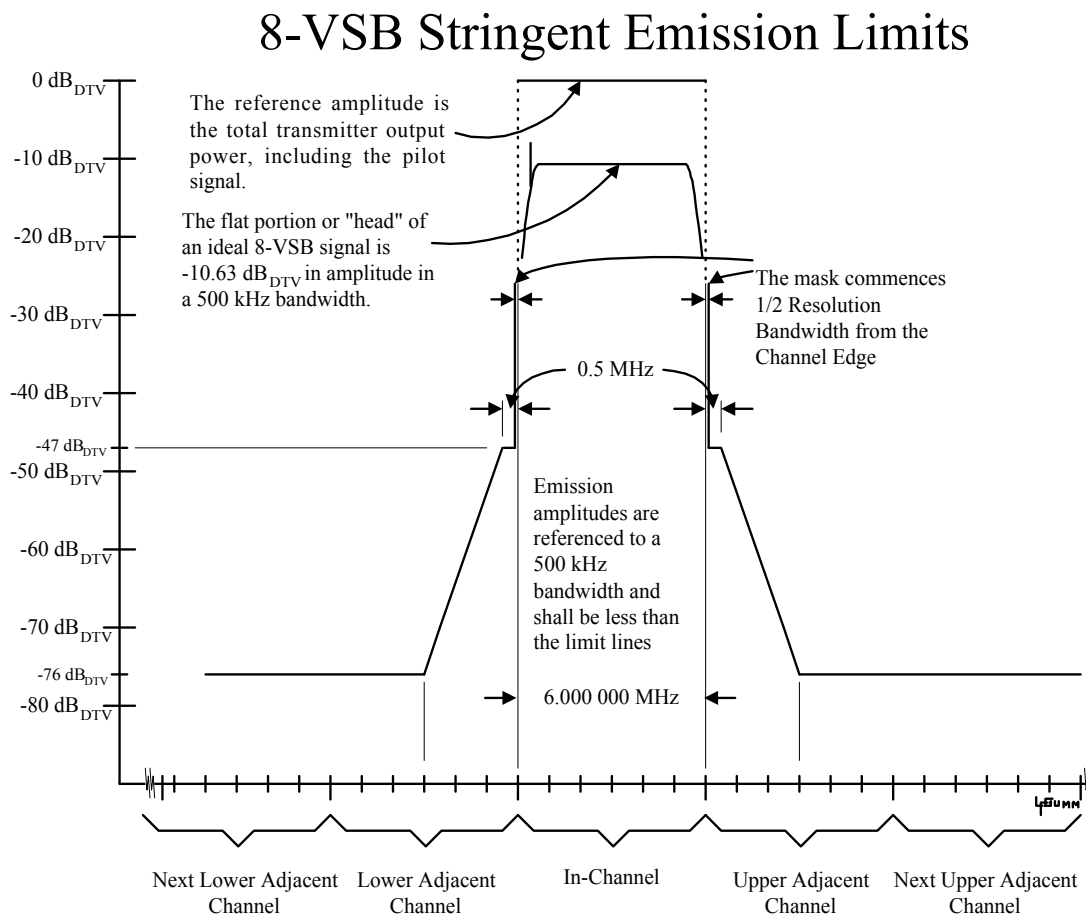


Figure 4—Stringent emissions mask requirements for 8-VSB LPTV transmitters and translators

4.6.4 Simple emissions mask for LPTV DTV transmitters

Certain 8-VSB TV transmitters licensed for LPTV or translator service should meet the following out-of-channel emissions requirements [FCC 47CFR§74.794(a)]:

- a) In the range between one half the width of the resolution bandwidth filter used and 6 MHz from the channel edge, as shown in Equation (10):

$$\text{Emissions} \leq -((\Delta F^2 / 1.44) + 46) \text{ dB}_{\text{DTV}} \quad (10)$$

where

ΔF is the frequency difference, in megahertz, from the channel edge

More than 6 MHz beyond the channel edge, as shown in Equation (11):

$$\text{Emissions} \leq -71 \text{ dB}_{\text{DTV}} \quad (11)$$

These requirements are shown graphically in Figure 5.

NOTE—The FCC requires that attenuation between the power amplifier's output terminals and the transmitter's output shall be verified for low-power transmitters operating on certain channels. (See 4.7.)

4.6.5 Notes for all masks

NOTE 1—Measurements need not be made any closer to the channel edge than one half of the width of the resolution bandwidth filter used in the measurement instrument.

NOTE 2—Although Figure 3 through Figure 5 depict only the band of frequencies near the transmitter's output signal, the FCC's ultimate attenuation requirement specifically applies to all emissions greater than 6.0 MHz away from the transmitter's channel edges, including harmonics, subharmonics, or other spurious signals.

NOTE 3—The FCC accepts measurements made using one of two methods (FCC Public Notice DA-05-1321A1):

Method 1: Measure the emissions in a narrow resolution bandwidth (30 kHz, 10 kHz, or narrower). Either scale the measured *power* to a 500 kHz bandwidth based on $10 \log(500 \text{ kHz/noise bandwidth of the resolution filter})$ or scale the measured *attenuation* (i.e., $10 \log(\text{measured power/total signal power})$) based on $10 \log(\text{noise bandwidth of the resolution filter/500 kHz})$. These values are then compared *point by point* with the emission mask.

Method 2: Sum the power across a 500 kHz window in order to implement an effective measurement bandwidth of 500 kHz; this power is then compared with the emission mask value computed for the *center* frequency of the 500 kHz sub-band. This method may be performed either by manually summing the measurements or by using a measurement instrument's band power measurement function. It is sufficient to measure a contiguous sequence of twelve 500 kHz windows across each adjacent channel, plotting the measured value at the center of the 500 kHz sub-band window.

The FCC allows a single method to be used for all measurements, or if desired, one of the above methods may be employed in the 500 kHz window adjacent to each channel edge and the other method for all other measurements further from the channel edge. The FCC requires that the frequency bin spacing on the measurement test instrument is to be less than or equal to the resolution bandwidth as displayed.

NOTE 4—Method 2 is the basis for the measurement procedures given in Clause 5 and most of the theory outlined in Clause 6. An indirect measurement method also using Method 2, which may prove more useful than in a manufacturing setting, is outlined in Clause 6. Measurements using Method 1 are specifically allowed by the FCC and may be advantageous for certain automatic systems or measurements controlled by a computer. However, implementation of a suitable procedure and ensuring its conformance to the FCC's regulations is beyond the scope of this document.

8-VSB Simple Emission Limits

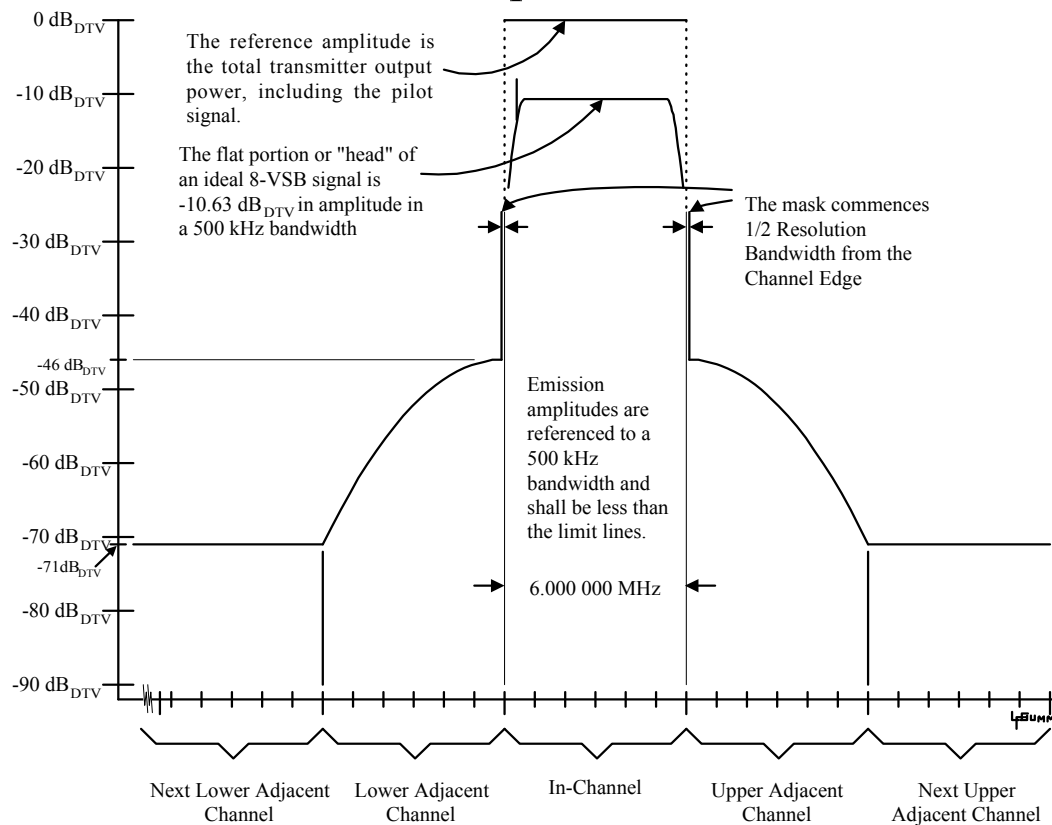


Figure 5—Simple emissions mask requirements for low-power 8-VSB LPTV transmitters and translators

4.7 Required filtering for some LPTV DTV transmitters and translators

To protect the RNSS bands (i.e., the Radio Navigational Satellite Service, which is also called the Global Positioning System or GPS), the FCC requires that low-power DTV transmitters operating on Channels 22–34, Channel 36, Channel 38, and Channels 65–69, exhibit sufficient filtering between the transmitter's power amplifier and its antenna terminals to ensure sufficient suppression of harmonics [FCC 47CFR§74.794(b)].

At least 85 dB of attenuation (with respect to the loss exhibited at the transmitter's fundamental frequency) in the frequency ranges of 1164 MHz to 1215 MHz (Band L5), 1215 MHz to 1240 MHz (Band L2), and 1559 MHz to 1610 MHz (Band L1) is required between the output of the transmitter's power amplifier and the transmitter's antenna output terminals.

5. Measurement procedures

5.1 General

This section provides the step-by-step procedures necessary to measure 8-VSB transmitter's near-channel emissions using a method that allows direct, in-service (or out-of-service) measurements. Near-channel emissions are those that are on either side of and close to the transmitter's channel (e.g., within approximately a dozen megahertz of the channel's center). Specialized test equipment that automatically makes the required emissions measurements to the FCC requirements may be used instead of these procedures. If available, use of such equipment will greatly simplify the measurement process.

If automatic equipment is not available, then general-purpose test equipment (i.e., spectrum analyzers) may be computer-controlled to make this measurement, or measurements may be made manually. If a computer-controlled, general-purpose instrument is used, the creation and testing of a program that reliably makes measurements to the requirements of 4.6 is well beyond the scope of this document and is left to the user.

If the measurement is to be performed manually, use the procedure given in this clause. The approach used is listed as Method 2 of NOTE 4 in 4.6.5. This approach is used because it requires a limited number of measurements, and all required noise bandwidth and detector corrections are automatically made by the band power or channel power algorithms within the test equipment. A band stop filter is employed to obtain the necessary measurement dynamic range while often allowing in-service measurements.

Another, indirect, method is outlined in Clause 6, and its use may be advantageous in a manufacturing setting.

5.2 General measurement information

Emission measurements are made in a total of 24 sub-bands, each 500 kHz wide, on both sides of the transmitter's signal. To facilitate measurements, the sub-bands are numbered as shown in Figure 6.

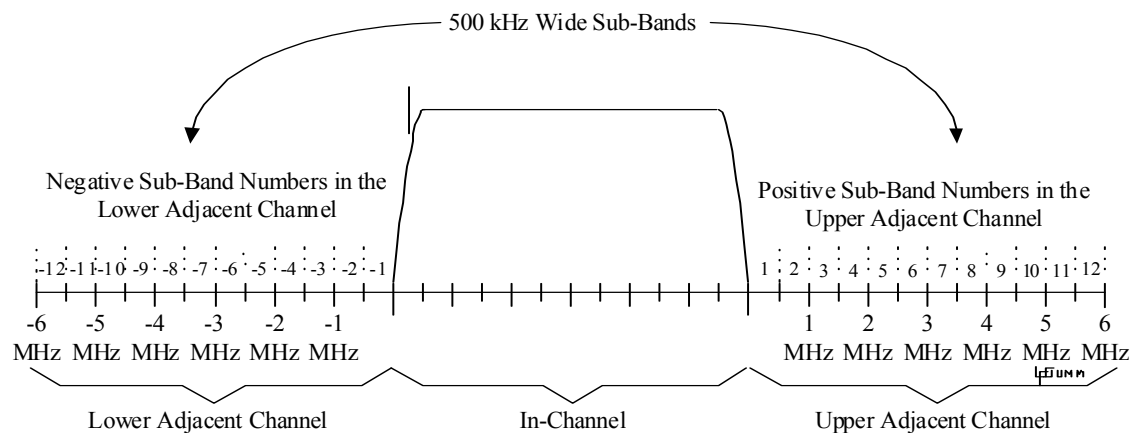


Figure 6—Numbering of the 500 kHz frequency sub-bands in the adjacent frequency bands next to the transmitter's channel