



Kyutech

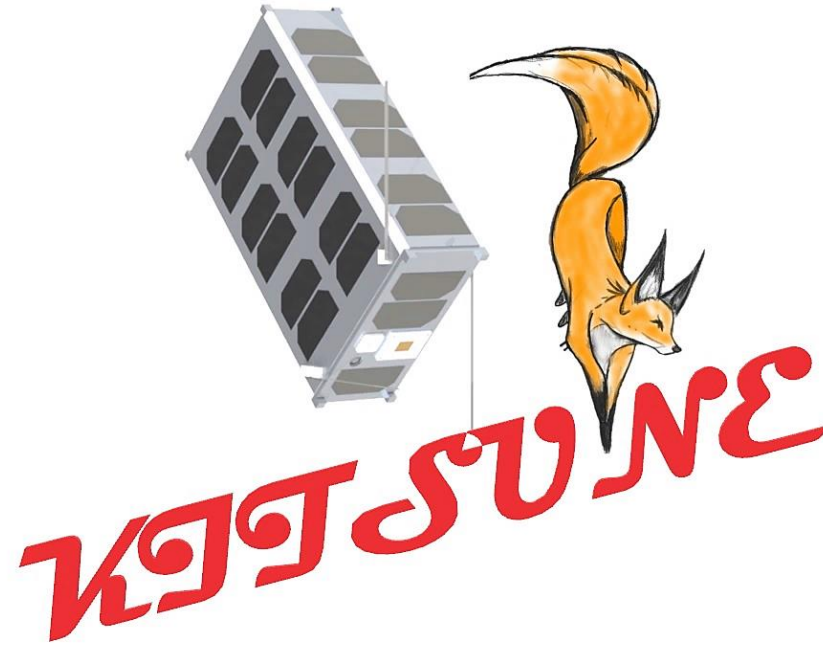
Kyushu Institute of Technology

国立大学法人

九州工業大学



Laboratory of
Spacecraft
Environment
INteraction
Engineering



Link Budget

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Editor : Daisuke Nakayama

Amateur UHF



Line Name		Unit	CW beacon	Telemetry and Mission data	Command	Command Backup
Direction			Downlink	Downlink	Uplink	Uplink
GS			UHF amateur (all amateur station)	UHF amateur (all amateur station)	UHF amateur (BIRDS network)	UHF amateur (BIRDS network)
Frequency		MHz	437.375	437.375	435-438	435-438
bandwidth		kHz	0.5		8	16
Modulation			CW	GMSK	GMSK	FSK
Protocol			Morse code	AX.25	AX.25	AX.25
Data Rate		wps/bps		20	4800	600
Emission Type			500HA1A	8K00F1D	8K00F1D	16K0F1D
Transmission side	Output power	W	0.1		0.8	50
	Line Loss	dBW	-10.0		-1.0	17.0
	Antenna gain	dB	1.0		1.0	3.0
	EIRP	dB	1.7		1.7	22.0
	Antenna pointing loss	dB	-9.3		-0.3	36.0
Satellite position	Altitude	deg	6.4		6.4	3.0
	Elevation	m	4.00E+05	4.00E+05	4.00E+05	4.00E+05
	range	deg	0		10	0
Path	Path loss	m	2.30E+06	1.44E+06	1.44E+06	2.30E+06
	polarization loss		152.5		148.4	152.4
	Atmospheric losses	dB	3.0		3.0	3.0
	Ionospheric losses	dB	1.0		1.0	1.0
Receive side	Istropic signal level at Receive side with 0dBi antenna	dB	0.4		0.4	0.4
	Antenna pointing loss	dBW	-172.6		-159.5	-119.8
	Antenna gain	dB	3.0		3.0	6.4
	Line loss	dB	22.0		22.0	1.7
	Receive Power at LNA Input	dB	3.0		3.0	1.0
	Effective Noise Temperature	dBW	-156.6		-143.5	-125.5
	Thearmal Noise	K	300		300	3200
	Signal-Noise ratio (Eb/N0 or S/N)	dB/Hz	-203.8		-203.8	-193.5
	BER	dB	20.2		23.5	31.2
	Required SNR				1.00E-05	1.00E-05
	Receive sensitivity	dB	10		12.5	12.5
Link margin	dBW	-		-	-	
	dB	10.2		11.0	18.7	

Amateur C-band (Satellite to Kyutech 2.4Φ dish) (1)



Line Name		20Mbps Down	10Mbps Down	5Mbps Down
Direction	Unit	Downlink	Downlink	Downlink
GS		C-band amateur (Kyutech station φ2.4m)	C-band amateur (Kyutech station φ2.4m)	C-band amateur (Kyutech station φ2.4m)
Frequency	MHz	5840	5840	5840
bandwidth	kHz	1.96E+04	1.00E+04	1.00E+04
Modulation		QPSK	QPSK	BPSK
Protocol		Reed Solomon (Interleave L = 5) CCSDS compliant	Reed Solomon (Interleave L = 5) CCSDS compliant	Reed Solomon (Interleave L = 5) CCSDS compliant
Data Rate	bps	20000000	10000000	5000000
Emission Type		19M6G1D	10M0G1D	10M0G1D
	W	0.8	0.8	0.8
Output power	dBW	-1.0	-1.0	-1.0
Line Loss	dB	1.0	1.0	1.0
Antenna gain	dB	6.0	6.0	6.0
EIRP	dBW	4.0	4.0	4.0
Transmission side	Antenna pointing loss	3.0	3.0	3.0
	Altitude	4.00E+05	4.00E+05	4.00E+05
	Elevation	40	40	35
Satellite position	range	5.98E+05	5.98E+05	6.60E+05
	Path loss	163.3	163.3	164.2
	polarization loss	1.0	1.0	1.0
	Atmospheric losses	0.0	0.0	0.0
Path	Ionospheric losses	0.0	0.0	0.0
	Istropic signal level at Receive side with 0dBi antenna	-163.3	-163.3	-164.1
	Antenna pointing loss	1.0	1.0	1.0
	Antenna gain	40.0	40.0	40.0
	Line loss	1.0	1.0	1.0
	Receive Power at LNA Input	-125.3	-125.3	-126.1
	Effective Noise Temperature	200	200	200
	Thearmal Noise	-205.6	-205.6	-205.6
	Signal-Noise ratio (Eb/N0 or S/N)	7.3	10.3	12.5
	BER	1.00E-03	1.00E-05	1.00E-05
	Required SNR	6.2	2.1	2.1
Receive side	Receive sensitivity	-	-	-
Link margin	dB	1.1	8.2	10.4

Amateur C-band (Satellite to Kyutech 2.4Φ dish) (2)



Line Name		2Mbps Down	1Mbps Down	500kbps Down
Direction	Unit	Downlink	Downlink	Downlink
GS		C-band amateur (Kyutech station φ2.4m)	C-band amateur (Kyutech station φ2.4m)	C-band amateur (Kyutech station φ2.4m)
Frequency	MHz	5840	5840	5840
bandwidth	kHz	4.00E+03	2.00E+03	1.00E+03
Modulation		BPSK	BPSK	BPSK
Protocol		Reed Solomon (Interleave L = 5) CCSDS compliant	Reed Solomon (Interleave L = 5) CCSDS compliant	Reed Solomon (Interleave L = 5) CCSDS compliant
Data Rate	bps	2000000	1000000	500000
Emission Type		4M00G1D	2M00G1D	1M00G1D
	W	0.8	0.8	0.8
Output power	dBW	-1.0	-1.0	-1.0
Line Loss	dB	1.0	1.0	1.0
Antenna gain	dB	6.0	6.0	6.0
EIRP	dBW	4.0	4.0	4.0
Transmission side Antenna pointing loss	dB	3.0	3.0	3.0
Altitude	m	4.00E+05	4.00E+05	4.00E+05
Elevation	deg	20	10	5
Satellite position range	m	9.85E+05	1.44E+06	1.81E+06
Path loss		167.6	170.9	172.9
polarization loss	dB	1.0	1.0	1.0
Atmospheric losses	dB	0.0	0.0	0.0
Path Ionospheric losses	dB	0.0	0.0	0.0
Istropic signal level at Receive side with 0dBi antenna	dBW	-167.6	-170.9	-172.9
Antenna pointing loss	dB	1.0	1.0	1.0
Antenna gain	dB	40.0	40.0	40.0
Line loss	dB	1.0	1.0	1.0
Receive Power at LNA Input	dBW	-129.6	-132.9	-134.9
Effective Noise Temperature	K	200	200	200
Thearmal Noise	dBW/Hz	-205.6	-205.6	-205.6
Signal-Noise ratio (Eb/N0 or S/N)	dB	13.0	12.7	13.7
BER		1.00E-05	1.00E-05	1.00E-05
Required SNR	dB	2.1	2	2.1
Receive side Receive sensitivity	dBW	-	-	-
Link margin	dB	10.9	10.7	11.6

Amateur C-band (Satellite to Kyutech 2.4Φ dish) (3)



Line Name		100kbps Down	CW beacon(C-band)	
Direction	Unit	Downlink	Downlink	
GS		C-band amateur (Kyutech station φ2.4m)	C-band amateur (Kyutech station φ2.4m)	
Frequency	MHz		5840	5840
bandwidth	kHz		2.00E+03	0.5
Modulation		BPSK	CW	
Protocol		Reed Solomon (Interleave L = 5) CCSDS compliant	Morse code	
Data Rate	wps/bps		100000	20
Emission Type		200KG1D	500HA1A	
	W		0.8	0.08
Output power	dBW		-1.0	-11.0
Line Loss	dB		1.0	1.0
Antenna gain	dB		6.0	6.0
EIRP	dBW		4.0	-6.0
Transmission side	Antenna pointing loss	dB	3.0	3.0
	Altitude	m	4.00E+05	4.00E+05
	Elevation	deg	0	0
Satellite position	range	m	2.30E+06	2.30E+06
	Path loss		175.0	175.0
	polarization loss	dB	1.0	1.0
	Atmospheric losses	dB	0.0	0.0
Path	Ionospheric losses	dB	0.0	0.0
	Istropic signal level at Receive side with 0dBi antenna	dBW	-175.0	-185.0
	Antenna pointing loss	dB	1.0	1.0
	Antenna gain	dB	40.0	40.0
	Line loss	dB	1.0	1.0
	Receive Power at LNA Input	dBW	-137.0	-147.0
	Effective Noise Temperature	K	200	200
	Thearmal Noise	dBW/Hz	-205.6	-205.6
	Signal-Noise ratio (Eb/N0 or S/N)	dB	18.6	58.6
	BER		1.00E-05	
	Required SNR	dB	2.1	10
Receive side	Receive sensitivity	dBW	--	
Link margin		dB	16.5	48.6

Amateur C-band (Satellite to mobile 0.6Φ dish, Downlink)



Line Name		Unit	2Mbps Down (mobile)	1Mbps Down (mobile)	500kbps Down (mobile)	100kbps Down (mobile)	CW beacon	4800bps Down
Direction		Unit	Downlink	Downlink	Downlink	Downlink	Downlink	Downlink
			C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)
GS								
Frequency	MHz		5840	5840	5840	5840	5840	5840
bandwidth	kHz		4.00E+03	2.00E+03	1.00E+03	2.00E+03	0.5	10
Modulation			BPSK Reed Solomon (Interleave L = 5) CCSDS compliant	BPSK Reed Solomon (Interleave L = 5) CCSDS compliant	BPSK Reed Solomon (Interleave L = 5) CCSDS compliant	BPSK Reed Solomon (Interleave L = 5) CCSDS compliant	CW Morse code	GMSK AX.25
Protocol								
Data Rate	wps/bps		2000000	1000000	500000	100000	20	4800
Emission Type			4M00G1D	2M00G1D	1M00G1D	200KG1D	500HA1A	10K0F1D
	W		0.8	0.8	0.8	0.8	0.08	0.8
Output power	dBW		-1.0	-1.0	-1.0	-1.0	-11.0	-1.0
Line Loss	dB		1.0	1.0	1.0	1.0	1.0	1.0
Antenna gain	dB		6.0	6.0	6.0	6.0	6.0	6.0
EIRP	dBW		4.0	4.0	4.0	4.0	-6.0	4.0
Antenna pointing loss	dB		3.0	3.0	3.0	3.0	3.0	6.5
Altitude	m		4.00E+05	4.00E+05	4.00E+05	4.00E+05	4.00E+05	4.00E+05
Elevation	deg		40	40	40	15	0	30
range	m		5.98E+05	5.98E+05	5.98E+05	1.18E+06	2.30E+06	7.40E+05
Path loss			163.3	163.3	163.3	169.2	175.0	165.1
polarization loss	dB		1.0	1.0	1.0	1.0	1.0	1.0
Atmospheric losses	dB		0.0	0.0	0.0	0.0	0.0	0.0
Ionospheric losses	dB		0.0	0.0	0.0	0.0	0.0	0.0
Istropic signal level at Receive side with 0dBi antenna	dBW		-163.3	-163.3	-163.3	-169.1	-185.0	-168.6
Antenna pointing loss	dB		1.0	1.0	1.0	1.0	1.0	1.0
Antenna gain	dB		28.0	28.0	28.0	28.0	28.0	28.0
Line loss	dB		1.0	1.0	1.0	1.0	1.0	1.0
Receive Power at LNA Input	dBW		-137.3	-137.3	-137.3	-143.1	-159.0	-142.6
Effective Noise Temperature	K		200	200	200	200	200	500
Thearmal Noise	dBW/Hz		-205.6	-205.6	-205.6	-205.6	-205.6	-201.6
Signal-Noise ratio (Eb/N0 or S/N)	dB		5.3	8.3	11.3	12.4	46.6	22.2
BER			1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05
Required SNR	dB		2.1	2	2.1	2.1	10	12.5
Receive side Receive sensitivity	dBW		-	-	-	-	-	-
Link margin	dB		3.2	6.3	9.2	10.3	36.6	9.7

Amateur C-band (mobile 0.6Φ dish to Satellite, Uplink)



Line Name		4kbps uplink	1kbps uplink
Direction	Unit	Uplink	Uplink
		C-band amateur (mobile station φ0.6m)	C-band amateur (mobile station φ0.6m)
GS			
Frequency	MHz	5660	5660
bandwidth	kHz	80	80
Modulation		PCM-PSK-PM	PCM-PSK-PM
Protocol		CCSDS	CCSDS
Data Rate	bps	4000	1000
Emission Type		80K0G2D	80K0G2D
	W	8	8
Output power	dBW	9.0	9.0
Line Loss	dB	3.0	3.0
Antenna gain	dBi	28.0	28.0
Transmission EIRP	dBW	34.0	34.0
side Antenna pointing loss	dB	1.0	1.0
Altitude	m	4.00E+05	4.00E+05
Satellite Elevation	deg	30	10
position range	m	7.40E+05	1.44E+06
Path loss		164.9	170.7
polarization loss	dB	1.0	1.0
Atmospheric losses	dB	0.0	0.0
Path Ionospheric losses	dB	0.0	0.0
Istropic signal level at Receive side with 0dBi antenna	dBW	-132.8	-138.6
Antenna pointing loss	dB	15.0	15.0
Antenna gain	dBi	6.0	6.0
Line loss	dB	1.0	1.0
Receive Power at LNA Input	dBW	-142.8	-148.6
Effective Noise Temperature	K	300	300
Thearmal Noise	dBW/H	-203.8	-203.8
Signal-Noise ratio (Eb/N0 or S/N)	dB	25.0	25.2
BER		1.00E-05	1.00E-05
Required SNR	dB	13.6	13.6
Receive side Receive sensitivity	dBW	-	-
Link margin	dB	11.4	11.6