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  2. : 2000 1 1 2000 12 31
  3. :
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- 가.

		1	2	3	4	5	6	7	8	9	10	11	12	
가.   ○ 7  - : , , , , , , - : 30MHz 18GHz ○ , ,  . 가 ○ , GIS 가 ○ ○ 가														-----  _____
(%)														

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: 30MHz 18GHz

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## 2

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#### 1.

가.

○

- 20 40 : (34 )
- 40 70 : (50 )
- 70 90 : (85 )
- 90 180 : (100 )
- 180 300 : (250 )
- 300 500 : (380 )
- 500 : (1,032 )

○

- : ,
- : , .
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- 

. (T S9965)

(1)

○

(Vertical Dipole Antenna) HE309

- : 20 1000 MHz
- : , 가
- 1GHz

○ (Log Periodic Antenna) HL025- AMP

- : 1 18 GHz

- : 8.5dB ,  
(32dB )

- 1GHz

○

가

GP- IB (General Purpose Instruments

Bus, IEEE 488) ,

가 .

(2)

: ESMI Rohde & Schwarz

H/W S/W

(CISPR 16- 1)가 가

. 20Hz 40GHz - 150 +30

dBm , EMI Test Receiver, Scalar

Network Analyzer .

EMI Receiver (Bandwidth)

.

(3)

: Pentium PC Controller ,

,

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(1) (Frequency Domain) -

○ : 30MHz 10GHz

○ 30MHz 10GHz

○

30MHz 300MHz	50kHz	120kHz	2	EMI Receiver
300MHz 1GHz	100kHz	120kHz	2	
1GHz 10GHz	1MHz	120kHz	2	EMI Receiver

(2) (Time Domain)

○

: 30MHz 18GHz 5

10

- 35, 40, 50, 74, 110, 220 MHz
- 300, 350, 450, 485, 580 MHz
- 650, 740, 800, 850, 900 MHz
- 1000, 1500, 1800, 2100, 3000 MHz
- 5000, 8000, 10000, 15000, 18000 MHz

○

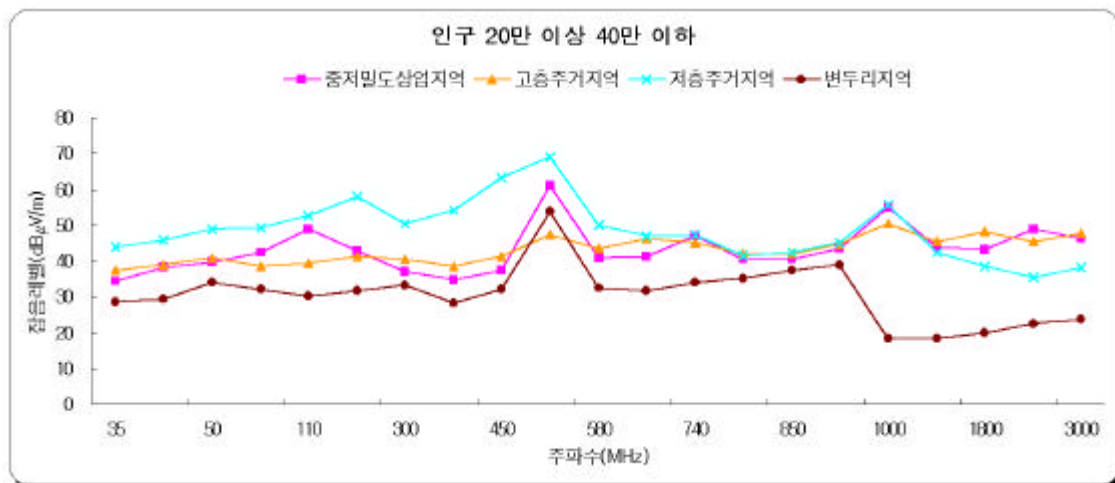
1GHz	5 seconds	120kHz	130	EMI Receiver
1GHz	5 seconds	120kHz	120	EMI Receiver



2. ,

가. 20 40 ( :dB $\mu$ V/m)

(MHz)				
35	34.3	37.2	43.8	28.4
40	38.0	38.8	45.8	29.5
50	39.6	40.8	48.9	34.0
74	42.3	38.4	49.1	32.1
110	48.6	39.1	52.6	30.1
220	42.7	41.2	57.9	31.5
300	37.1	40.5	50.4	33.3
350	34.5	38.4	54.2	28.1
450	37.4	41.1	63.4	32.0
485	60.9	47.2	69.1	53.9
580	40.7	43.3	49.8	32.2
650	41.0	46.0	46.9	31.8
740	46.9	44.8	47.2	34.0
800	40.4	41.8	41.7	35.2
850	40.2	41.8	42.4	37.2
900	43.3	44.6	45.0	38.8
1000	55.0	50.4	55.7	18.3
1500	43.7	45.3	42.4	18.3
1800	43.2	48.1	38.4	19.8
2100	48.9	45.2	35.4	22.5
3000	46.1	47.7	38.2	23.5

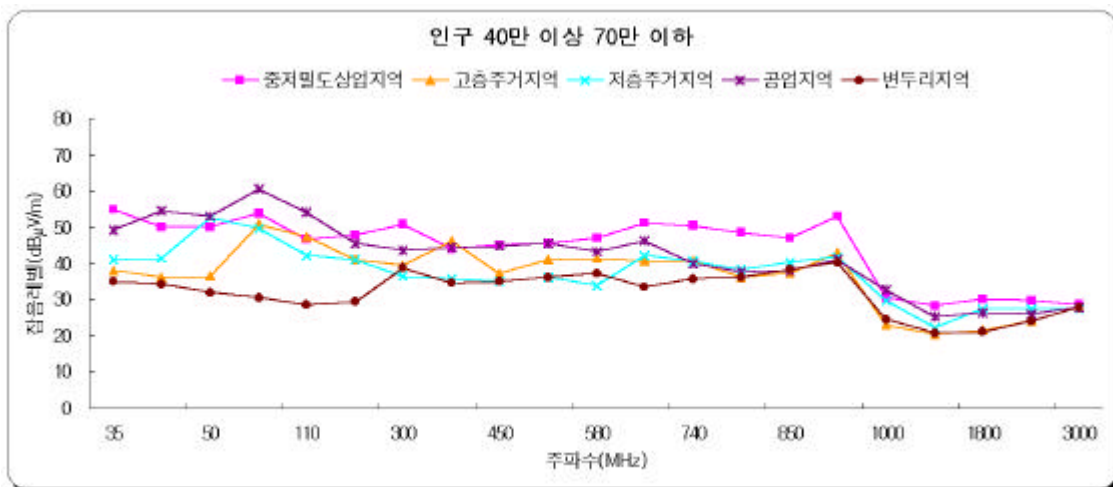


40

70

( :dB $\mu$ V/m)

(MHz)					
35	54.9	37.9	40.8	49.1	34.9
40	50.1	35.9	41.3	54.6	34.3
50	49.8	36.4	52.4	52.8	31.8
74	53.7	50.6	49.6	60.5	30.6
110	46.6	47.3	42.0	54.1	28.6
220	47.6	41.1	40.8	45.4	29.4
300	50.6	39.4	36.3	43.7	38.6
350	44.1	46.1	35.8	44.5	34.6
450	45.1	37.2	34.8	44.6	34.9
485	45.6	40.9	35.9	45.5	36.1
580	47.1	41.3	33.9	43.3	37.1
650	51.2	40.4	42.2	46.1	33.4
740	50.2	40.7	40.4	39.7	35.8
800	48.3	36.2	38.4	37.6	36.0
850	46.9	37.2	40.3	37.8	38.2
900	52.8	43.0	41.6	40.8	40.3
1000	30.6	23.0	29.6	32.6	24.4
1500	28.0	20.1	22.0	25.1	20.6
1800	29.9	21.3	27.4	26.2	21.2
2100	29.7	23.9	27.3	25.9	24.0
3000	28.6	27.7	27.3	27.7	27.8

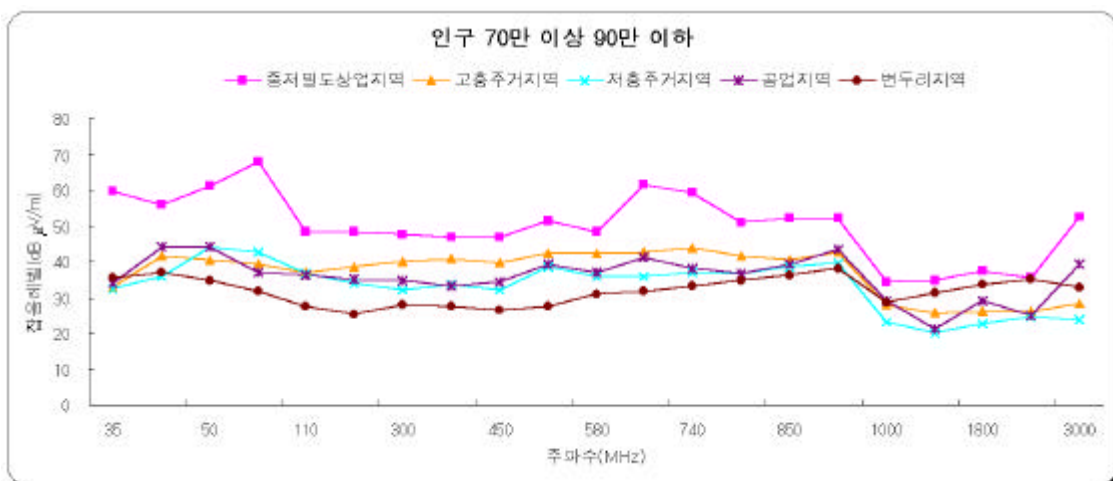


70

90

( :dB $\mu$ V/m)

(MHz)					
35	59.7	32.7	32.5	33.9	35.3
40	56.0	41.5	35.8	44.2	37.1
50	61.1	40.4	44.2	44.1	34.7
74	67.8	39.4	42.5	37.1	31.7
110	48.3	37.0	36.7	36.4	27.4
220	48.3	38.6	33.9	35.2	25.2
300	47.7	40.0	32.0	34.7	27.9
350	46.8	40.8	33.4	33.3	27.4
450	46.9	39.8	32.1	34.3	26.3
485	51.2	42.3	38.4	39.2	27.6
580	48.3	42.4	36.0	36.9	31.1
650	61.6	42.7	35.9	41.1	31.8
740	59.1	43.8	36.8	38.3	33.1
800	50.9	41.7	36.6	36.7	34.8
850	52.2	40.5	38.6	39.1	36.2
900	52.0	42.8	39.7	43.5	38.0
1000	34.3	28.0	23.1	29.2	28.8
1500	34.7	25.5	19.9	21.1	31.2
1800	37.5	25.9	22.7	29.0	33.5
2100	35.6	26.1	24.6	24.9	35.0
3000	52.5	28.4	23.6	39.4	32.7

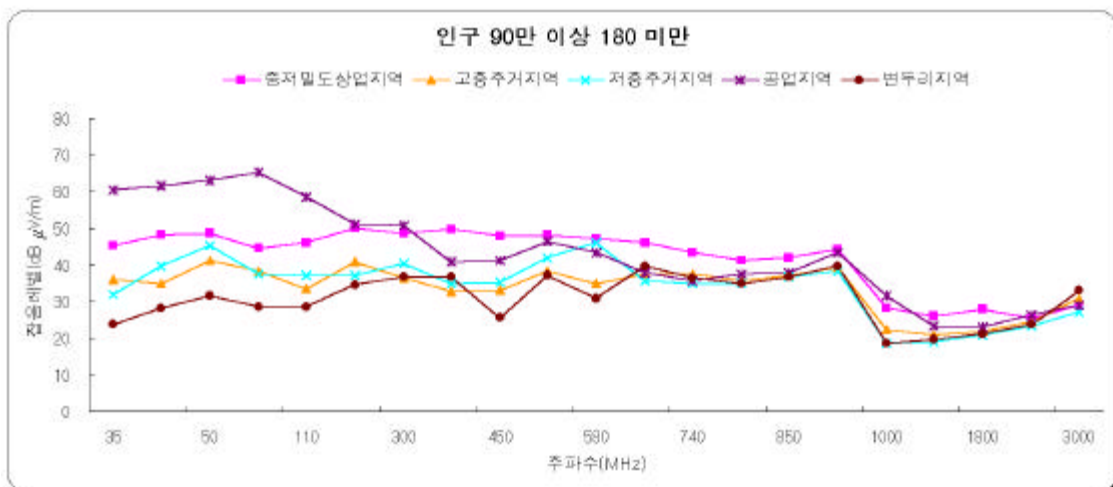


90

180

( :dB $\mu$ V/m)

(MHz)					
35	45.3	35.9	31.8	60.5	23.8
40	48.1	35.0	39.6	61.5	28.1
50	48.5	41.2	45.1	62.8	31.6
74	44.6	38.1	37.4	65.2	28.5
110	46.1	33.4	37.2	58.7	28.7
220	50.1	40.9	37.0	51.2	34.6
300	48.4	36.2	40.4	50.6	36.5
350	49.5	32.7	34.8	40.8	36.8
450	47.7	33.0	35.1	41.1	25.7
485	48.2	38.2	41.8	46.2	37.1
580	47.1	34.7	46.1	43.2	30.9
650	45.9	37.5	35.6	37.9	39.5
740	43.5	37.3	34.7	35.7	36.2
800	41.0	35.7	34.9	37.3	35.0
850	41.8	37.2	36.7	37.7	36.5
900	44.2	39.1	38.3	43.4	39.7
1000	28.2	22.4	18.4	31.6	18.6
1500	26.0	20.6	19.0	23.4	19.6
1800	27.9	21.9	20.6	22.8	21.1
2100	25.3	24.3	23.2	26.4	23.8
3000	28.9	30.9	27.1	29.0	32.8

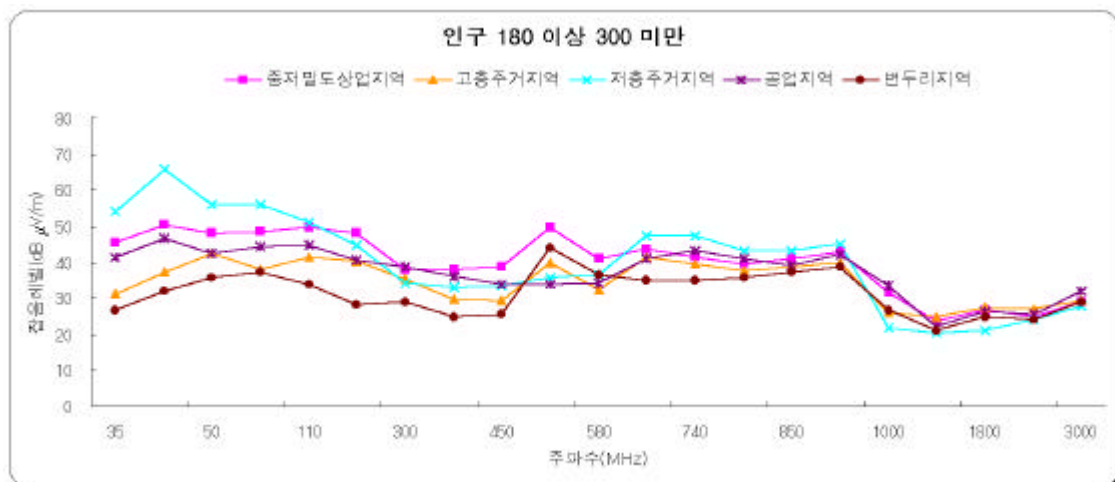


180

300

( :dB $\mu$ V/m)

(MHz)					
35	45.5	31.3	54.1	41.5	26.7
40	50.3	37.2	65.8	46.7	31.9
50	48.0	42.4	55.8	42.6	35.7
74	48.6	38.1	55.8	44.5	37.0
110	49.7	41.5	50.9	44.6	33.8
220	48.0	40.1	44.7	40.4	28.3
300	37.8	35.3	34.1	38.5	28.8
350	37.8	29.5	33.2	36.1	24.7
450	38.6	29.4	33.5	33.7	25.6
485	49.6	39.7	35.7	33.8	44.1
580	40.9	32.4	36.5	34.3	36.6
650	43.7	41.3	47.3	40.8	34.8
740	41.4	39.5	47.5	43.1	35.1
800	39.5	37.4	43.1	41.0	35.7
850	40.9	38.5	43.1	38.9	37.3
900	42.9	39.9	44.9	42.0	38.8
1000	31.4	25.9	21.9	33.6	26.5
1500	23.8	24.7	20.3	22.2	20.9
1800	26.6	27.6	21.1	26.2	24.8
2100	24.9	27.2	23.9	25.6	24.0
3000	29.0	29.4	27.8	31.8	29.1

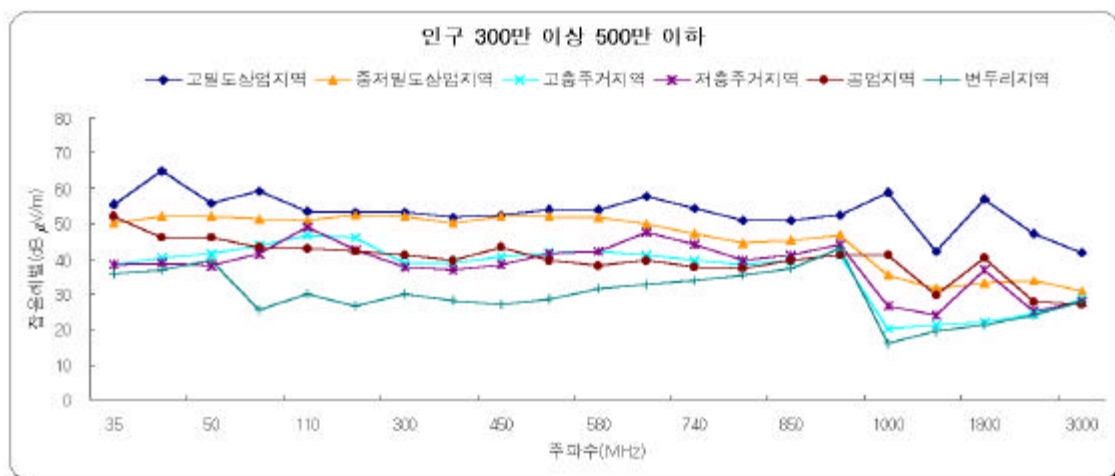


300

500

( :dB $\mu$ V/m)

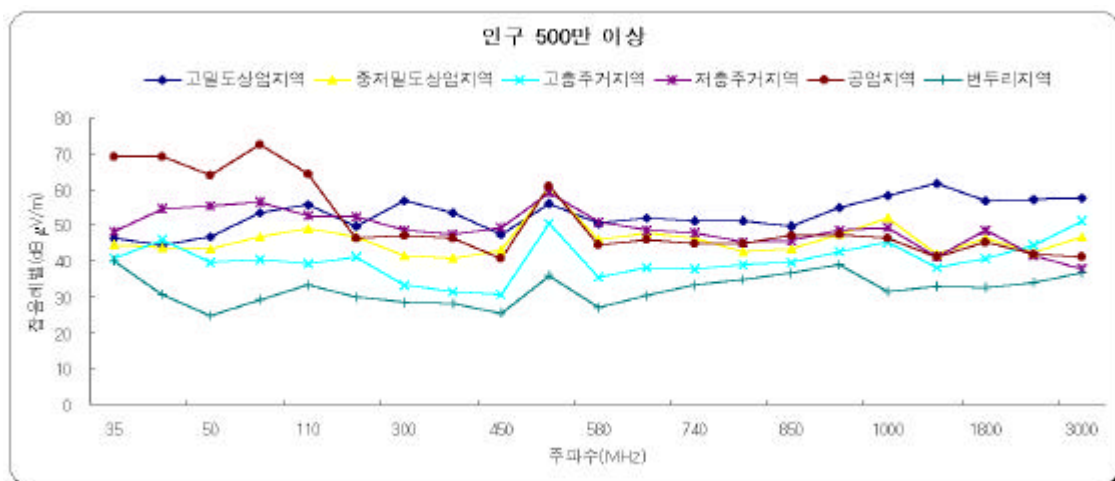
(MHz)						
35	55.5	50.1	38.3	38.2	51.9	35.7
40	64.7	51.8	40.1	38.8	45.7	36.7
50	55.9	52.1	41.4	38.1	45.8	39.3
74	59.3	51.0	43.5	41.3	43.4	25.5
110	53.4	50.9	46.7	48.8	42.9	30.0
220	53.2	52.5	45.7	42.5	42.1	26.6
300	53.1	52.0	38.6	37.5	40.9	29.8
350	51.4	50.2	38.6	36.6	39.6	28.1
450	52.4	51.9	40.5	38.3	43.4	27.1
485	54.0	51.8	41.8	41.3	39.6	28.6
580	53.9	51.5	42.0	42.0	38.1	31.3
650	57.7	49.7	41.0	47.3	39.4	32.7
740	54.3	47.0	39.5	44.0	37.5	33.9
800	50.9	44.4	38.3	39.3	37.2	35.3
850	50.9	45.2	39.5	40.9	39.3	37.0
900	52.4	46.7	40.8	43.9	41.1	42.7
1000	58.7	35.4	20.2	26.4	40.8	15.9
1500	42.1	31.3	21.4	23.8	29.7	19.5
1800	56.8	33.1	21.9	36.8	40.3	21.2
2100	47.1	33.9	24.2	25.2	27.7	23.7
3000	41.6	30.6	28.3	27.8	26.9	27.8

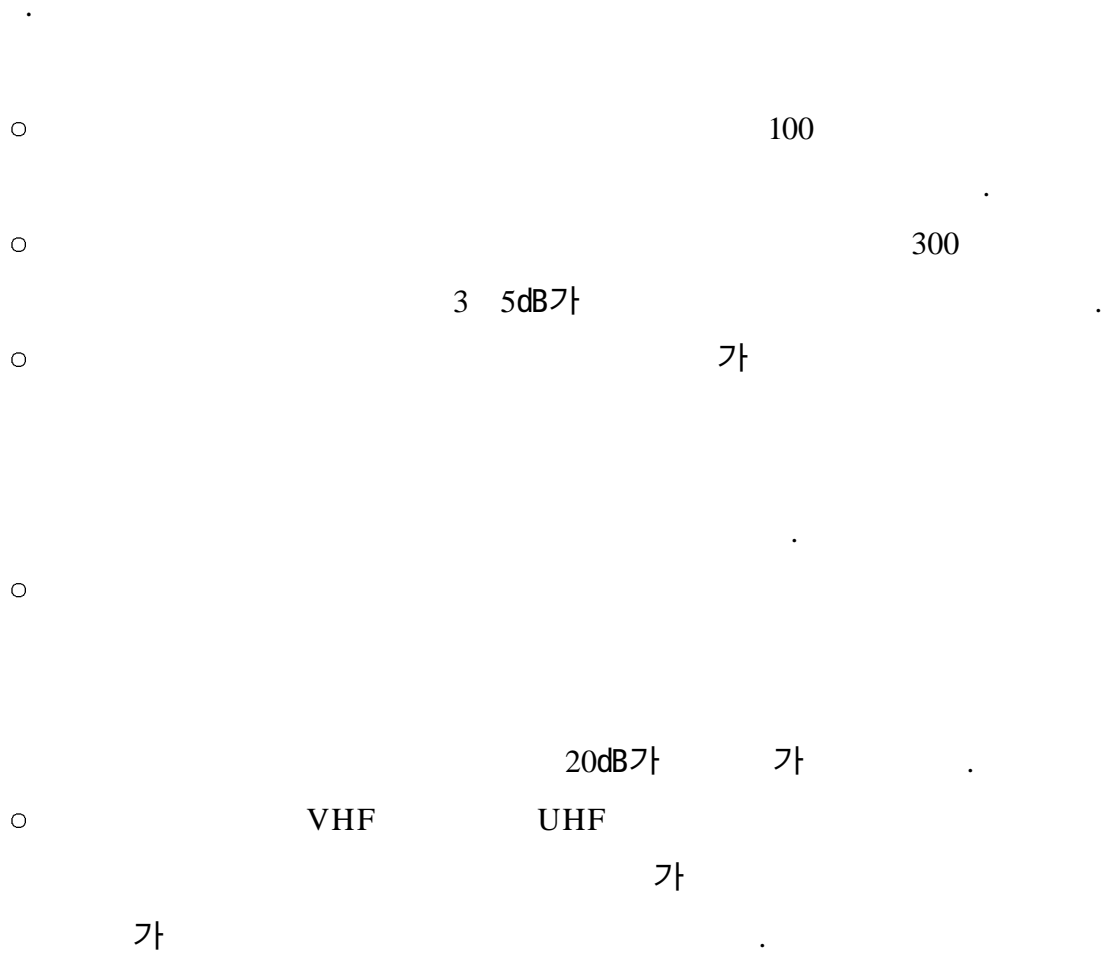


500

( :dB $\mu$ V/m)

(MHz)						
35	46.5	44.5	40.6	48.4	69.1	39.9
40	44.6	43.7	46.0	54.5	69.3	30.8
50	46.8	43.2	39.8	55.3	63.9	24.8
74	53.5	46.8	40.5	56.4	72.5	29.3
110	55.8	49.0	39.1	52.7	64.3	33.3
220	49.9	46.8	41.0	52.4	46.4	29.8
300	57.0	41.6	33.1	48.6	47.0	28.4
350	53.5	40.7	31.3	47.4	46.4	28.0
450	47.4	43.0	30.7	49.4	40.8	25.6
485	56.2	60.4	50.3	59.1	61.1	35.8
580	50.5	46.0	35.7	50.7	44.5	27.1
650	51.8	48.0	38.0	48.7	46.0	30.3
740	51.1	46.2	37.9	47.9	44.9	33.3
800	51.2	42.5	38.8	45.1	45.0	34.9
850	49.9	43.3	39.7	45.5	47.0	36.5
900	55.0	47.4	42.8	48.5	47.6	38.8
1000	58.2	52.1	45.1	49.2	46.4	31.5
1500	61.8	41.8	38.1	41.1	41.3	32.9
1800	56.9	46.4	40.6	48.6	45.2	32.5
2100	57.1	42.3	44.5	41.5	41.8	33.9
3000	57.7	46.8	51.2	37.9	41.2	36.6







2

가

1. 가

가.

(1)

○ 가 가

○

○ 가  
가

(2) TV

○ TV

- : ATSC(Advanced Television Systems  
Committee) ( )

- : 7 51 , UHF 270MHz

- : 8 level VSB(Vestigial Sideband)

○ TV

- ATSC

• (DVB-T) (ISdB-T)

• 가

가

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TV

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## 2. 가

가.

(1) , dB 3 GIS

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(3) 가

○ 3 ,

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(4) 가

○ 3

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(6) 가

- 가 GUI
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(1)

(가)

	<ul style="list-style-type: none"><li>○ Intel Pentium- 600MHz 2</li><li>○ Cache Memory : 512 K</li></ul>
	<ul style="list-style-type: none"><li>○ : 512 MB ( 2 GB 가 )</li></ul>
	<ul style="list-style-type: none"><li>○ : 36 GB (18 GB × 2, 100 GB 가 )</li><li>○ : 7200 RPM</li><li>○ : WU SCSI-3</li></ul>
	<ul style="list-style-type: none"><li>○ FDD : 3.5"(1.44MB)</li><li>○ CD-Rom Drive : 24</li><li>○ CD-RW Drive : W8× RW4× R24</li><li>○ Backup Drive : 12/ 24 GB 4 mm DDS-3</li><li>○ SCSI Controller : 2 Wide Ultra SCSI-3</li><li>○ Video Memory : 1 MB</li><li>○ Sound Card : 32bit sound</li><li>○ Hot Pluggable Power Supply</li></ul>

	<ul style="list-style-type: none"> <li>○ LAN Card : 10/ 100 MBPS TX/PCI UTP</li> <li>○ Serial Port 2 , Parallel Port 1</li> <li>○ PCI 5 , PCI/EISA 3</li> </ul>
	<ul style="list-style-type: none"> <li>○ : 21"</li> <li>○ Mouse :</li> <li>○ Keyboard : 106 Key</li> <li>○ Speaker : 200W</li> <li>○ DDS Data Cartridge : DDS2 4/8GB 120m - 30 , DDS3 12/ 24GB 125m - 30</li> </ul>

( )

- : WINDOW NT SERVER 4.0
- : Visual C++
- : TCP/IP

( )

- :
- : 1200 DPI
- : 16 PPM/A4
- : 12 MB
- : (100 ) (250 )
- : A3
- : KSSM, KS, PCL5e, HPGL2 S/W
- : , ,
- , ZOOM , TCP/IP
- (10/ 100MBPS Auto Sensor LAN Card )
- : AC 220V/ 60 Hz

. 가

(1) TV 가

(가) 3

3 (ray tracing)

○

○ 3

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( )

3 (ray tracing)

○

3 DRT

(deterministic ray tube)

○ 3

○

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○

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3 ,

가

○

○

○ RMS

○ BER(bit error rate)

(2) 가

(가)

3 (ray tracing)

- 3 DRT
- 
- 가
- 
- .

( )

가

- 
- 
- BER(bit error rate)
- (coherence bandwidth)

(3) GUI 가

- 가 가
- , GUI
- , ,
- 
- 3 dB
- 3 (3 )
- DXF
-

○

- 
- , ,
- 
- 

○

- , RMS , BER
- 
- 
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. 가

(1)

	<ul style="list-style-type: none"><li>-</li><li>-</li></ul>	<ul style="list-style-type: none"><li>- EM theory<ul style="list-style-type: none"><li>• 가</li></ul></li><li>-</li></ul>
	(> 100m)	(< 10m)
	(macrocell)	(microcell, picocell)
	Okumura-Hata model, Walfisch-Ikegami model, etc.	Ray tracing model, TLM model, etc.



## (2) Ray Tracing( )

(가)

○ 가  
가 . 가 가  
가 ,

○ 가  
(ray tracing)

○ , 3

가  
'large cell  
model'

'small cell model' 가  
,  
(ray tracing) , UTD

( ) large cell

○ ( 1) 3

가 가

○ Large cell

가

가 (plane

wave)

가

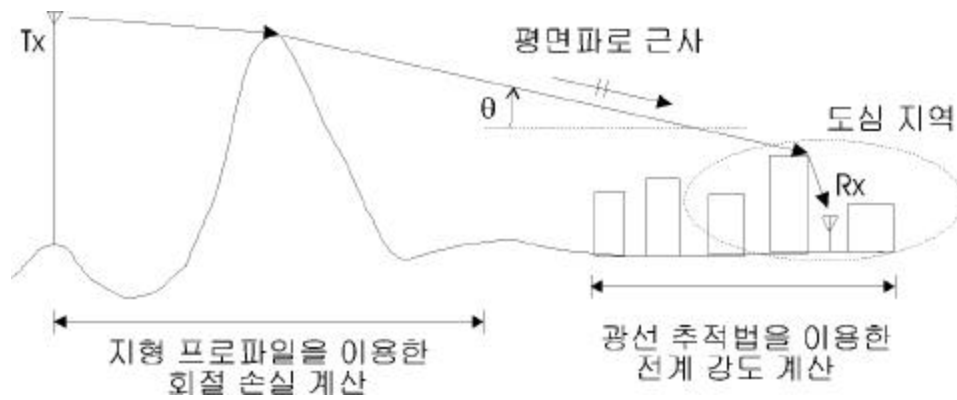
○

,

가

UHF

VHF



1.

가

○

가

가

UTD

( ) DRT (Deterministic Ray Tube)

- (ray launching)  
(electric image) 가 가 ,

가 DRT  
(Deterministic Ray Tube) .

- DRT (Deterministic Ray Tube)

- 가
- 3

- (reception test) 가  
가

- DRT 3 .  
3 가

· , TV

가

DRT .

3 .

- 3

(pixel)

· ( 2)

·

(patch)

3 . , ,  
·

○ 3

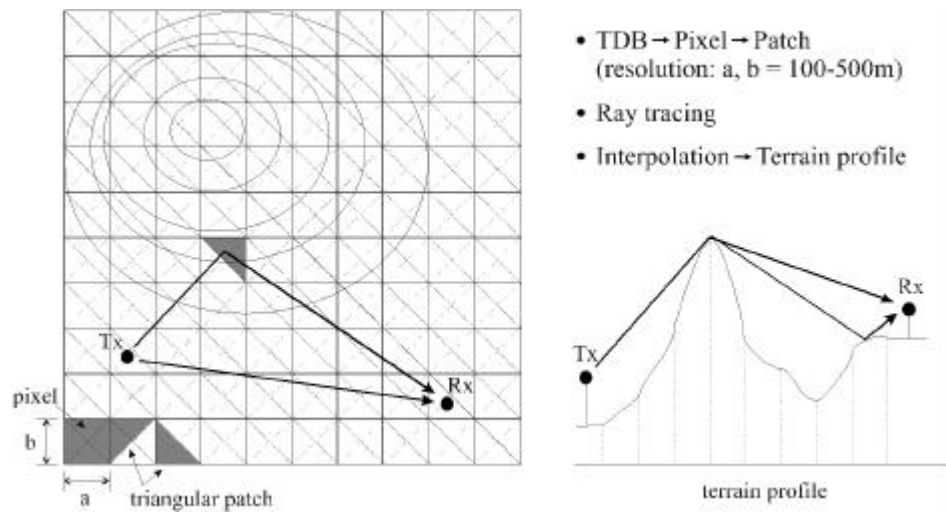
가

( 3)

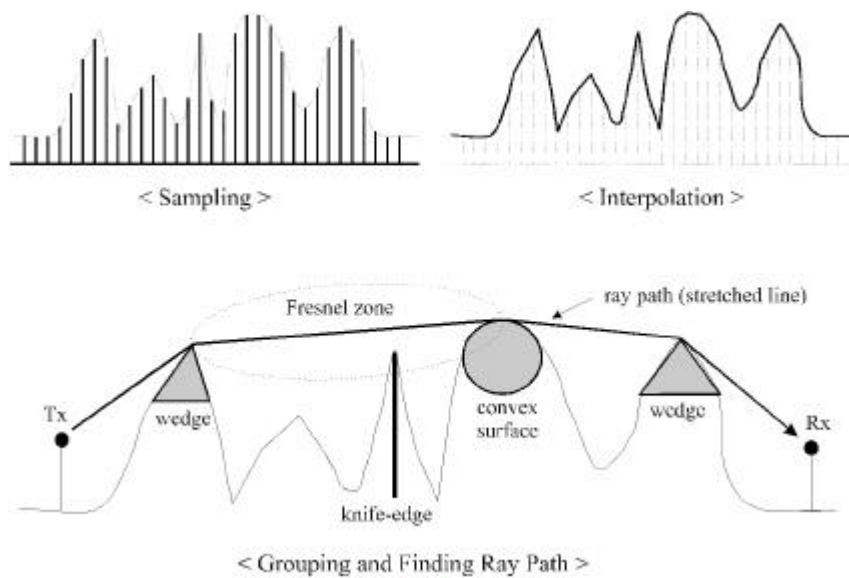
가

3

가



2. 3



3.

3

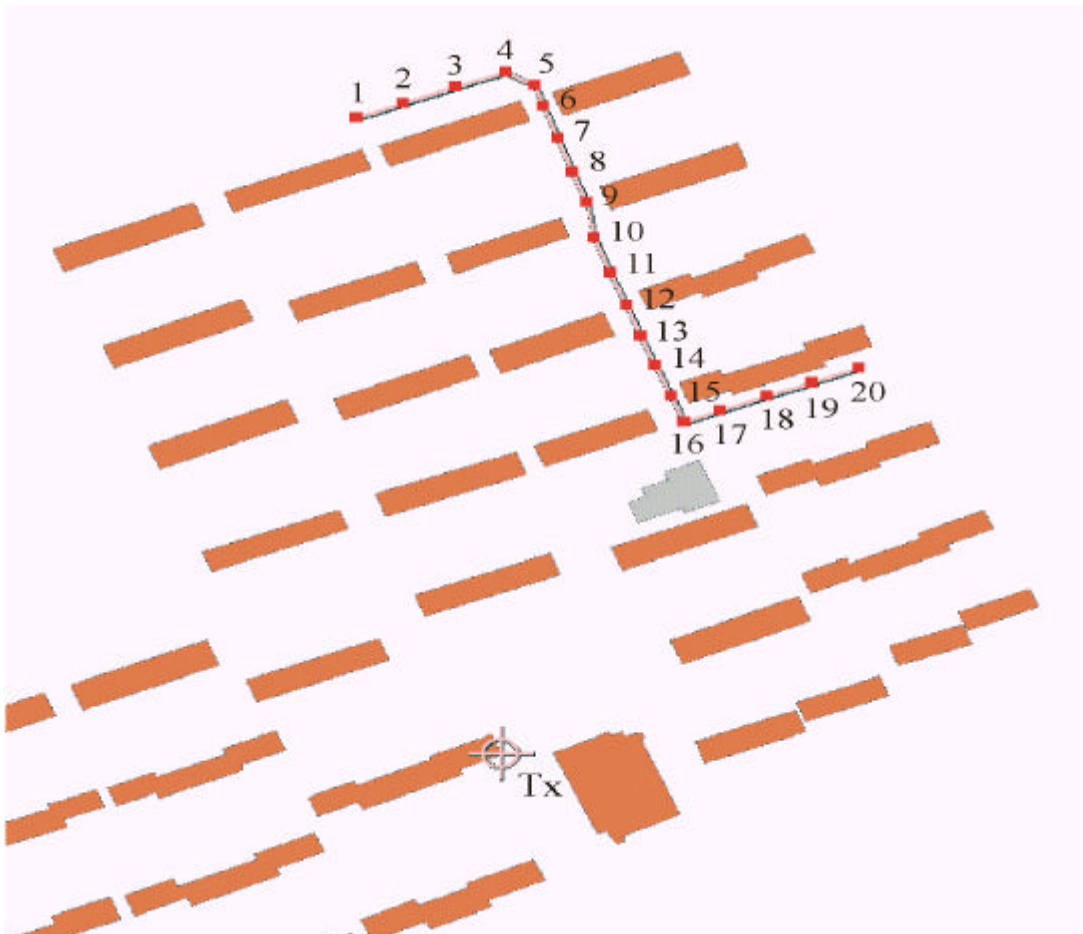
가

가

1.

- : 500MHz, 1GHz, 2GHz
- :
- 가 가 20
- 3m 4

2.



4.

3.

가. (transmitter)

○ (signal generator) 500MHz, 1GHz 2GHz

○ DC

○ (pole) dipole

. (receiver)

○ (dipole antenna), ,

, (spectrum analyzer),

(cart)

○ HP83006A

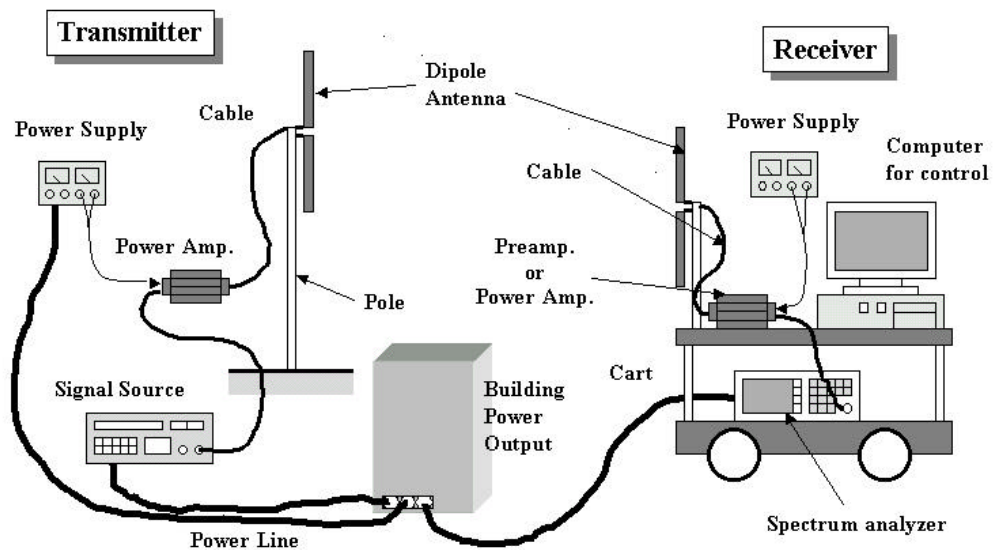
○

○ - 110dBm 가

○ (HP - IB)

○

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	( )		
			500MHz, 1GHz, 2GHz
		46dBm output	
	(ED 200E)	0 15Volts × 2	DC
		4m	
		1.5dB Gain	
		4m	(PVC)
		50m	
		1.5dB Gain	
		1m	( )
		1m × 2	
	(HP83006A)	20dB Gain 20dBm Output	
	(ED 200E)	0 15Volts × 2	DC
	(HP8562A)	9kHz 22GHz - 90dB Noise Level	
	(Pentium)	HP - IB	
		100m	

. Calibration

○

Frequency	500MHz	1GHz	2GHz
Power amplifier output power	46.3 dBm	46.1dBm	44.0dBm
Cable loss (power amp. antenna)	2.89dB	4.36dB	6.34dB

○

Frequency		500MHz	1GHz	2GHz
LNA gain		28.6 dB	28.6dB	28.6dB
Cable loss	Antenna LNA	0.35dB	0.53dB	1.08dB
	LNA spectrum analyzer	0.34dB	0.55dB	0.71dB

○ Calibration

- Chamber

signal generator, power amplifier, attenuator, antenna

. attenuator chamber

.

- cart antenna,  
amp, spectrum analyzer, PC (500MHz, 1  
GHz, 2GHz) 5m .

○

-

.



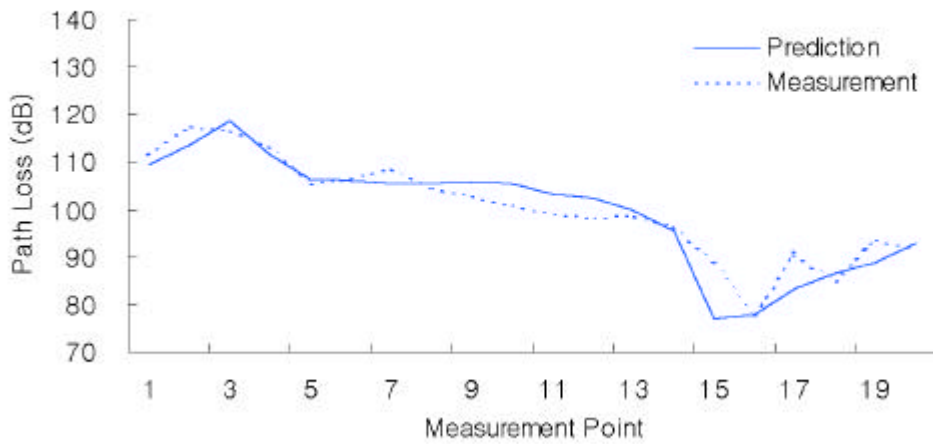


	1 GHz				1 GHz		
	[dB]	[dB]	[dB]		[dB]	[dB]	[dB]
1	118.5 ± 2.2	117.1 ± 4.5	1.4	11	112.5 ± 1.0	106.6 ± 4.1	5.9
2	121.2 ± 1.8	120.3 ± 3.7	0.9	12	111.4 ± 1.2	101.3 ± 2.1	10.1
3	128.8 ± 0.3	123.1 ± 8.0	5.7	13	108.9 ± 1.0	98.8 ± 2.2	10.1
4	121.2 ± 4.2	121.7 ± 4.1	- 0.5	14	104.4 ± 4.0	99.8 ± 4.9	4.6
5	115.6 ± 1.9	110.8 ± 4.9	4.8	15	83.6 ± 5.9	95.4 ± 8.5	- 11.8
6	115.2 ± 0.4	107.7 ± 2.8	7.5	16	84.6 ± 1.8	84.5 ± 2.9	0.1
7	114.4 ± 0.4	114.6 ± 8.5	- 0.2	17	90.4 ± 3.4	93.0 ± 4.4	- 2.6
8	114.1 ± 0.9	109.6 ± 1.8	4.5	18	93.0 ± 1.8	88.4 ± 3.5	4.6
9	114.9 ± 0.6	108.5 ± 4.4	6.4	19	96.0 ± 2.0	98.1 ± 3.8	- 2.1
10	114.5 ± 0.7	108.3 ± 8.5	6.2	20	101.6 ± 1.0	100.0 ± 4.0	1.6
[dB] : 2.9 ± 5.1							
RMS : 5.7							

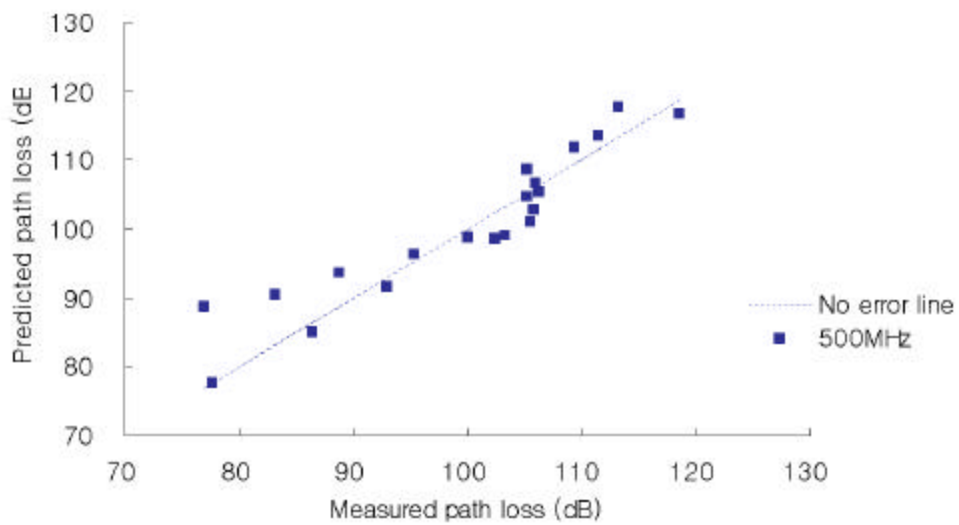
	2 GHz				2 GHz		
	[dB]	[dB]	[dB]		[dB]	[dB]	[dB]
1	127.7 ± 2.8	121.9 ± 2.9	5.8	11	121.4 ± 1.1	111.2 ± 3.7	10.2
2	129.2 ± 1.5	135.2 ± 7.4	- 6.0	12	120.3 ± 1.1	113.9 ± 5.7	6.4
3	139.2 ± 0.5	129.0 ± 1.7	10.2	13	117.8 ± 0.8	106.0 ± 2.3	11.8
4	130.9 ± 4.9	128.6 ± 4.6	2.3	14	113.9 ± 4.6	102.6 ± 3.7	11.3
5	124.5 ± 2.1	121.7 ± 3.0	2.8	15	90.3 ± 6.7	91.7 ± 6.7	- 1.4
6	124.3 ± 0.6	122.1 ± 4.6	2.2	16	91.5 ± 2.1	88.8 ± 2.9	2.7
7	123.4 ± 0.4	114.5 ± 1.7	8.9	17	97.6 ± 4.0	104.2 ± 5.1	- 6.6
8	123.1 ± 1.0	114.2 ± 2.4	8.9	18	98.8 ± 1.9	101.8 ± 5.4	- 3.0
9	123.6 ± 0.6	116.1 ± 2.1	7.5	19	103.1 ± 3.0	100.7 ± 2.1	2.4
10	123.3 ± 0.6	112.3 ± 1.9	11.0	20	110.3 ± 1.2	108.7 ± 7.0	1.6
[dB] : 4.5 ± 5.7							
RMS : 7.1							

(1) 500MHz

○

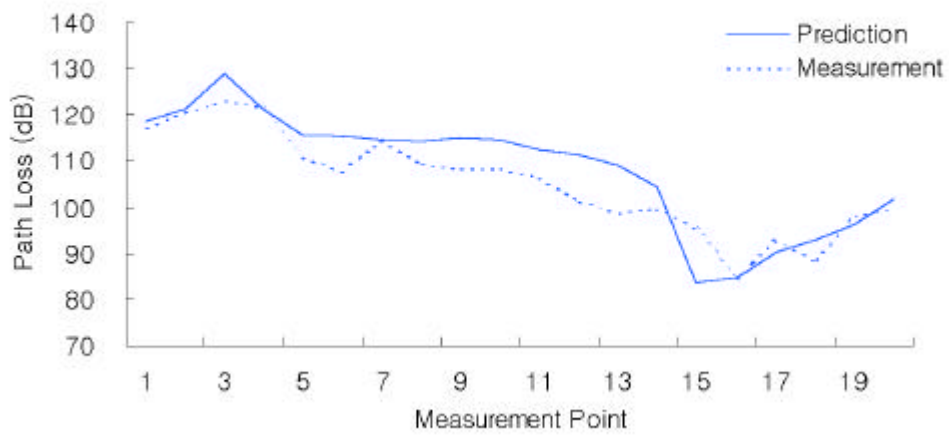


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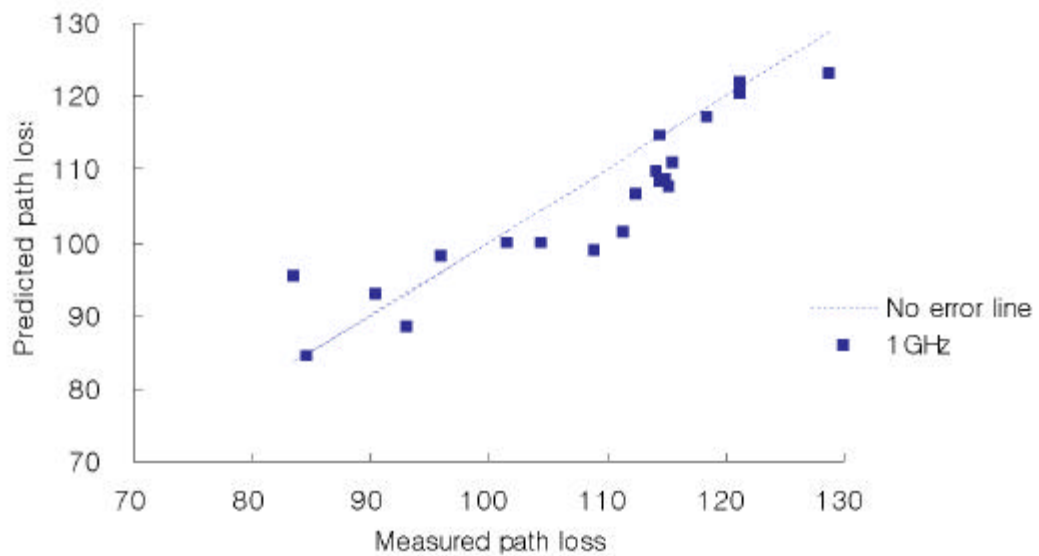


(2) 1000MHz

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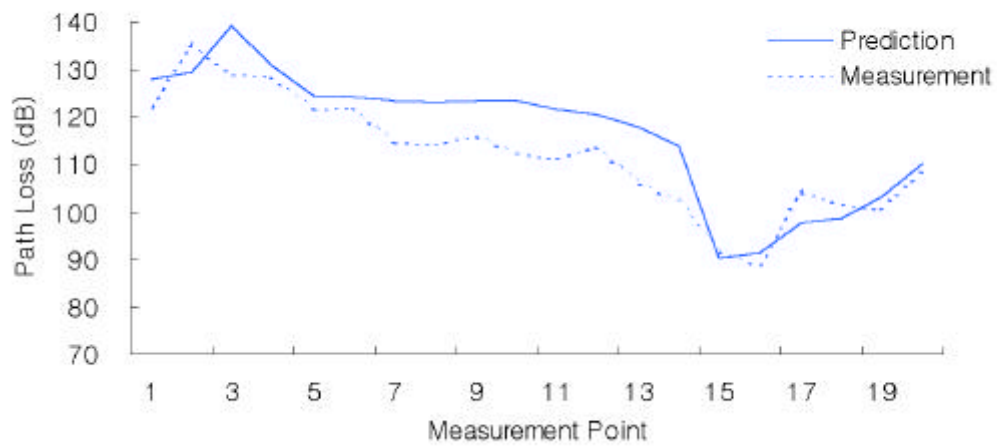


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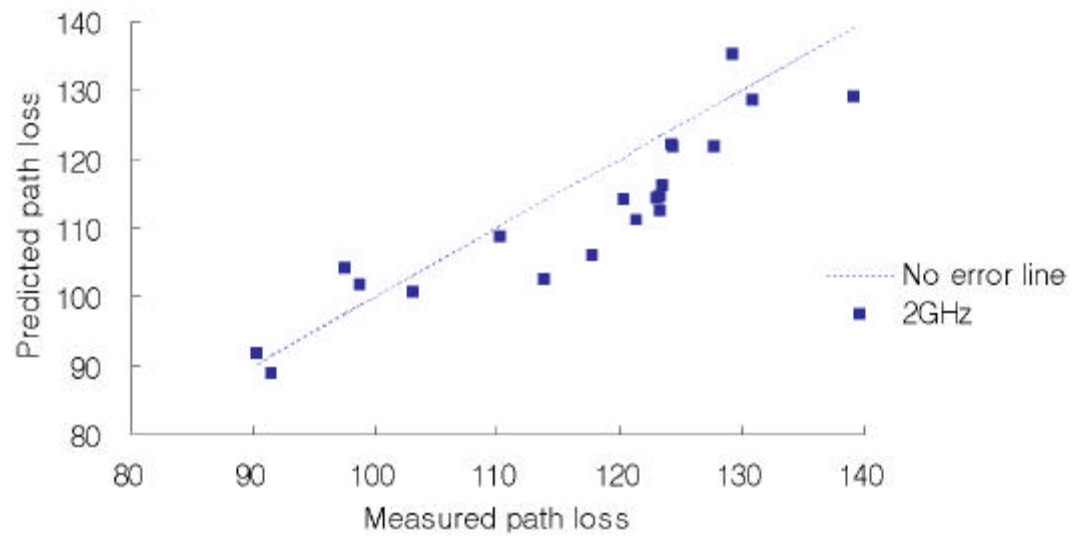


(3) 2000MHz

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(4)

- RMS 가 10dB  
가 .
- 가 11  
15 가  
가 .
- 500MHz 2GHz  
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300

3 5dB가

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20dB가

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VHF

UHF

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10dB

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2 3dB

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