

## Link Budget for Telecommand at X band

S/S receive antenna gain: 20 dBi

S/S antenna noise temperature: 290K

Losses between antenna and receiver: 7.1 dB

Receiver noise figure: 3.5 dB

Noise Temperature at antenna output flange:

$$T = 290 + 290 \cdot (10^{(7.1/10)} - 1) + 290 \cdot (10^{(3.5/10)} - 1) \cdot (10^{(7.1/10)}) = \\ = 290 \cdot (10^{(.35)}) \cdot (10^{(.71)}) \approx 3300\text{K}$$

Receiver threshold: -107 dBm = -137 dBW

Minimum required margin: 10 dB

Allowance for 20% interference: 1 dB

Receiver minimum input: -126 dBW

Uplink path loss at 7026 MHz for 90° elevation: 200.5 dB

Atmospheric Absorption: 0.1 dB

Uplink e.i.r.p. required:  $-126 + 7.1 - 20 + 200.5 + 0.1 = 61.7$  dBW

Transmit antenna gain: 48.6 dBi

Minimum uplink power: 13.1 dBW

BW = 440 kHz

C/N in 440 kHz:

$$61.7 - 200.5 - 0.1 + 20 - 10 \cdot \log(3300) + 228.6 - 10 \cdot \log(440000) = 18.1 \text{ dB}$$