

EXHIBIT NUMBER 2

TCAS TRANSMITTER NECESSARY BANDWIDTH DESCRIPTION

Pulses emitted by TCAS equipment vary in width and amplitude, and contain angle modulation during the pulse. It is a single channel containing digital information without the use of a modulation subcarrier. The type of information transmitted is for data transmission. Thus, the TCAS emission type as defined in Sect. 2.201 is V1D.

Due to the relatively complex nature of the signals transmitted by the TCAS, there is no one single formula which would predict the necessary bandwidth. The modulation characteristics are outlined in Exhibit 1. The modulation with the fastest temporal characteristics, and thus the greatest effect on frequency domain spectrum, is the binary phase shift keying which occurs during a Mode S transmission.

A search was conducted for a CCIR formula which dealt with binary phase shift key modulation, but none was found. The following was taken from Digital and Analog Communication Systems, Shanmugam, K. Sam, John Wiley, 1979, p. 403. "...the shapes of the psd of the binary PSK signal and the ASK signal are similar. The only difference is that the PSK spectrum does not have an impulse at the carrier frequency. The bandwidth requirements of the PSK signal is the same as that of the ASK signal." Thus, we believe that the formula from the procedures of Report 836 of the International Radio Consultative Committee, Recommendation and Reports of the CCIR, 1982 will accurately predict the necessary bandwidth for a BPSK pulse, as well as for an unmodulated pulse. Since there is no minimum switching time specified in RTCA DO-185A, the formula for a rectangular pulse will be used. Considering the spectrum of a group of pulses to fall within the envelope defined by the spectrum of a single pulse, the formula

$$B_n = 6.36 / t$$

Is employed, where B_n is the necessary bandwidth, and t is the pulse width. The narrowest chip permitted by RTCA DO-185A has $t = 230$ nanoseconds as outlined in Exhibit 1 "TCAS to Mode S Transmissions" section where it discusses the timing between the data phase reversals. The necessary bandwidth then becomes $B_n = 27.65$ MHz.

Thus the complete emission designation according to Sect. 2.201 and 2.202 is 27M7V1D.