

CALCULATION OF MODULATOR NOISE AT THE HEADEND

Let us suppose that a typical modulator has an in band Carrier to Noise ratio of -65 dB and an out of band Carrier to Noise ratio of -65 dB. Lets assume that there are 64 such modulators at the Headend. The noise of all these 64 modulators will add up, lets calculate. The exact mathematical formula for calculation of noise is :

$C/N_n = C/N_1 - 10 \log n$ where:

C/N₁ is the Carrier To Noise ratio of the 1st Modulator n: The Total Number of Modulators at the Headend C/N_n : Resulting C/N of the total n modulators.

However let us ignore elaborate mathematics. Fairly accurate estimates can be arrived by simple "Rule of Thumb". "Doubling the number of Amplifiers or Modulators increases the total noise by 3 dB i.e. the Carrier to Noise ratio reduces by 3 dB". The out of band noise of 1 modulator is assumed to be -65 dB.

Therefore 2 modulators would reduce the C/N to -62 dB.

4 modulators C/N -59 dB. 8 modulators C/N -56 dB.

16 modulators C/N -53 dB. 32 modulators C/N -50 dB.

64 modulators C/N -47 dB.

It quickly becomes apparent that the out of band noise is now a bigger concern than the noise generated by each modulator within its own channel bandwidth !

In practice, the situation sometimes is a little better because manufacturers often provide output filters on their modulators which reduce all signals including noise at frequencies far away from the operating frequency. High quality international modulators such as BARCO have an out of band C/N of approximately -90dB and an In band C/N of -70 dB. A Headend of 64 Modulators would therefore reduce this by 18 dB i.e. the C/N of just the modulators put together would have deteriorated to -52 dB.

This ofcourse excludes the noise contributed by the Dish + LNB and the Satellite Receiver !

NOISE OF THE CASCADE

The exact formula to calculate the Noise of a cascade of amplifiers is : $C / N_n = C / N_1 - 10 \log (n)$ n = No. of Amplifiers in Cascade Further, the BIS specifies that C/N_n should not be worse than 43 dB.

Ofcourse this formula is daunting for anyone short of an engineer with a Scientific Calculator ! Lets take a simpler approach.

Once the noise of the first Amplifier is determined it is simple to estimate the total noise of the Amplifier cascade, without even a calculator ! Similar to the case of Modulators, the noise performance is reduced by 3 dB for a doubling of the number of Amplifiers. Hence :

2 Amplifiers 60 dB 4 Amplifiers 57 dB

8 Amplifiers 54 dB 16 Amplifiers 51 dB

32 Amplifiers 49 dB

In most actual systems, the cascade will not exceed 12 to 16 Amplifiers. Hence, for a 16 Hybrid Amplifier cascade, with an input signal level of 70 dBu for each Amplifier, the output signal will have a carrier to noise ratio of 51 dB. The BIS specifies that the carrier to noise ratio to the last customer should not be worse than 43 dB. Ofcourse this 43 dB is a noise contribution of the Amplifier cascade, the Modulators and the Dish Antenna, LNB + Satellite Receiver, etc. However it is clear that the Amplifiers in such a cable network will not contribute significantly in terms of noise.