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Calculations for CR, TM, and DL S/N ratios

The following calculations are intended for information to interested personnel. All calculations are for the best linear polorization.

Antenna Gains

	Gain (DB)	Gain (above isotropic)
Satellite	2.15	1.64
Hybla Old TM	22	159
Hybla New TM	23	200
Hybla Old CR	12	15.9
Hybla New CR	21	126
Hybla New DL	24	252
Other Stations CR	12	15.9
Other Stations TM	12	15.9
Other Stations TM	16	38

All signal to noise ratios are for the case where the satellite is at the horizon in a 500 NM circular orbit. (2210 statute miles) All signal to noise ratios will be 12DB better when the satellite is directly overhead. It is assumed that the satellite has the following characteristics:

TM radiated power: 40 MW

DL radiated power: $\frac{1}{2}$w peak

CR sensitivity (10 DB combining loss): -90 DBM

All ground preamps have noise figures 3 DB above theoritical thermal agitation noise at atmospheric temperatures. The bandwidth for the telemetry receivers is taken as 10 KC; for the DL, 100 KC. The noise figures for the receivers are taken as 3 DB above theoritical thermal agitation noise with the above bandwidths taken into account. Satellite command receiver S/N ratios are defined as DB above minimum signal necessary to throw the decoder relays with a basic receiver sensitivity of -100 DBM and a satellite harness combining loss of 10 DB.

The pthat loss equation is:

$$\frac{P_R}{P_T} = \left(\frac{A}{4\pi d}\right)^2 g_t g_r$$

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[redacted] the satellite is at the horizon follow. The preamps [redacted] DB noise figure and 22 DB gain.

Place	Sig. level at Ant. Term	Sig. level @pre-amp out	RCVR noise pwr.(3DB noise fig.)	S/N (DB) RCVR.
Hybla TM	-111 DBM	- 92 DBM	-131 DBM	39
Hybla DL*	-101 DBM	- 82 DBM	-121 DBM	39
Other TM	-123 DBM	-104 DBM	-131 DBM	27
Other DL*	-109 DBM	- 90 DBM	-121 DBM	31

*Note: for 100 KC receiver bandwidth, for 200 KC receiver bandwidths, decrease S/N by 3 DB.

The following S/N ratios (in DB) will occur at the satellite receiver terminals when the satellite is at the horizon when commanded as follows:

XMTR. Power	ANTENNA Gain	S/N (DB above required to throw relays)
250 W	12 DB (hybla)	12 DB
250 W	21 DB (hybla)	21 DB
50 W	12 DB (other)	5 DB

It is to be noted that the above calculations are for areas of the world free from ignition, city, and industrial noise. It is also to be noted that the resultant S/N ratios should be worse in the summer and better in the winter. It is expected that these geophysical conditions can change the S/N ratios by as much as ±10 DB.

Also at times, depending of satellite orientation, the S/N ratios my degrade by as much as 3 DB due to nulls in the satellite antenna patterns.

Therefore, taking satellite worst case antenna nulls (3 DB) into account and allowing 10 DB loss due to geophysical conditions and/or ignition noise, the following S/N ratios apply at the horizon.

Place and Function	S/N (DB)
Hybla TM	26
Hybla DL (100kc)*	26

Place and Funtion	S/N (DB)
~~Other TM~~	14
Other DL (100Kc) *	18

*Note for 200KC, decrease S/N by 3 DB.

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