

Development will comply with

MM Docket No. 99-325

Topic:

IV. ADOPTION OF IBOC AM AND FM STANDARDS

digital broadcasting need comply with any notification or technical requirements.
Per (IBOC) system.

This system is designed to permit a smooth evolution from current analog Amplitude Modulation (AM) and Frequency Modulation (FM) radio to a fully digital in-band on-channel (IBOC) system. This system delivers digital audio and data services to mobile, portable, and fixed receivers from terrestrial transmitters in the existing Medium Frequency (MF) and Very High Frequency (VHF) radio bands

Analog FM Modulator

For the Hybrid and Extended Hybrid waveforms, the appropriately delayed baseband analog signal $m(t-\tau)$ is frequency modulated to produce an RF analog FM waveform identical to existing analog signals. The FM-modulated analog signal, including any SCAs, will maintain compatibility with Title 47 CFR Part 73, Subparts B, C, and H. In addition, the analog signal will be compatible with the emergency alert system (EAS) as specified in Title 47 CFR Part 11.

Analog/Digital Combiner

When broadcasting the Hybrid or Extended Hybrid waveform, the analog-modulated FM RF signal is combined with the digitally-modulated RF signal to produce the VHF FM IBOC waveform, $s(t)$. Both the analog and digital portions of the waveform are centered on the same carrier frequency.

Each spectrum described in the remaining subsections shows the subcarrier number and center frequency of certain key OFDM subcarriers. The center frequency of a subcarrier is calculated by multiplying the subcarrier number by the OFDM subcarrier spacing Δf . The center of subcarrier 0 is located at 0 Hz. In this context, center frequency is relative to the radio frequency (RF) *allocated channel*.

For example, the upper Primary Main sideband is bounded by subcarriers 356 and 546, whose center frequencies are located at 129,361 Hz and 198,402 Hz, respectively. The frequency span of the Primary Main sideband is 69,041 Hz. (198,402 – 129,361).

Hybrid Spectrum

The digital signal is transmitted in PM sidebands on either side of the analog FM signal, as shown in Figure Error! No text of specified style in document.-1. Each PM sideband is comprised of ten frequency partitions, which are allocated among subcarriers 356 through 545, or -356 through -545. Subcarriers 546 and -546, also included in the PM sidebands, are additional reference subcarriers. The amplitude of the subcarrier within Primary Main sidebands are uniformly scaled by an *amplitude scale factor*, a_0 . The amplitude scaling factor is described in Appendix A. Table Error! No text of specified style in document.-1 summarizes the upper and lower Primary Main sidebands for the Hybrid waveform.

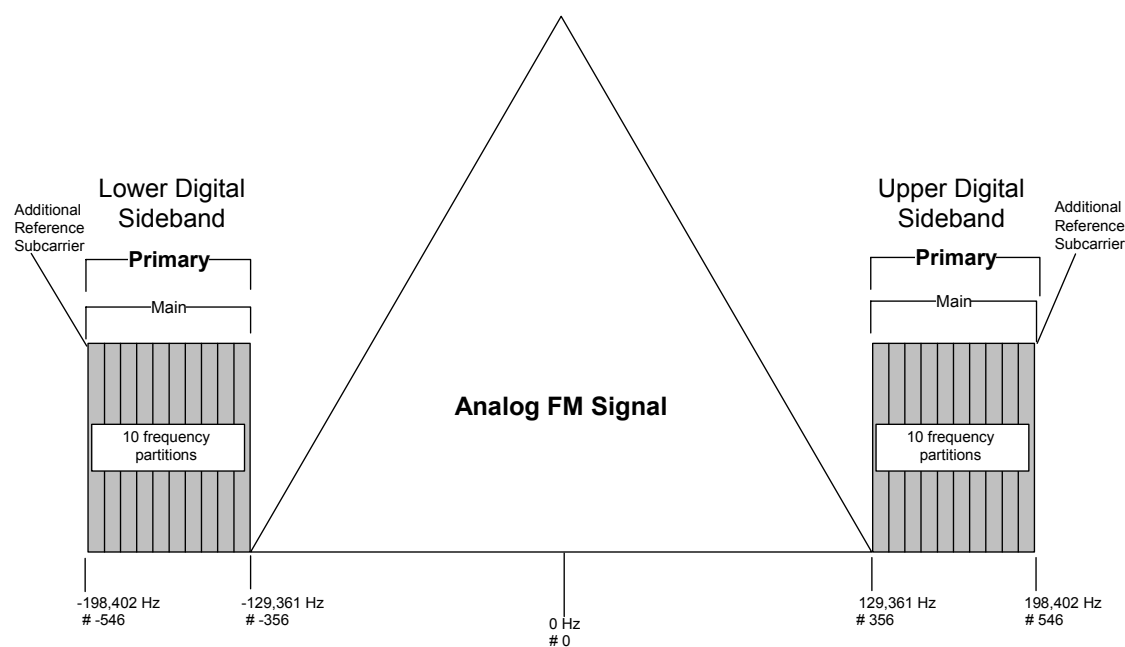


Figure Error! No text of specified style in document.-1 Spectrum of the Hybrid Waveform–Service Mode MP1

Table Error! No text of specified style in document.-1 Hybrid Waveform Spectral Summary–Service Mode MP1

Sideband	Number of Frequency Partitions	Frequency Partition Ordering	Subcarrier Range	Subcarrier Frequencies (Hz from channel center)	Ampl. Scale Factor	Frequency Span (Hz)	Comments
Upper Primary Main	10	A	356 to 546	129,361 to 198,402	a_0	69,041	Includes additional reference subcarrier 546

Lower Primary Main	10	B	-356 to -546	-129,361 to -198,402	a_0	69,041	Includes additional reference subcarrier - 546
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Note: Refer to Appendix A for details regarding the amplitude scale factors shown above.

Extended Hybrid Spectrum

The Extended Hybrid waveform is created by adding Primary Extended sidebands to the Primary Main sidebands present in the Hybrid waveform, as shown in Figure **Error! No text of specified style in document.-2**. Depending on the service mode, one, two, or four frequency partitions can be added to the inner edge of each Primary Main sideband.

Each Primary Main sideband consists of ten frequency partitions and an additional reference subcarrier spanning subcarriers 356 through 546, or -356 through -546. The upper Primary Extended sidebands include subcarriers 337 through 355 (one frequency partition), 318 through 355 (two frequency partitions), or 280 through 355 (four frequency partitions). The lower Primary Extended sidebands include subcarriers -337 through -355 (one frequency partition), -318 through -355 (two frequency partitions), or -280 through -355 (four frequency partitions). The subcarriers within Primary Extended sidebands are uniformly scaled the same *amplitude scale factor*, a_0 , as the Primary Main sidebands. The amplitude scaling factor is described in Appendix A. **Error! Reference source not found.** summarizes the Upper and Lower Primary sidebands for the Extended Hybrid waveform.

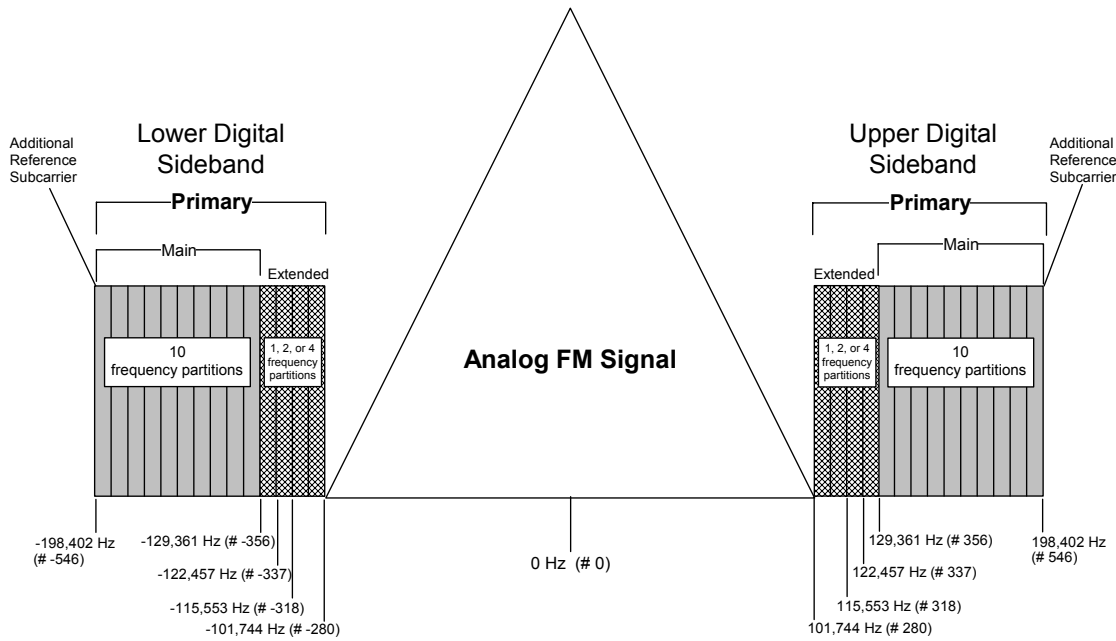


Figure Error! No text of specified style in document.-2 Spectrum of the Extended Hybrid Waveform–Service Modes MP2 through MP4

All Digital Spectrum

The All Digital waveform is constructed by removing the analog signal, fully expanding the bandwidth of the primary digital sidebands, and adding lower-power secondary sidebands in the spectrum vacated by the analog signal. The spectrum of the All Digital waveform is shown in Figure **Error! No text of specified style in document.-3**.

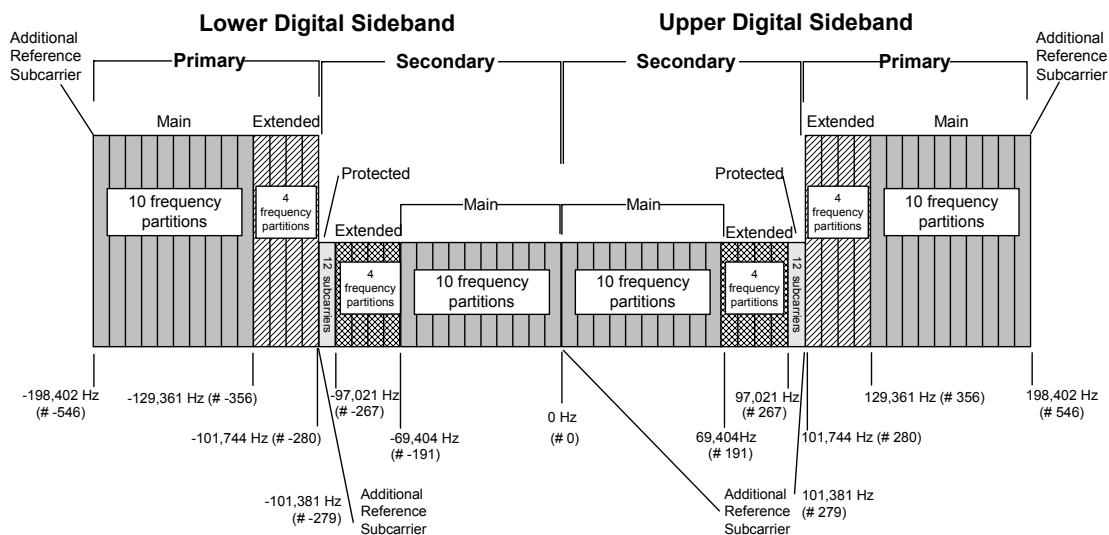


Figure Error! No text of specified style in document.-3 Spectrum of the All Digital Waveform–Service Modes MP5 through MP7, MS1 through MS4

In addition to the ten main frequency partitions, all four extended frequency partitions are present in each primary sideband of the All Digital waveform. Each secondary sideband also has ten Secondary Main (SM) and four Secondary Extended frequency partitions. Unlike the primary sidebands, however, the Secondary Main frequency partitions are mapped nearer to channel center with the extended frequency partitions farther from the center.

Each secondary sideband also supports a small Secondary Protected (SP) region consisting of 12 OFDM subcarriers and reference subcarriers 279 and -279. The sidebands are referred to as “protected” because they are located in the area of spectrum *least* likely to be affected by analog or digital interference. An additional reference subcarrier is placed at the center of the channel (0). Frequency partition ordering of the SP region does not apply since the SP region does not contain frequency partitions as defined in **Error! Reference source not found.** and **Error! Reference source not found.**

Each Secondary Main sideband spans subcarriers 1 through 190 or -1 through -190. The upper Secondary Extended sideband includes subcarriers 191 through 266, and the upper Secondary Protected sideband includes subcarriers 267 through 278, plus additional reference subcarrier 279. The lower Secondary Extended sideband includes subcarriers -191 through -266, and the lower Secondary Protected sideband includes subcarriers -267 through -278, plus additional reference subcarrier -279. The total frequency span of the entire All Digital spectrum is 396,803 Hz. The subcarriers within the Primary Main and Primary Extended sidebands are scaled by an amplitude scale factor, a_2 , as indicated in **Error! Reference source not found.** The subcarriers within the Secondary Main, Secondary Extended and Secondary Protected sidebands are uniformly scaled by an amplitude scale factor having four discrete levels a_4 – a_7 , as indicated in **Error! Reference source not found.** **Error! Reference source not found.** summarizes the upper and lower, primary and secondary sidebands for the All Digital waveform.