

# CW BEACON

<b>DESIGNATION OF EMISSION</b>	400HA1A
<b>PROTOCOL</b>	AX.25
<b>DIRECTION</b>	Downlink

Satellite Side (Transmitting) Parameter	
Model	RFM96W
Modulation	CW
BR (kbps)	0.2
Bandwidth (kHz)	0.4

GS Side (Receiving) Parameter	
Model	R820T RTL-SDR
Modulation	CW
BR (kbps)	0.2
Bandwidth (kHz)	0.4

ORBIT		5°	10°	15°	20°	40°	60°	80°
Frequency	(MHz)	437.425	437.425	437.425	437.425	437.425	437.425	437.425
Orbit altitude	(km)	550	550	550	550	550	550	550
Elevation Angle	(Deg)	5	10	15	20	40	60	80
Slant Range	(km)	2205.9	1815.7	1518.4	1293.8	812.1	626.9	557.8
SATELLITE								
Transmit Output Power	(W)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Transmit Output Power	(dBm)	20	20	20	20	20	20	20
Transmit Output Power (Max peak power)	(dBW)	-10	-10	-10	-10	-10	-10	-10
Maximum Power Density	(dBW/Hz)	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0
Antenna Gain	(dBi)	2	2	2	2	2	2	2
Transmission Line Loss	(dB)	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Effective Isotropic Radiated Power	(dBW)	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
DOWNLINK PATH								
SAT Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Polarization Loss	(dB)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Atmospheric Loss	(dB)	2.1	1.1	0.8	0.6	0.4	0.2	0.1
Ionospheric Loss	(dB)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Free Space Path Loss	(dB)	152.1	150.4	148.9	147.5	143.5	141.2	140.2
Power at the Ground Station	(dBW)	-167.5	-164.8	-163.0	-161.4	-157.2	-154.7	-153.6
GROUND STATION								
GS Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Gain	(dB)	16	16	16	16	16	16	16
Transmission Line Loss	(dB)	3.6	3.6	3.6	3.6	3.6	3.6	3.6
System Noise Temperature (Ts)	(K)	300	300	300	300	300	300	300
Figure of Merit (Gr/Ts)	(dB/K)	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8
Boltzman's Constant	(dBW/HzK)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Data rate	(dBHz)	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Carrier to Interference Required (C/I req)	(dB)	31.9	34.6	36.4	38.0	42.3	44.7	45.8
Carrier to Noise Power Ratio C/N	(dB)	19.7	22.4	24.2	25.8	30.1	32.5	33.6
Carrier to Noise Density Ratio C/No	(dB)	45.7	48.4	50.2	51.8	56.1	58.5	59.6
Eb/No (or SNR)	(dB)	22.7	25.4	27.2	28.8	33.1	35.5	36.6
BER		-	-	-	-	-	-	-
Required SNR	(dB)	10	10	10	10	10	10	10
Link Margin	(dB)	12.7	15.4	17.2	18.8	23.1	25.5	26.6

# MISSION & TELEMETRY DATA

<b>DESIGNATION OF EMISSION</b>	10K0F1D
<b>PROTOCOL</b>	AX.25
<b>DIRECTION</b>	Downlink

GS Side (Transmitting) Parameter	
Model	RFM96W
Modulation	GFSK
FDA (kHz)	5
BR (kbps)	1.2
Bandwidth (kHz)	10

Satellite Side (Receiving) Parameter	
Model	RFM96W
Modulation	GFSK
FDA (kHz)	5
BR (kbps)	1.2
Bandwidth (kHz)	10

ORBIT		5°	10°	15°	20°	40°	60°	80°
Frequency (MHz)	(MHz)	437.425	437.425	437.425	437.425	437.425	437.425	437.425
Orbit altitude (km)	(km)	550	550	550	550	550	550	550
Elevation Angle (Deg)	(Deg)	5	10	15	20	40	60	80
Slant Range (km)	(km)	2205.9	1815.7	1518.4	1293.8	812.1	626.9	557.8
SATELLITE								
Transmit Output Power (W)	(W)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Transmit Output Power (dBm)	(dBm)	20	20	20	20	20	20	20
Transmit Output Power (Max peak power) (dBW)	(dBW)	-10	-10	-10	-10	-10	-10	-10
Maximum Power Density (dBW/Hz)	(dBW/Hz)	-50	-50	-50	-50	-50	-50	-50
Antenna Gain (dBi)	(dBi)	2	2	2	2	2	2	2
Transmission Line Loss (dB)	(dB)	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Effective Isotropic Radiated Power (dBW)	(dBW)	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
DOWNLINK PATH								
SAT Antenna Pointing Loss (dB)	(dB)	3	3	3	3	3	3	3
Antenna Polarization Loss (dB)	(dB)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Atmospheric Loss (dB)	(dB)	2.1	1.1	0.8	0.6	0.4	0.2	0.1
Ionospheric Loss (dB)	(dB)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Free Space Path Loss (dB)	(dB)	152.1	150.4	148.9	147.5	143.5	141.2	140.2
Power at the Ground Station (dBW)	(dBW)	-167.5	-164.8	-163.0	-161.4	-157.2	-154.7	-153.6
GROUND STATION								
GS Antenna Pointing Loss (dB)	(dB)	3	3	3	3	3	3	3
Antenna Gain (dB)	(dB)	16	16	16	16	16	16	16
Transmission Line Loss (dB)	(dB)	3.6	3.6	3.6	3.6	3.6	3.6	3.6
System Noise Temperature (Ts) (K)	(K)	300	300	300	300	300	300	300
Figure of Merit (Gr/Ts) (dB/K)	(dB/K)	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8
Boltzman's Constant (dBW/HzK)	(dBW/HzK)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Data rate (dBHz)	(dBHz)	30.8	30.8	30.8	30.8	30.8	30.8	30.8
Carrier to Interference Required (C/I req) (dB)	(dB)	17.9	20.6	22.4	24.0	28.3	30.7	31.8
Carrier to Noise Power Ratio C/N (dB)	(dB)	5.7	8.4	10.2	11.8	16.1	18.5	19.6
Carrier to Noise Density Ratio C/No (dB)	(dB)	45.7	48.4	50.2	51.8	56.1	58.5	59.6
Eb/No (or SNR) (dB)	(dB)	14.9	17.6	19.5	21.0	25.3	27.7	28.8
BER		0.001	0.001	0.001	0.001	0.001	0.001	0.001
Required SNR (dB)	(dB)	12	12	12	12	12	12	12
Link Margin (dB)	(dB)	2.9	5.6	7.5	9.0	13.3	15.7	16.8

# COMMAND

DESIGNATION OF EMISSION	10K0F1D
PROTOCOL	AX.25
DIRECTION	Uplink

GS Side (Transmitting) Parameter	
Model	RFM96W
Modulation	GFSK
FDA (kHz)	5
BR (kbps)	1.2
Bandwidth (kHz)	10

Satellite Side (Receiving) Parameter	
Model	RFM96W
Modulation	GFSK
FDA (kHz)	5
BR (kbps)	1.2
Bandwidth (kHz)	10

ORBIT		5°	10°	15°	20°	40°	60°	80°
Frequency	(MHz)	437	437	437	437	437	437	437
Orbit altitude	(km)	550	550	550	550	550	550	550
Elevation Angle	(Deg)	5	10	15	20	40	60	80
Slant Range	(km)	2205.9	1815.7	1518.4	1293.8	812.1	626.9	557.8
GROUND STATION								
Transmit Output Power	(W)	3	3	3	3	3	3	3
Transmit Output Power	(dBm)	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Transmit Output Power (Max peak power)	(dBW)	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Maximum Power Density	(dBW/Hz)	-35.2	-35.2	-35.2	-35.2	-35.2	-35.2	-35.2
Antenna Gain	(dBi)	16	16	16	16	16	16	16
Transmission Line Loss	(dB)	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Effective Isotropic Radiated Power	(dBW)	17.2	17.2	17.2	17.2	17.2	17.2	17.2
UPLINK PATH								
GS Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Polarization Loss	(dB)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Atmospheric Loss	(dB)	2.1	1.1	0.8	0.6	0.4	0.2	0.1
Ionospheric Loss	(dB)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Free Space Path Loss	(dB)	152.1	150.4	148.9	147.5	143.4	141.2	140.2
Power at the Satellite	(dBW)	-140.6	-137.9	-136.0	-134.4	-130.2	-127.7	-126.6
SATELLITE								
SAT Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Gain	(dB)	2	2	2	2	2	2	2
Transmission Line Loss	(dB)	1.8	1.8	1.8	1.8	1.8	1.8	1.8
System Noise Temperature (Ts)	(K)	1010	1010	1010	1010	1010	1010	1010
Figure of Merit (Gr/Ts)	(dB/K)	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0
Boltzman's Constant	(dBW/HzK)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Data rate	(dBHz)	30.8	30.8	30.8	30.8	30.8	30.8	30.8
Carrier to Interference Required (C/I req)	(dB)	27.4	30.1	32.0	33.5	37.8	40.2	41.3
Carrier to Noise Power Ratio C/N	(dB)	15.2	17.9	19.8	21.3	25.6	28.0	29.1
Carrier to Noise Density Ratio C/No	(dB)	55.2	57.9	59.8	61.3	65.6	68.0	69.1
Eb/No (or SNR)	(dB)	24.4	27.1	29.0	30.5	34.8	37.2	38.4
BER		0.001	0.001	0.001	0.001	0.001	0.001	0.001
Required SNR	(dB)	12	12	12	12	12	12	12
Link Margin	(dB)	12.4	15.1	17.0	18.5	22.8	25.2	26.4

# MISSION DATA

DESIGNATION OF EMISSION	31K3F1D
PROTOCOL	AX.25
DIRECTION	Uplink

Satellite Side (Receiving) Parameter	
Model	RFM96W
Modulation	LoRa
Bandwidth (kHz)	31.25
Spreading Factor	10
BR (kbps)	0.146

ORBIT		5°	10°	15°	20°	40°	60°	80°
Frequency	(MHz)	437	437	437	437	437	437	437
Orbit altitude	(km)	550	550	550	550	550	550	550
Elevation Angle	(Deg)	5	10	15	20	40	60	80
Slant Range	(km)	2205.9	1815.7	1518.4	1293.8	812.1	626.9	557.8
GROUND STATION								
Transmit Output Power	(W)	1	1	1	1	1	1	1
Transmit Output Power	(dBm)	30	30	30	30	30	30	30
Transmit Output Power (Max peak power)	(dBW)	0	0	0	0	0	0	0
Maximum Power Density	(dBW/Hz)	-44.9	-44.9	-44.9	-44.9	-44.9	-44.9	-44.9
Antenna Gain	(dBi)	4	4	4	4	4	4	4
Transmission Line Loss	(dB)	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Effective Isotropic Radiated Power	(dBW)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
UPLINK PATH								
GS Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Polarization Loss	(dB)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Atmospheric Loss	(dB)	2.1	1.1	0.8	0.6	0.4	0.2	0.1
Ionospheric Loss	(dB)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Free Space Path Loss	(dB)	152.1	150.4	148.9	147.5	143.4	141.2	140.2
Power at the Satellite	(dBW)	-157.3	-154.6	-152.8	-151.2	-146.9	-144.5	-143.4
SATELLITE								
SAT Antenna Pointing Loss	(dB)	3	3	3	3	3	3	3
Antenna Gain	(dB)	2	2	2	2	2	2	2
Transmission Line Loss	(dB)	1.8	1.8	1.8	1.8	1.8	1.8	1.8
System Noise Temperature (Ts)	(K)	1010	1010	1010	1010	1010	1010	1010
Figure of Merit (Gr/Ts)	(dB/K)	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0
Boltzman's Constant	(dBW/HzK)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Data rate	(dBHz)	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Carrier to Interference Required (C/I req)	(dB)	10.5	13.2	15.0	16.6	20.8	23.3	24.4
Carrier to Noise Power Ratio C/N	(dB)	-1.7	1.0	2.8	4.4	8.6	11.1	12.2
Carrier to Noise Density Ratio C/No	(dB)	38.4	41.1	43.0	44.6	48.8	51.3	52.4
Eb/No (or SNR)	(dB)	16.8	19.5	21.3	22.9	27.2	29.6	30.7
BER		0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Required SNR	(dB)	6	6	6	6	6	6	6
Link Margin	(dB)	10.8	13.5	15.3	16.9	21.2	23.6	24.7