

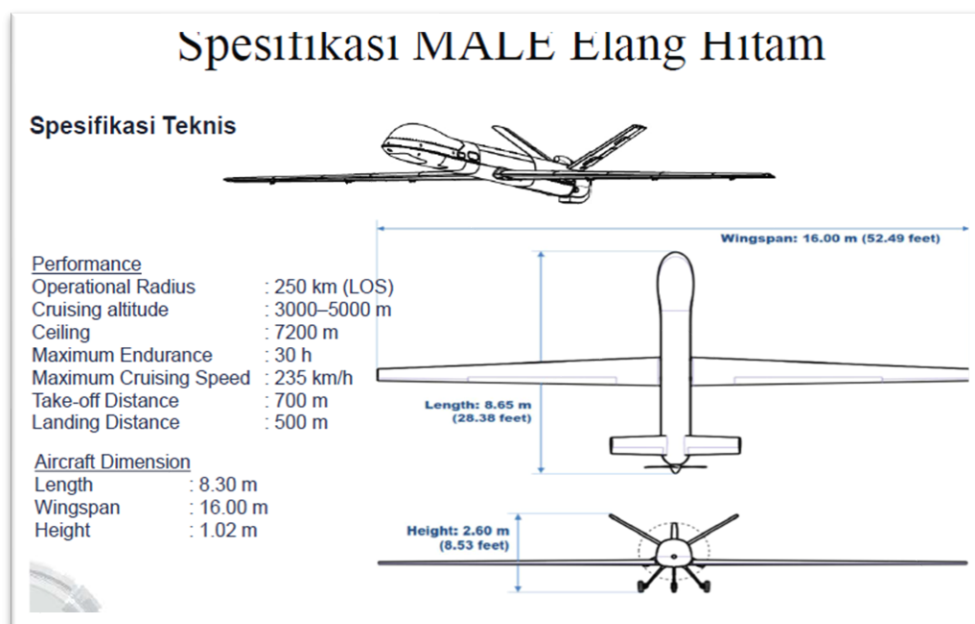
## Lampiran

### Lampiran 1 Perhitungan Gmax Sudut Elevasi

E3 :  $=10*(\text{LOG}(C3;10))$

	A	B	C	D	E	F
1						
2	Azimuth and Elevation	Eliptical	Rectangular	10 log elipticall	10 log rectangular	
3	1	41253	52525	46,15455537	47,20366	
4	2	10313,25	13131,25	40,13395545	41,18306	
5	3	4583,666667	5836,111111	36,61213027	37,66124	
6	4	2578,3125	3282,8125	34,11335554	35,16246	
7	5	1650,12	2101	32,17515528	33,22426	
8	6	1145,916667	1459,027778	30,59153036	31,64064	
9	7	841,8979592	1071,938776	29,25259457	30,3017	
10	8	644,578125	820,703125	28,09275563	29,14186	
11	9	509,2962963	648,4567901	27,06970518	28,11881	
12	10	412,53	525,25	26,15455537	27,20366	
13	11	340,9338843	434,0909091	25,32670166	26,37581	
14	12	286,4791667	364,7569444	24,57093045	25,62004	
15	13	244,1005917	310,7988166	23,87568832	24,92479	
16	14	210,4744898	267,9846939	23,23199465	24,2811	
17	15	183,3466667	233,4444444	22,63273019	23,68184	
18	16	161,1445313	205,1757813	22,07215571	23,12126	
19	17	142,7439446	181,7474048	21,54557694	22,59468	
20	18	127,3240741	162,1141975	21,04910527	22,09821	
21	19	114,2742382	145,498615	20,57948335	21,62859	
22	20	103,1325	131,3125	20,13395545	21,18306	
23	21	93,54421769	119,1043084	19,71016947	20,75927	
24	22	85,23347107	108,5227273	19,30610175	20,35521	

### Lampiran 2 Desain PUNA MALE



## Lampiran 3 Karakteristik Data Link

Table 2-1. Command and Return Datalink RF Technical Characteristics

Characteristics	Specifications			
	<b>Transmitter</b>			
Tuning Range, MHz	5250 – 5850			
Tuning Increment, MHz	1			
Transmitter Power, dBm	40			
Spurious/Harmonic Attenuation, dB	65			
	<b>Command Link</b>		<b>Return Link</b>	
<b>Link Type</b>	LOS Command Link	DLOS Command Link	LOS Return Link	DLOS Return Link
Emission Designators	560KF1D	88K3F1D	17M0F9F	4M72F1D
Emission Bandwidth, MHz				
-3-dB	0.34	0.063	8.5	2.8
-20-dB	0.42	0.088	18.0	20.0
-40-dB	NA	0.219	NA	NA
-60-dB	1.2	0.671	46.2	66.0
	<b>Receiver</b>			
Tuning Range, MHz	5250 – 5850			
RF Selectivity, MHz				
-3-dB	303			
-20-dB	375			
-60-dB	525			
1 <sup>st</sup> IF Selectivity, MHz				
-3-dB	35			
-20-dB	55			
-60-dB	115			
<b>Link Type</b>	<b>Command Link</b>		<b>Return Link</b>	
2 <sup>nd</sup> IF Selectivity, MHz				
-3-dB	1		20	
-20-dB	3.2		22.5	
-60-dB	4		28	
Emission Designators	560KF1D	88K3F1D	17M0F9F	4M72F1D
Sensitivity, dBm	-98	-98	-84	-86
Sensitivity Criterion	1x10 <sup>-3</sup> BER	1x10 <sup>-3</sup> BER	23-dB S/N	1x10 <sup>-3</sup> BER
Noise Figure, dB	2			
Spurious Rejection, dB	50			
	<b>Diplexer</b>			
Low-Band Port Frequency Band, MHz	5250 – 5475			
Cross-Over Frequency Band, MHz	5475 – 5625			
High-Band Port Frequency Band, MHz	5625 – 5850			
	<b>GDT LNA</b>			
Manufacturer	JCA Technologies			
Gain, dB	18			
Noise Figure, dB	1.8			

Table 2-1. Datalink Technical Characteristics

Characteristic	Specifications					
<b>Transmitter</b>						
Tuning Range, MHz	4400 – 4940		5250 – 5850		14400 – 15350	
Tuning Increment, MHz	1					
Transmitter Power, dBm	40					
Link Type	Command	Return	Command	Return	Command	Return
Emission Bandwidth, MHz						
-3 dB	0.34	8.5	0.34	8.5	28	9.4
-20 dB	0.42	18.0	0.42	18.0	101	57.4
<b>Receiver</b>						
Tuning Range, MHz	4400 – 4940		5250 – 5850		14400 – 15350	
Link Type	Command	Return	Command	Return	Command	Return
2 <sup>nd</sup> IF Selectivity, MHz						
-3 dB	0.75	20.0	0.75	20.0	14.1*	4.7*
-20 dB	1.5	22.5	1.5	22.5	64.0*	21.4*
Noise Figure (NF), dB	5.0*	2.0*	5.0*	2.0*	3.9	3.7
Noise Power (N), dBm <sup>a</sup>	-110.2	-99.0	-110.2	-99.0	-98.6	-103.6
SBVI Interference Threshold (I <sub>T</sub> ), dBm <sup>a</sup>	-80.8		-83.8		-81.6	
NMBS I <sub>T</sub> , dBm <sup>a</sup>	-74.5		-77.5		-75.3	
<b>Antenna</b>						
GDT Gain, dBi	30.5		29.0		40.0	
UAV Gain, dBi	15.0*		15.0		15.0*	
UAV Elevation -3 dB Beamwidth, degrees	30*		30		30*	
GDT Height, m	18.3*		18.3		18.3*	
UAV Height, m	7620*		7620		7620*	
* Estimated value						
<sup>a</sup> These items were taken from values calculated in Section 3 and are listed to provide a complete picture of the system in the table.						

Table 2-1. Predator UAV C-Band Data Link Characteristics

Characteristics	Specifications			
<b>Transmitter</b>				
Tuning Range, MHz	5250-5850			
Tuning Increment, MHz	1			
Transmitter Power, dBm	40			
Link Type	CL		RL	
Emission Designators	560KF1D	88K3F1D	17M0F9F	4M72F1D
Emission Bandwidth, MHz				
-3-dB	0.34	0.063	8.5	2.8
-20-dB	0.42	0.088	18.0	20.0
-40-dB	NA	0.219	NA	NA
-60-dB	1.2	0.671	46.2	66.0
<b>Diplexer</b>				
Low-Band Port Frequency Band, MHz	5250-5475			
Cross-Over Frequency Band, MHz	5475-5625			
High-Band Port Frequency Band, MHz	5625-5850			
<b>GDT Parabolic Dish Antenna</b>				
Gain, dBi	33.0			
Antenna Illumination Type	Cosecant Squared			
<b>UAV Horn Antenna</b>				
Manufacturer	Technical Associates, Inc.			
Model Number	11572			
Gain, dBi	15.0			
Azimuth/Elevation Beamwidth, degrees	30/30			

Example of command and non-payload communication link budget

LINK BUDGET	Small UA		Medium/Large UA					
	UA → UACS	UA (video) → UACS	UACS (tracking antenna) → UA	UACS (sectoral antenna) → UA	UA → UACS (tracking antenna)	UA → UACS (sectoral antenna)	UA (video) → UACS (tracking antenna)	UA (video) → UACS (sectoral antenna)
Modulation	4QPSK	4QPSK	4QPSK	4QPSK	4QPSK	4QPSK	4QPSK	4QPSK
Frequency (MHz)	5 091	5 091	5 091	5 091	5 091	5 091	5 091	5 091
Wavelength (m)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
UACS – UAV distance d (km)	26	26	200	200	200	200	35	35
UACS – UAV distance d (NM)	14	14	108	108	108	108	19	19
Free space losses (dB)	-134.88	-134.88	-152.6	-152.6	-152.6	-152.6	-137.5	-137.5
e.i.r.p. (dBm)	25.5	25.5	52	52	41	41	41	41
Transmitting antenna gain (dBi)	3	3	24	10	3	3	3	3
Transmitter cable losses (dB)	-2	-2	-1	-1	-2	-2	-2	-2
Received noise level (dBm)	-126.26	-117.23	-126.26	-126.26	-126.26	-126.26	-117.23	-117.23
Noise factor (dB)	2	2	2	2	2	2	2	2
kT (dBm/Hz)	-174	-174	-174	-174	-174	-174	-174	-174
Symbol rate (kHz)	37.5	300	37.5	37.5	37.5	37.5	300	300
Receiving antenna gain (dBi)	10	10	3	3	24	10	24	10
Receiver cable losses (dB)	-1	-1	-2	-2	-1	-1	-1	-1
Received power (dBm)	-100.38	-100.38	-99.6	-99.6	-88.6	-102.6	-73.5	-87.7
Received $E_s/N_o$ (dB)	25.88	16.85	26.66	26.66	37.66	23.66	43.77	29.77
Required min $E_s/N_o$ (dB)	6	6	6	6	6	6	6	6
CNPC link margin (dB)	19.88	10.85	20.66	20.66	31.66	17.66	37.77	23.77