

## CH-1/2 (Command and Telemetry)

No.	Item	Unit	CH-1 (VHF-Up)	CH-2 (UHF-Down)		Comment
				I	II	
	Modulation / Format		F1D /Original	F1D/WSJT		
	Bit rate (BR)	bps	10	4	4	
(1)	Transmission frequency	MHz	145	437	437	
(2)	Transmission power	dBm	47.0	29.0	29.0	50W for Up 0.8W for WSJT.
(2a)	Bandwidth	kHz	3.0	3.0	3.0	
(2b)	Maximum power density	dBW/Hz	-17.8	-35.7	-35.7	=(2)-{10log(2b)-60
(3)	Transmitter feeder loss	dB	3.0	0.5	0.5	
(4)	Transmitter antenna gain	dBi	15.0	0.0	0.0	
(5)	EIRP	dBm	59.0	28.5	28.5	=(2)-(3)+(4)
(6)	Polarization loss	dB	3.0	3.0	3.0	
(7)	Communication distance	km	384,400	1,153,200	7,688,000	CH-2/I earth-moon distance*3 CH-2/II earth-moon distance*20
(8)	Elevation Angle	deg	5	5	5	
(9)	Transmission loss in free	dB	187.3	206.4	222.9	=32.4+20log(f[MHz])
(10)	Ionospheric absorption loss	dB	0.5	0.5	0.5	
(11)	Rainfall loss	dB	0.1	1.0	0.1	
(12)	Antenna pointing loss	dB	0.2	0.2	0.2	
(13)	Receiver antenna gain	dBi	0.0	20.0	34.3	
(14)	Receiver feeder loss	dB	0.5	1.0	1.0	
(15)	Receiver input signal power	dBm	-132.1	-163.1	-164.4	=(5)-(6)-(9)-(10)-(11)-(12)+(13)-(14)
(16)	Receiver noise power density	dBm/Hz	-164.8	-164.8	-164.8	-123 dBm(Typ)@3kHz
(17)	C/N0 (Expected)	dBHz	32.7	1.7	0.4	=(15)-(16) -10*log10(BW/3kHz)
(18)	Loss in mod/demod proc.	dB	0.4	-20	-20	Gain is shown by minus.
(19)	Noise bandwidth	dBHz	10.0	6.0	6.0	=10log(BR)
(20)	S/N0	dB	13.9	-6.5	-6.5	BER=1.0E-11
(21)	C/N0 (Required)	dBHz	23.9	-0.5	-0.5	=(19)+(20)
(22)	Link margin	dB	8.8	2.2	0.8	=(17)-(21)

Note (B)

Note(C), (D)

note (E)

note (F)

### Notes

#### (A) Direction of Communication

CH-1: Earth-> Shin-en2, CH-2 : Shin-en2 -> Earth

#### (B) Communication distance

The distance of 384,480 km is corresponding to earth-moon distance. Shin-en2 arrives to this point in a half day.

The distance of 1,153,200 km is corresponding to 3 x earth-moon distance. Shin-en2 arrives this point within three days.

The distance of 7,688,000 km is corresponding to 20 \* earth-moon distance. Shin-en2 arrives to this point in five months.

Shin-en2 will approach to the earth at the distance less than 9,000,000 km in 1.5 years after separation (see orbit).

#### (C) CH-2/I is a case using Yagi-antenna of 20-dB gain as a ground-base antenna.

#### (D) CH-2/II is a case using large aperture antenna 'AMATERAS' as a ground-base antenna..

AMATERAS is twin cylindrical parabola antennas with size of 31 m by 33 m.

The antenna is located at Fukushima, Japan, and is operating by Tohoku University.

This antenna is usually used for solar and Jovian radio observations and has wide receiving band including 430-MHz band.

Effective Aperture Area (Ae) = 100 m<sup>2</sup>

Antenna Gain (G) is calculated by

$$G = (4 \pi A_e) / \lambda^2,$$

where pi=3.14, lambda is observation wave length of 0.63 m.