18

1

18 Ka Ku

18 C

13m Ku 9m Ku 6.2m

ka 13m

E

18

GB8702-2014

2

2.1.1

1 2015 1 1

2 2016 9 1

3 682

2017 10 1

4 18 1997

3 25

5 44

2019 9 1

2.1.2

1 GB8702-2014

2 - HJ2.1-2016

3 -

HJ/T10.3-1996

4 - HJ/T10.2-1996

5 GB13615-92

2.1.3

1 18

2

GB8702-2014

- HJ/T10.3-1996

1 24h 6 min

2-1 C 5.625GHz 6.425GHz Ku

13.75GHz 14.5GHz 3000MHz~15000MHz Ka

27.5GHz 30GHz 15GHz 300GHz

2-1

	E V/m	H A/m	B μT	S_{eq} W/m^2
3000MHz~15000MHz	$0.22f^{1/2}$	$0.00059f^{1/2}$	$0.00074f^{1/2}$	f/7500
15GHz 300GHz	27	0.073	0.092	*2*

f MHz

2-2

	GB8702-2014 W/m^2	W/m^2
C	0.75 0.86	0.75
Ku	1.83 1.93	1.83
Ka	2	2

-

HJ/T10.3-1996 GB8702-2014

GB8702-2014

GB8702-2014 1/2

1/5

1/2 2-3

2-3

	GHz	GB8702-2014 W/m^2	W/m^2
C	5.625 6.425	0.75	0.375
Ku	13.75 14.5	1.83	0.915
Ka	27.5 30	2	1.0

1

1

(GB3095-2012) 2-4

2-4 g/m^3

1	SO_2	60	150	500	GB3095 2012
2	NO_2	40	80	200	
3	PM_{10}	70	150		
4	$PM_{2.5}$	35	75		
5	O_3		160	200	
6	CO		4	10	

2

GB 3096-2008 1

2-5

2-5 /dB(A)

	1	55	45

2

1

GB8978-1996

2-6

2-6

SS	400	mg/L
pH	6~9	
COD	500	mg/L
BOD_5	300	mg/L
	100	mg/L

2

GB12523-2011

≤70dB(A) ≤50dB(A)

(GB12348 2008)

1 2-7

2-7 dB A

	1	55	45

3

115.5 E

0.5km

2-8

2-8

115.5 E		180.1	500m

2-1

2-1

(2011) 2013

3.

18

3

3.1

1 18

2

3 5000

4 18

5

E115 34 53 N40 23 21

1

3.2

3.2.1

1 IOT

2 CSM 24

3 ESVA

4

9 Ku 750W 6.2 Ku 750W

3.2.2

/

SOC

13 C 1500W

3.2.3

13 Ka 200W

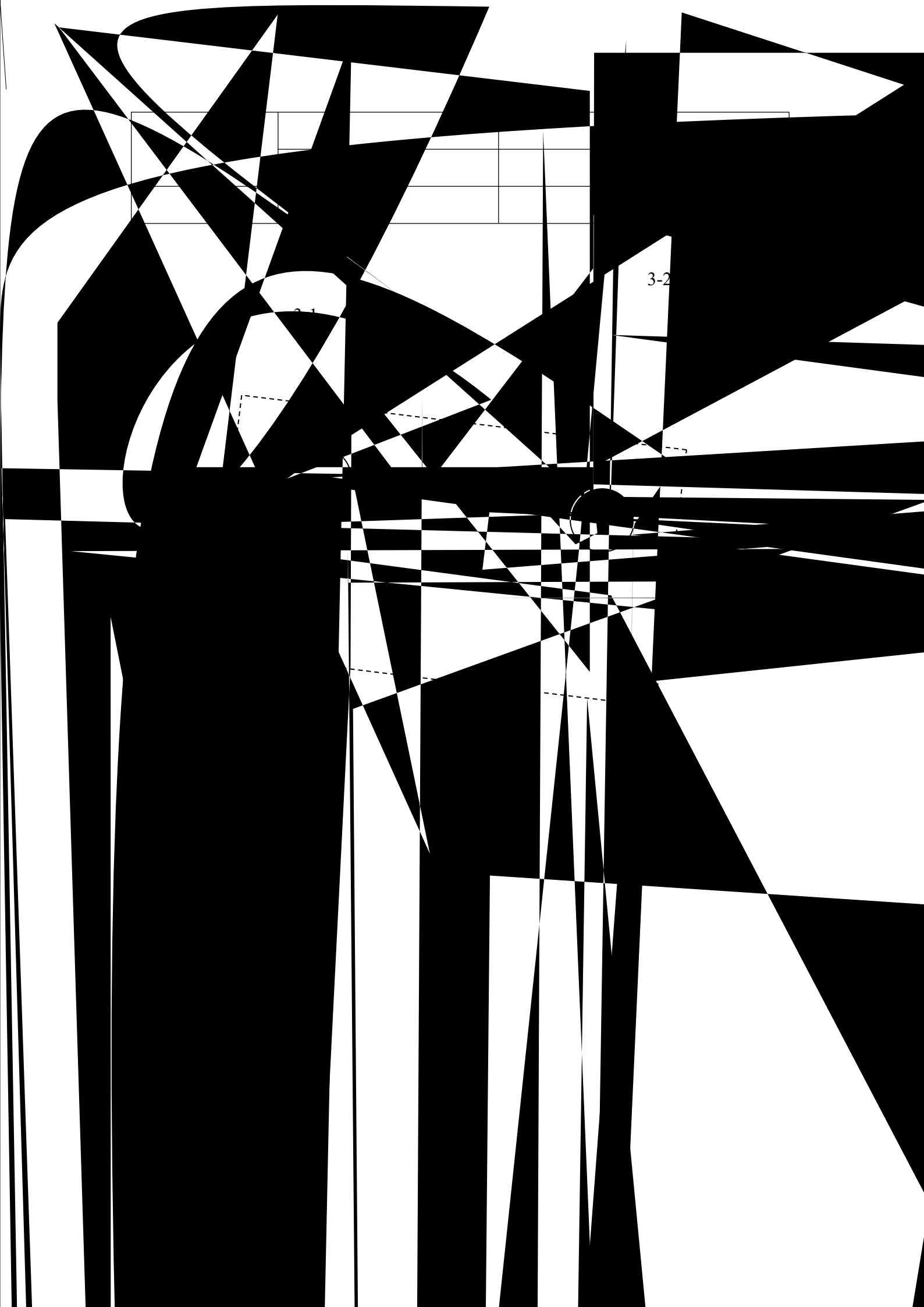
3.2.4

10000

3-1

3-1

		13 C 1
		9 Ku 1
		6.2 Ku 1
		13 Ka 1
	1	10000
	2	
	3	
	4	
	1	
	2	


3-2

3-2

	/				GHz					dBi	(W)	(W)			
C	1	13m			5.85 6.67	3.4 4.2		43.3	180.1	56	3000	200	115.5		
Ku	1	9m			13.75 14.5	10.7 12.75		43.3	180.1	60	750	200	115.5		
Ku	1	6.2m			13.75 14.5	10.95 12.75		43.3	180.1	56	750	200	115.5		
Ka	1	13m			27.5 30	17.7 20.2		43.3	180.1	58	200	100	115.5		

3.2.3

3.2.4

2 16

3-7

3-7

		16	16
/			/
(m)		13	13
dB		56.4	68.6
		16	16
		189.24	189.24
		43.41	43.41
		C	Ka
GHz		5.850 6.725GHz	27.5GHz~29GHz
		3.4 4.2GHz	17.7GHz~18.7GHz
(m)		610.585	610.585
(W)		3000	3000
(W)		200	500

3-2

3-2 16

3.3.4

1

2

3

3.3.5

50m 110

3-1

250m 300m

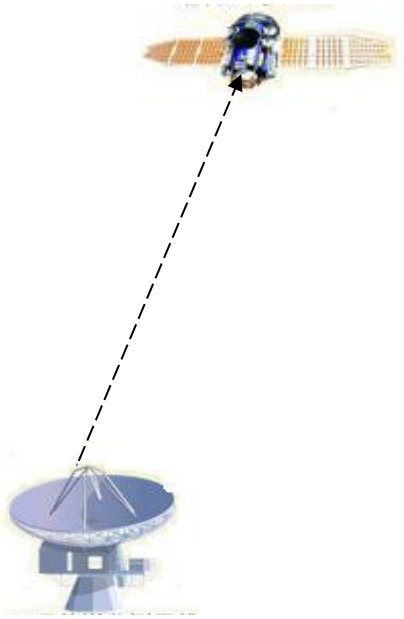
300m

40m 80m

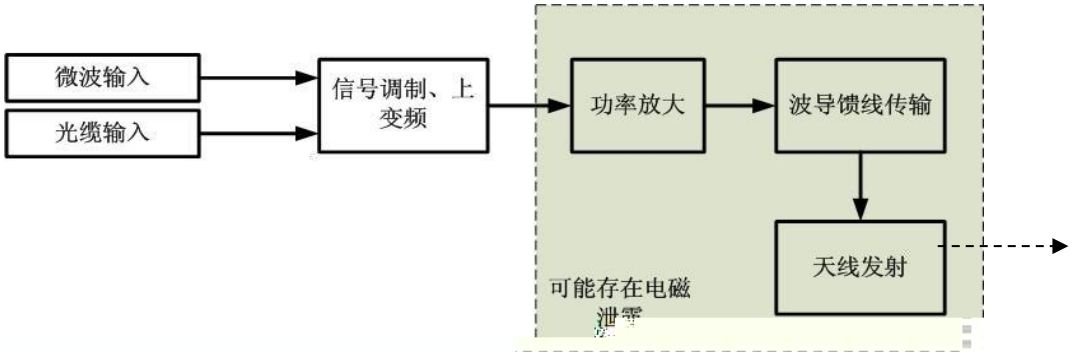
350m 490m

3-1

4



4-2



4-2

1 2

4.3.1

18 115.5 E

A 180º arctan[$\frac{\tan(\phi s - \phi e)}{\sin\theta}$] (0º) 4.1

$$E \quad \arctan\left[\frac{\cos\theta\cos(\phi s-\phi e)-0.15127}{\sqrt{1-[\cos(\phi s-\phi e)\cos\theta]^2}}\right] \quad (\qquad 0^{o}) \qquad 4.2$$

Øs

Øe

θ

4-1

4-1

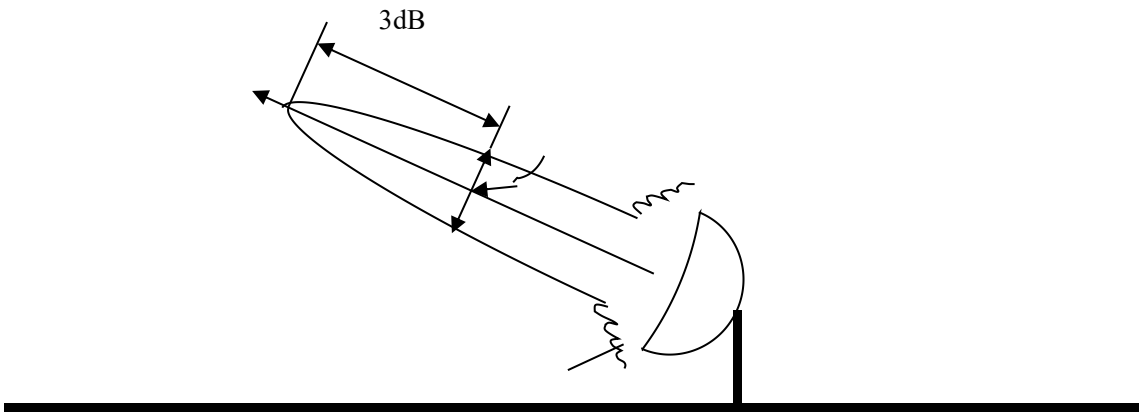
	18	/°	/°
E115 34 53 N40 23 21	115.5		

4.3.2

“ ”

( )

4-3



4-3

36000

d_0 $d< d_0$ $d> d_0$

d_0 D^2/λ 4.3

d_0 — m;

D— m;

λ— m

C 13m Ku 9m 6.2m Ka

13m 4.1 4-2

4-2

	C	Ku	Ku	Ka
D	13m	9m	6.2m	13m
f/ GHz	5.85 6.67	13.75 14.5	13.75 14.5	27.5~30
λ(3×10^8 f) / m	0.045 0.051	0.021 0.022	0.021 0.022	0.01 0.011
d_0/ m	6627 7511	7364 7714	3495 3661	30727 33800

4-2

4.2.3

$P_{dmax}=4\ P_T$ A W/m^2

P_T —— / W 100%

A —— / m^2

(4.2) 4-4

$$Pd = \frac{P \times G}{4 \times \pi \times r^2} \quad W/m^2 \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad 4.5$$

P W

G

r m

2

4 C 13m Ku

9m Ku 6.2m Ka 13m

4-3

4-3

		C 13m	Ku 9m	Ku 6.2m	Ka 13m
		13m	9m	6.2m	13m
	W	1500	750	750	200
	W	200	200	200	100
		2h/d	2h/d	1h/d	1h/d

3

4-4

4-4

	C 13m	Ku 9m	Ku 6.2m	Ka 13m
D m	13	9	6.2	13
W	1500	750	750	200
m	7511	7741	3661	33800
(4.4) W/m^2	45.2	47.2	99.4	6.0

4-5

4-5 W/m²

m	C 13m	Ku 9m	Ku 6.2m	Ka 13m
7511m C 13m	0.84			
7741m Ku 9m		1.0		
3661m Ku 6.2m			1.77	
33800m Ka 13m				0.01

4-5

GB8702-2014

4.4 4.5

12 dB

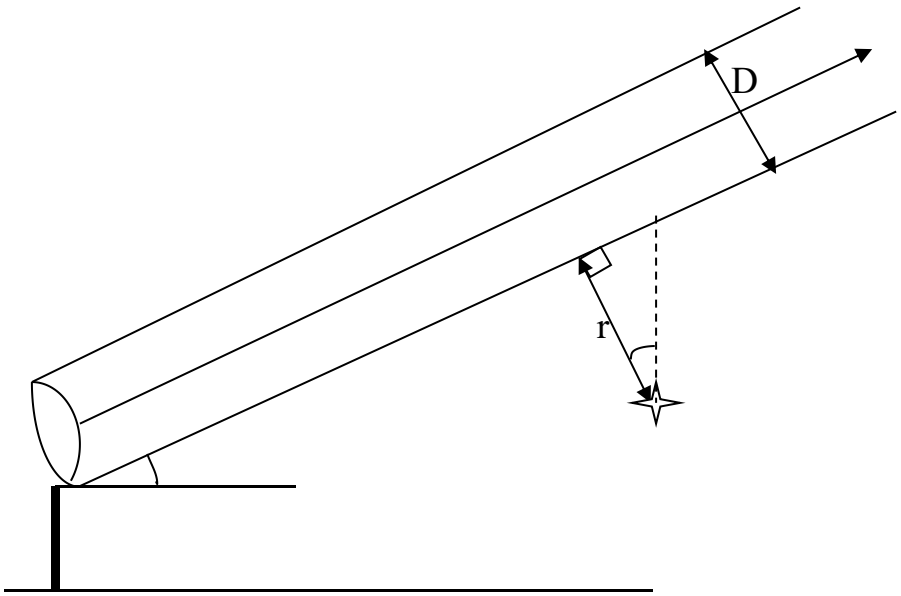
$$Pd \times 10^{\frac{-12\times\frac{2r}{D}}{10}} \quad W/m^2 \qquad 4.6$$

D——

P_d—— P_{dmax}

r ——

4-3



4-3

(4.6) 10 20 30 50

100 4-6

4-6

	C 13m	Ku 9m	Ku 6.2m	Ka 13m
D/ m	13	9	6.2	13
/ W	1500	750	750	200
Pd W/m^2	45.2	47.2	99.4	6.0
r=1 W/m^2				
r=5 W/m^2				
r=10 W/m^2				
r=20 W/m^2				
r=30 W/m^2				

r r 4-7

4-7

	C 13m	Ku 9m	Ku 6.2m	Ka 13m
D m	13	9	6.2	13
W	1500	750	750	200
W/m^2	0.15	0.37	0.37	0.4
r m	13.4	7.9	6.3	6.4

4-7

6.3m 13.4m

5

V

792 394

1978 535

602

33.4% 450 25%

749 41.6%

1000 40

3027

149 42.2℃ 23.3℃

9.1℃ 396 2.3

4

1951 10

41.6 22.7 3

482.8 479 479 175

89% 130

1801 2.24

3.1 2.54 4521

10 17.8 “

” 3.1 27.4

2.06 47.2%

20 13

1871 2865 303

2209 615 1984

1701

30

1973

88

28

8

4000

2016 364787 4981

363711 1980 51.58%

2.46 185

2016 1449084 8.3%

238866 6.2%

351807 9.1% 858411 8.4%

90715 1130

3770 6085 4.3%

2016 234950 35.2%

152860 12.9%

2016 16.2% 2.6

49 37 8 1

1 1 1 4.48

3824 3557 “ ”

“ ” 2015

412 1039 600 94

677 608 25% 100%

515 6

17 268 7 215

967 577 390

25.7 98%

6 173

7091 3574 1190 32738

5901 1313 401.6

729 2016 2150

278% 95%

56422 800

191 3770 2779

5.3

2016 2016

4.50 2015 4.64 3.0%

0.66 74 27

GB3095-2012 2016

288 78.7% 78 2015

10 15 1

2016

11 10 III

100%

IV III 2015

2015

33.8% 30.8% 2015

25% 2015 21.7%

III

2016 7

5

2

2017 8 1

4

1 5-1 AWA6228

GB3096-2008

5-1

5-1

		dB(A)		dB(A)	
1		45.6	55	38.1	45
2		44.6	55	38.5	45
3		43.8	55	38.9	45
4		50.6	55	40.6	45
5		48.2	55	41.8	45
6		44.7	55	40.1	45

GB3096-2008

5-1

1

GB8702-2014 -

HJ/T10.2-1996

2

Nadar EMR-300 PMM

8053B 5-2

5-2

	PMM
	8053B
	EP408
	1MHz 40GHz
	0.002W/m^2
	XDdj2017-2131
	2017 5 26

3

20

4

GB8702 2014

HJ/T10.2—1996

5

2017 8 1

PMM 8053B 5-1

5-3

5-3

			W/m^2	V/m
	1		0.002	0.8
	2		0.002	0.8
	3		0.002	0.8
	4		0.002	0.8
	5		0.002	0.8
	6		0.002	0.8

GB8702-2014

6

1

2

6.2

2 6-1

6-1

	C	Ku
	1500W	750W
	5.72	12.5
	12m	12m
	43.4	43.4
	189	189

2017 8 1

C 200W 43.4

189 Ku 200W 43.4 189

100W

18 55%RH

PMM 8053B EP408

1MHz 40GHz

0.002 W/m^2

6-2

6-2

			W/m^2	V/m
	1		0.002	0.8
	2		0.002	0.8
	3		0.002	0.8
	4		0.002	0.8
	5		0.002	0.8
	6		0.002	0.8

0.002W/

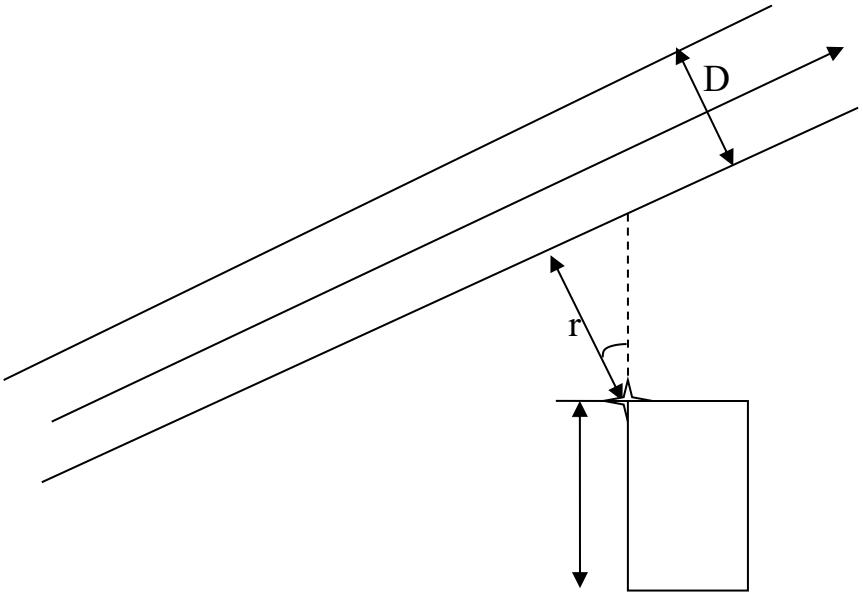
GB8702-2014 C

0.75W/ Ku 1.83W/

1

1

6-1



6-1 r

* h Y

,

r≈[Y tg h-] cos …… 6.1

P_{dmax}=4 P_T A W/m^2 ……

P_T—— / W 100%

A—— / m^2

$$Pd = \frac{P \times G}{4 \times \pi \times r^2} \quad W/m^2 \quad \cdots\cdots \quad 6.3$$

P W

G

r m

$$P_d \times 10^{\frac{-12\times\frac{2r}{D}}{10}} \quad W/m^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 6.4$$

D——

P_d—— P_{dmax}

r——

2

12m

1.7m

0m

C 1500W 56dBi Ku

750W 56dBi Ka 200W 58dBi

6-2-3

6-2-3

				m	m	m	(W/m^2)	(W/m^2)	(W/m^2)
C		143	43.3	235	0	1.7		0.002	0.002
		180	43.3	265	0	1.7		0.002	0.002
		233	43.3	175	0	1.7		0.002	0.002
		205	43.3	430	0	1.7	0	0.002	0.002
Ku		143	43.3	235	0	1.7		0.002	0.002
		180	43.3	265	0	1.7		0.002	0.002
		233	43.3	175	0	1.7		0.002	0.002
		205	43.3	430	0	1.7	0	0.002	0.002
Ka		143	43.3	235	0	1.7		0.002	0.002
		180	43.3	265	0	1.7		0.002	0.002
		233	43.3	175	0	1.7		0.002	0.002
		205	43.3	430	0	1.7	0	0.002	0.002

6-3

GB8702-2014

2

1

C Ku 16 C

Ku

2

PMM 8053B EP408

1MHz 40GHz

2016 8 1

C Ku

6-4

6-4

					W/m
C	1500W	43.4	189		0.002
	1500W	43.4	189		0.002
	1500W	43.4	189		0.002
	1500W	43.4	189		0.002
	1500W	43.4	189		0.002
	1500W	43.4	189		0.002

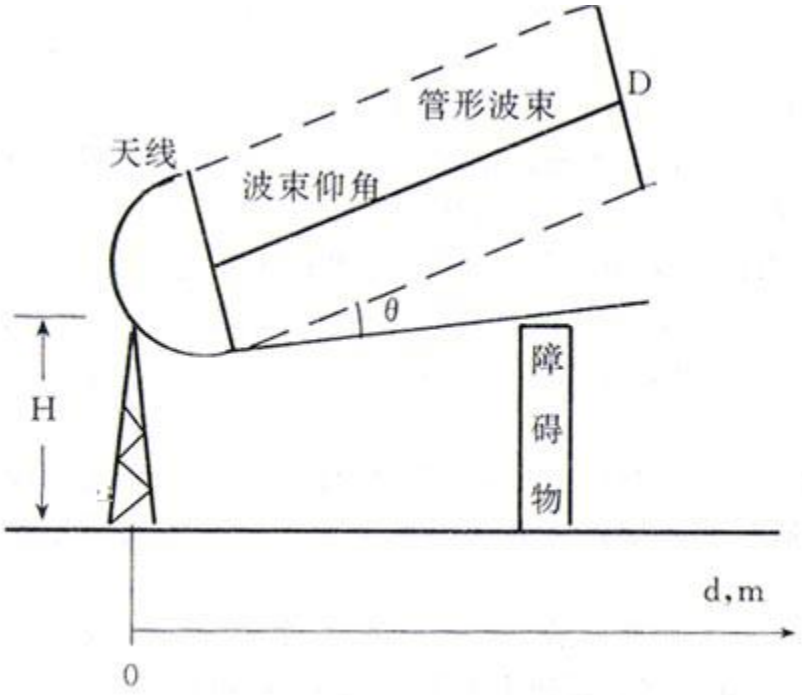
Ku	750W	43.4	189		0.002
	750W	43.4	189		0.002
	750W	43.4	189		0.002
	750W	43.4	189		0.002
	750W	43.4	189		0.002
	750W	43.4	189		0.002

5.85 6.67GHz 12.75 14.5GHz 27.5

30GHz MHz

(GB 13615-92) “ ”

6-2



6-2

H / m D / m d / m

θ 4/6GHz θ≥5°

11/14GHz θ≥10°

$$H_d=H-\frac{D}{COSE}(1.58+\frac{1}{2.4}\lg\frac{P}{S\cdot D^2})+d\cdot \tan E\ (m)\cdots\cdots \quad 6.5$$

H ,m

D ,m

P , w

E

d ,m

S μw/cm²

100m 200m 300m 400m 500m

6-6

6-6

	/°	/°	/m				
			100	200	300	400	500
1	180	43.3	68	135	203	271	339

7

8

1

2

GB 13615-1992

3

4

8-1

8-1

			GB8702-2014 1/5 C 0.15W/m^2 Ku 0.37W/m^{2,} Ka 0.4W/m^2

9

E

GB8702-2014

10

1

1 IOT

2 CSM 24

3 ESVA

4

9 Ku 750W 6.2 Ku 750W

2

/

SOC

13 C 1500W

3

13 Ka 200W

10.2

GB8702-2014

1

GB8702-2014 C 0.15W/

Ku 0.37W/

2

+

C

0.15W/ Ku 0.37W/ Ka

0.4W/

(2011) 2013

3.