



26 August 1991  
ET-9 1 - 190

GE-AstroSpace Division  
Corner of Rte 571 & 534  
East Windsor, NJ 08520

Attention: Larry Lucatorto

Subject: Formal Response to Action Item A38 from the DMSP 5D-3 Real-time Data Smooth (RDS) Preliminary Design Review (PDR).

Attached is DSEC's response to the subject action item. A detailed link budget was developed which not only includes inputs from both GE-ASD and Harris (both of whom were an integral part of the original 5D-3 RDS Study), but also included data from other (non-DMSP) contractors possessing satellite receiver expertise.

This link budget was then tailored for each of three following potential evolutionary RDS upgrades: 5D-2, 5D-3 and 5D-3 with Multi-Spectral OLS (MOLS). These three specific link budgets are enclosed for information and retention. It is noted that all three budgets, while conservative, each yield positive link margin.

SRA/DSEC plans to update these budgets in the coming months as the spacecraft's S-Band RDS design upgrade is finalized, plus other related 5D-3 changes.

If there are any questions, please contact Fred Lawler at 213/322-1174.

Sincerely,  
  
E. Tagaferr  
DSEC Program Manager

Enclosure

Distribution:

- MWSI (Capt Schultz)
- MWSU (Capt Olmscheid)
- MWEA (Capt Wesling)

DESIGN REVIEW ACTION ITEM REQUEST

PROGRAM DMSP		TITLE REALTIME DATA SMOOTH PDR		DATE 5/29-30/91	
SUBMITTED BY Fred Lawler		ORGN. SRA/DSEC		PHONE	
SUBJECT S-Band Link Budget					
STATEMENT OF CONCERN/REASON FOR REQUESTING ACTION 1. Not clear what is implied (e.g., simulation vs. implementation, link margin, other assumptions) in the existing Harris S-Band Link Budget.  2. GE is "backing-in" to their S-Band EIRP requirement					
ACTION REQUESTED Investigate/verify what Harris S-Band Link Budget contains/assumes, and how that meets the requirements stated in the STT TRD.,.  Confirm to GE that their S-Band EIRP requirement is valid.					
RECOMMENDATION OF CHAIRPERSON <div style="text-align: center;"> <input checked="" type="checkbox"/> ACTION ITEM    <input type="checkbox"/> FLAG ITEM    <input type="checkbox"/> COMMENT ONLY                 </div> <p style="text-align: center;">Closed via SRA/DSEC <b>Letter #ET-91-192</b> (attached).</p>					
SUBMITTED BY Fred Lawler		ORGN. SRA/DSEC		MCR. 6126191	
ACTIONEE		ORGN.		M G R	
"A. Katz		A. Stern		P1 P2	
					ITEM \$0. A38

DETAILED DMSP S-BAND 5D-2 RDS LINK BUDGET  
(For  $f_c = 2222.5$  MHz)

PARAMATER	QUANTITY
<b>SPACECRAFT - Related:</b>	
Transmit Power (5.2 Watts (EOL))	37.20 dBm
Limiter Power Loss	0.00 dB
VSWR Losses	-0.50 dB
Cable Losses	-1.00 dB
Antenna Gain (at alpha = 56 Deg)	-0.20 dBci
Resultant EIRP *	<u>35.50 dB</u>
<b>ETHER - Related:</b>	
Path Loss (20 Deg Elevation **)	-164.80 dB
Atmospheric Attenuation	-0.20 dB
Scintillation Fading Loss	-3.00 dB
Space/Ground Polarization Losses	-0.50 dB
Rain Loss	0.00 dB
Ether Sub-Total	<u>-168.50 dB</u>
Received Power at Antenna	-133.00 dBm
<b>Receiver - Related:</b>	
Antenna Gain	19.00 dB
Pointing Error Loss	-0.50 dB
Doppler Loss	0.00 dB
Sub Carrier Loss	0.00 dB
Receiver Loss	-1.00 dB
Bit Sync Loss	-1.00 dB
Decryptor Loss	-0.80 dB
Coding Gain (Theoretical)	5.20 dB
Viterbi Decoder Loss	-1.00 dB
Net Receiver Gain	<u>19.90 dB</u>
Signal Energy Achieved	-113.10 dBm
5D-2 Data Rate	66,500.00 bps
Eb Achieved	-161.33 dBm
Front-End Noise Temperature	150.00 K
Computed No	-176.84 dBm/K-Hz
Eb/No Achieved	<u>15.51 dB</u>
Eb/No Required (for $10 \times 10^{-6}$ BER**)	10.60 dB
<b>RESULTANT MARGIN {worst case}</b>	<b>4.91 dB</b>

- NOTES:
- This EIRP Value is different from 5D-3 RDS PDR value (per GE-ASD Letter 5D-AI-0722, dated 23 Jul 91)
  - \* Cited in the current STT TRD

DETAILED DMSP S-BAND 5D-3 RDS LINK BUDGET  
(For  $f_c = 2222.5$  MHz)

PARAMATER	QUANTITY
<b>SPACECRAFT - Related:</b>	
Transmit Power (5.2 Watts (EOL))	37.20 dBm
Limiter Power Loss	0.00 dB
VSWR Losses	-0.50 dB
Cable Losses	-1.00 dB
Antenna Gain (at alpha = 56 Deg)	-0.20 dBci
Resultant EIRP *	<u>35.50 dB</u>
<b>ETHER - Related:</b>	
Path Loss (20 Deg Elevation **)	-164.80 dB
Atmospheric Attenuation	-0.20 dB
Scintillation Fading Loss	-3.00 dB
Space/Ground Polarization Losses	-0.50 dB
Rain Loss	0.00 dB
Ether Sub-Total	<u>-168.50 dB</u>
Received Power at Antenna	-133.00 dBm
<b>Receiver - Related:</b>	
Antenna Gain	19.00 dB
Pointing Error Loss	-0.50 dB
Doppler Loss	0.00 dB
Sub Carrier Loss	0.00 dB
Receiver Loss	-1.00 dB
Bit Sync Loss	-1.00 dB
Decryptor Loss	-0.80 dB
Coding Gain (Theoretical)	5.20 dB
Viterbi Decoder Loss	-1.00 dB
Net Receiver Gain	<u>19.90 dB</u>
Signal Energy Achieved	-113.10 dBm
5D-3 Data Rate	88,746.00 bps
Eb Achieved	-162.58 dBm
Front-End Noise Temperature	150.00 K
Computed No	-176.84 dBm/K-Hz
Eb/No Achieved	<u>14.26 dB</u>
Eb/No Required (for $10 \times 10^{-6}$ BER**)	10.60 dB
<b>RESULTANT MARGIN (worst case)</b>	<b>3.66 dB</b>

- NOTES:
- This EIRP Value is different from 5D-3 RDS PDR value (per GE-ASD Letter 5D-AI-0722, dated 23 Jul 91)
  - \* Cited in the current STT TRD

DETAILED DMSP S-BAND 5D-3 (w/ MOLS) RDS LINK BUDGET  
(For  $f_c = 2222.5$  MHz)

PARAMATER	QUANTITY
SPACECRAFT - Related:	
Transmit Power (5.2 Watts (EOL))	37.20 dBm
Limiter Power Loss	0.00 dB
VSWR Losses	-0.50 dB
Cable Losses	-1.00 dB
Antenna Gain (at alpha = 56 Deg)	-0.20 dBci
Resultant EIRP *	<u>35.50 dB</u>
ETHER - Related:	
Path Loss (20 Deg Elevation **)	-164.80 dB
Atmospheric Attenuation	-0.20 dB
Scintillation Fading Loss	-3.00 dB
Space/Ground Polarization Losses	-0.50 dB
Rain Loss	0.00 dB
Ether Sub-Total	<u>-168.50 dB</u>
Received Power at Antenna	-133.00 dBm
Receiver - Related:	
Antenna Gain	<b>19.00 dB</b>
Pointing Error Loss	<b>-0.50 dB</b>
Doppler Loss	<b>0.00 dB</b>
Sub Carrier Loss	<b>0.00 dB</b>
Receiver Loss	<b>-1.00 dB</b>
Bit Sync Loss	<b>-1.00 dB</b>
Decryptor Loss	<b>-0.80 dB</b>
Coding Gain (Theoretical)	<b>5.20 dB</b>
Viterbi Decoder Loss	<b>-1.00 dB</b>
Net Receiver Gain	<u>19.90 dB</u>
Signal Energy Achieved	-113.10 dBm
5D-3 Data Rate (w/ MOLS)	133,100.00 <b>bps</b>
Eb Achieved	<b>-164.34 dBm</b>
Front-End Noise Temperature	150.00 K
Computed No	<b>-176.84 dBm/K-Hz</b>
Eb/No Achieved	<u>12.50 dB</u>
Eb/No Required (for $10 \times 10^{-6}$ BER**)	<b>10.60 dB</b>
RESULTANT MARGIN (worst case)	<b>1.90 dB</b>

- NOTES:    \* This EIRP Value is different from 5D-3 RDS PDR value  
               (per GE-ASD Letter 5D-AI-0722, dated 23 Jul 91)  
               • \* Cited in the current STT TRD