

FM Supplementary Carriers:

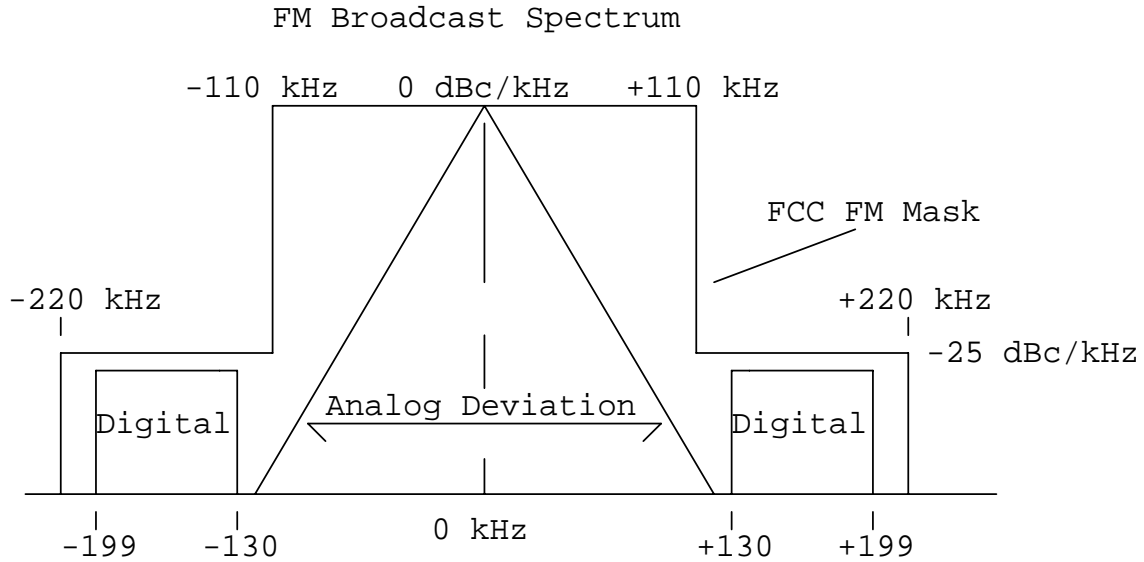


Figure 1 FM Broadcast Spectrum

The FCC allows supplementary carriers to be added to the basic FM broadcast station's analog channel, provided they are at a level 25 dB below the un-modulated FM analog carrier, and are at frequencies 199 kHz or less away from the primary analog carrier. This has been done using both NRZMSB and 3PRK modulation. Ref. [1]. Each station can transmit 2 or more supplementary carriers.

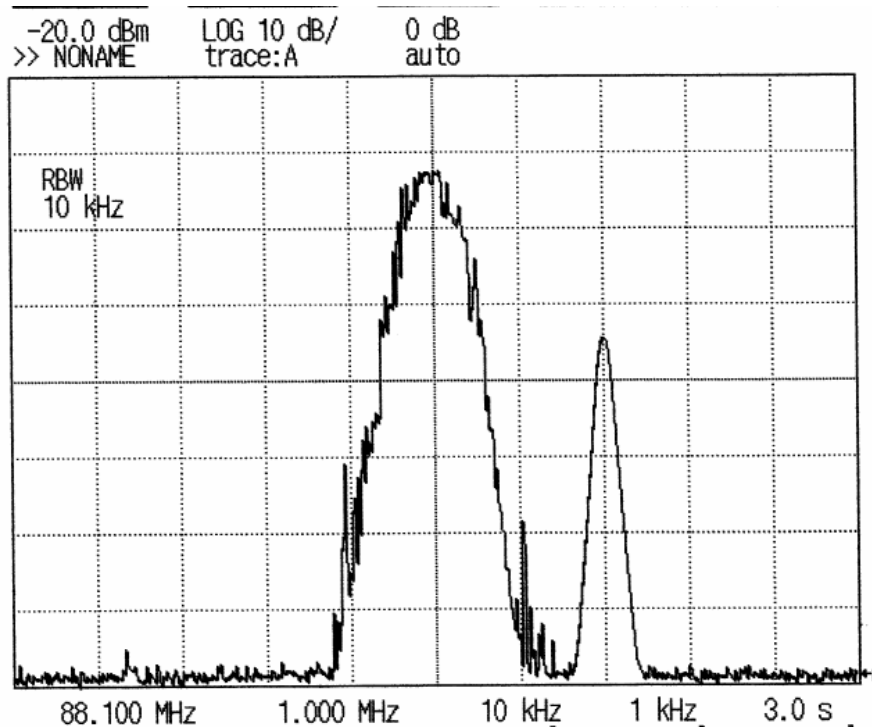


Figure 2. The Demonstrated Spectrum for an Analog FM Station plus the Spectrum for the MSB supplementary carrier at 88.299. Refer to Chapter 9 of the Ultra Narrow Band Modulation Textbook for the MSB spectrum using NRZMSB as the supplementary carrier. Chapter 13 shows the relative immunity to adjacent channel interference.

The data rate used in this demonstration was 3.2 Mb/s, however this can be increased to as high as 10 Mb/s using NRZMSB.

The original demonstration was designed to transmit 50 MP3 packetized audio channels, with each audio channel having a 64 kb/s data rate.

High definition video (HDTV) utilizing H264 (MPEG4) coding is obtainable with data rates as low as 6 Mb/s. This can easily be transmitted using MSB as the FM-SCA method, since data rates as high as 10 Mb/s are easily obtainable. Planning includes the use of the Mobilygen [5] chip set for HDTV on the FM supplementary carrier.

FCC Regulations on Emission and Bandwidth. CFR 47, Part 74.535 (2005).

(a) The **mean power of emissions** shall be attenuated below the mean transmitter power (P_{mean}) in accordance with the following schedule:

(2) When using transmissions employing digital modulation techniques:

(i) For operating frequencies below 15 GHz, in any 4 kHz reference bandwidth (B_{ref}), the center frequency of which is removed from the assigned frequency by more than 50% up to and including 250% of the authorized bandwidth:

As specified by the following equation, but in no event less than 50 decibels:

$$A = 35 + .8(G-50) + 10 \log_{10} B.$$

(Attenuation greater than 80 dB is not required).

Where:

A = Attenuation in dB below the mean output power level

G = Percent removed from the carrier frequency.

B = Authorized bandwidth in MHz.

These conditions are easily met utilizing either 3PRK or NRZMSB.

There is a competing method being promoted by iBiquity that employs OFDM modulation. The available data rate using OFDM is much lower than for Ultra Narrow Band MSB. Standards for the OFDM method have been published. See references[3][4].

References:

- [1] CFR 47, Parts 73 and 74.
- [2] “High definition Radio”, Electronic Design Magazine March 30, 2006 pp 40
< WWW.ELECTRONICDESIGN.COM > (Penton Publihing)
- [3] < www.iBuiquity.com >
- [4] National Radio Systems Standard NRSC5A
- [5] < www.svtech-corp.com >