

가 .

2000. 12.

「 가 .
」 .

2000. 12. 31.

:
:
:
:

가 .

1. : 가 .
2. : 2000. 1 2000. 12
3. :
4. 가.

		1	2	3	4	5	6	7	8	9	10	11	12	
가.														
o . ,														
- EMC														
-														
o														
- ,가 ,														
,														
o														
- ,														
- ,														
,														
o														
- ,														
,														
-														
(%)		20			50				80			100		

가 .

[illegible]

가 .

.

1)

o :

o :

o :

2)

o ,

3) EMC .

o ,

4) 2000 Japan EMC Symposium 가

o : 4. 18 4. 22 (5)

o : ()

5) .

o

6) .

o . . .

7)

8)

o

9)

o

o

가 .

5.

. 4 42
3 10 (23.8%)
가 B 2 , C 8 .
. 6 61 (, PCS)
, 146MHz
30 (49.2%) 60cm, 220MHz 36
(59.0%) 70cm , 440MHz
6 (9.8%) 40cm
가
.

6.

o

o

o .

7.

1) EMS

2) : 가 4 27

3) : 5 10

4)

- : 3 3

- PCS : 3 7

5) : 4 9 (1)

Summary

In these days, cellular phone and portable radio equipments could be used widely according to the rapid development of technology on electronic and communication. On the other hand, the electronic energy from them is radiated to the air and electrical power line and it makes the other I.T.E mis-operate. It is one of the current social issues.

This study was carried out to find out the effect of EMI and to submit the resolving method to strengthen EMS in anechoic chamber and in actual usage of them. The EUTs were electronic wattmeter, the guidance equipment for the blind, automatic fire-extinguisher and gas leakage detector. The tests for them were EMS test and influence test by the transmitted radio wave from portable radio equipment.

EMS test was carried out according to International standard(CISPR) and domestic regulation and influence test was carried out using cellular phone(CDMA), PCS phone and portable radio transmitter and radio equipment for HAM which are used widely.

The result said that EUTs were mis-operated by EMI and it is caused by frequency, electro magnetic wave strength and distance. The small and medium sized company could make good quality product and could increase exporting their product using the detail result of this study.

가 .

1	.....	9
2	.....	11
1	.....	11
2	.....	12
3	.....	19
3	.....	28
1	.....	28
2	.....	31
3	.....	33
4	.....	35
1	.....	35
2	.....	36
3	.....	38
4	.....	42
5	.....	45
6	.....	46
	.....	47

가 .

2- 1.	.....	11
2- 2.	.....	12
2- 3.	.....	13
2- 4.	.....	19
2- 5.	가 27	27
3- 1.	.....	28
3- 2.	10V/m 1kHz 80% AM	29
3- 3.	.....	31
4- 1.	.....	38
4- 2.	.....	38
4- 3.	.....	40
4- 4.	.....	40
4- 5.	.....	45

가 .

2- 1.	.....	13
2- 2. EMC	.....	15
2- 3.	.....	16
2- 4.	.....	17
2- 5.	.....	17
2- 6.	.....	22
2- 7.	.....	22
2- 8. 220MHz	.....	24
2- 9. 440MHz	.....	24
2- 10.	.....	25
3- 1.	...	30
3- 2.	.....	33
3- 3.	.....	34
4- 1.	.....	35
4- 2.	.....	36
4- 3.	.....	39
4- 4.	.....	39
4- 5.	.....	40
4- 6.	.....	41
4- 7.	가	43

가 .

1

가 가

가

. 가 1997 3 PCS

가 가 2600

. 가 가

가 가 .

, ,

가

.

가

.

가

가

가

가

가

.

EMC

가 .

1977

. .

120

,

,

. [1]

EU

CE

CE

EU

가 .

EU

.

EU

\$50,000,

\$ 10,000,

\$20,000,

\$5,000,

\$4,000,

\$2,500

가

,

£1,000,000(20)

[2]

,

(DCT),

(PCS)

가

/

(146MHz , 220MHz , 440MHz :

.)

.

2

, 3

가 .

2 .

. 2가
. (EMC)

, PCS ,

1

4 , 2 ,
10 , 가 41 , 2 , 2 6
61 2- 1

2- 1.

	()	
	4	
	2	
	10	가
가	41	가
	2	2.45GHz
	2	
	61	

1.
가.

1997-42 ()

2-2 .

2-2.

				가
			80 1000MHz 10V/m()	A

) : 가

.

가 가

가

2-3.

	Biconical Ant.	Horn Ant.
	162	191
	10V/m 1kHz 80% AM	
	30 200MHz	200 1000MHz
	1m	
	1% 가	
	(A)	

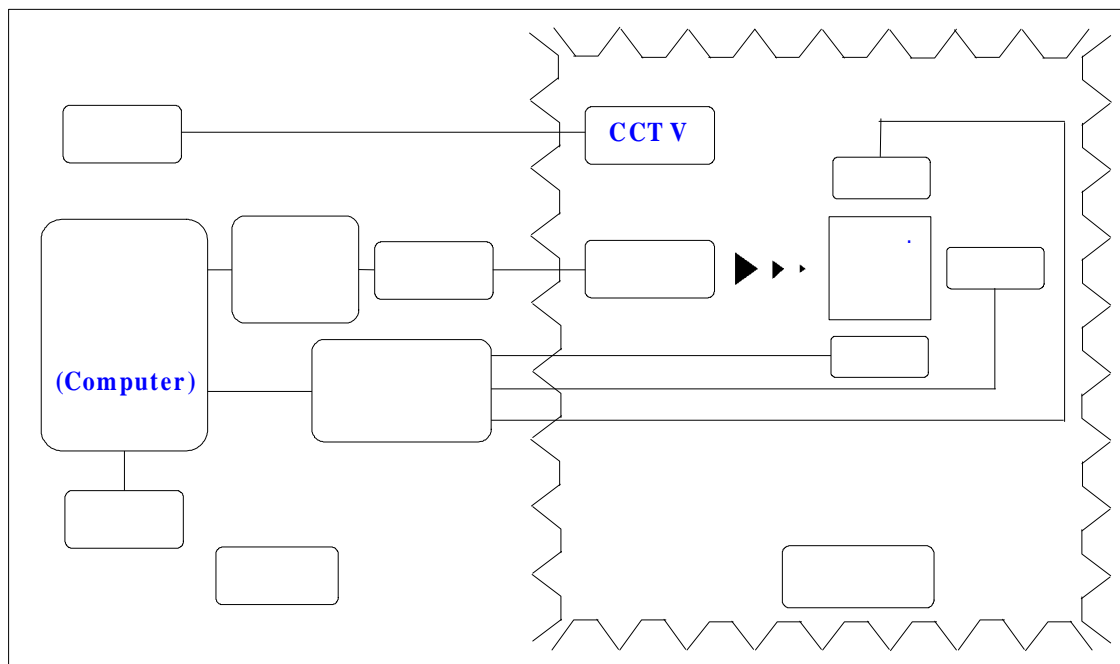
A :

B :

C :

2.

2- 1



2- 1.

· (EUT) 가 ·

Field

	(Biconical Ant.)	(Double Rigid
Horn Ant)가		· 20MHz
200MHz	(20 300MHz M9600)	20
0 1000MHz	(200 2000MHz M96002)	·

,

kHz 1000MHz 가 (FP2000) 10
(EUT)

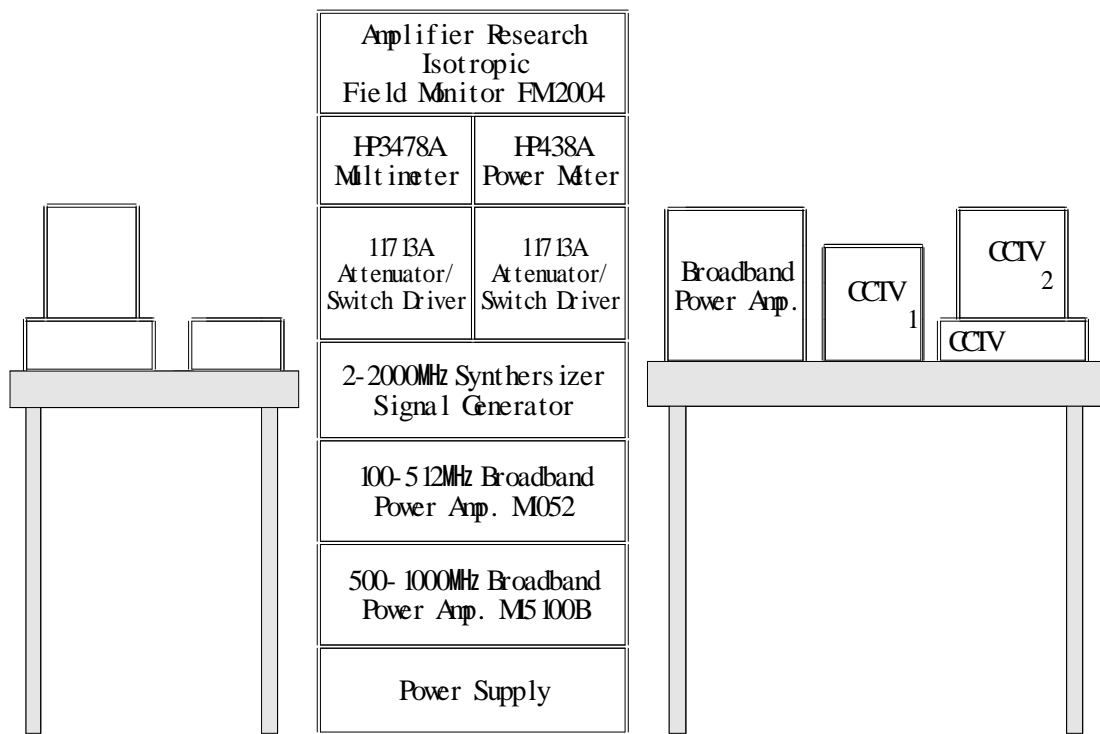
1m · Biconical
, Rigid Guide Horn

0.8m

·

0.1m · 2가

가 ·



2-2. EMC

2 2000MHz 1kHz 80% (AM)
 RF . 1.5×10^{-3} decade/s
 RF 30 200MHz
 162 , 200 1000MHz 191

()

가 3V/m, 10V/m

15dB

3.

가.

-

6

-

-

15dB

2-3

가

16

1

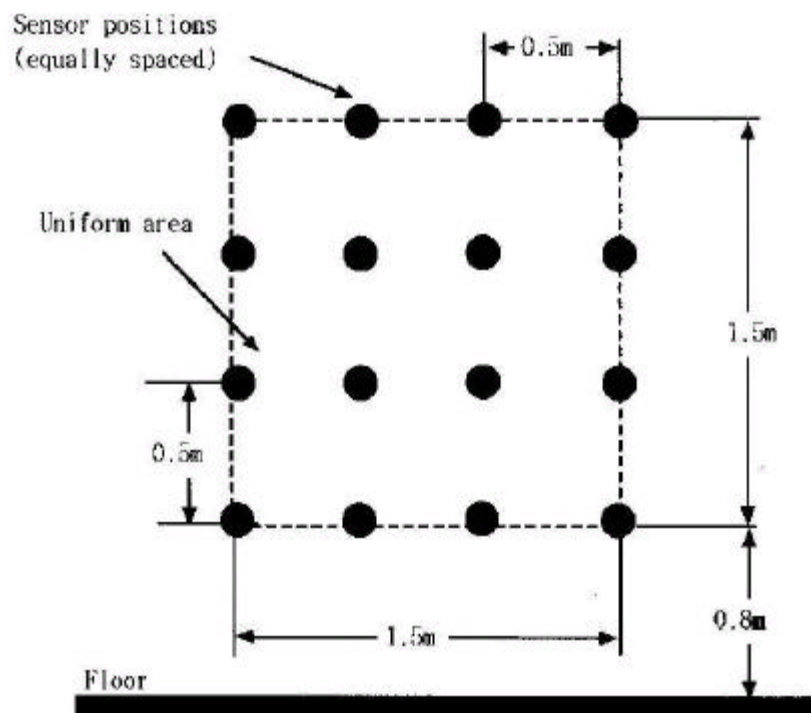
16

가 6dB

14

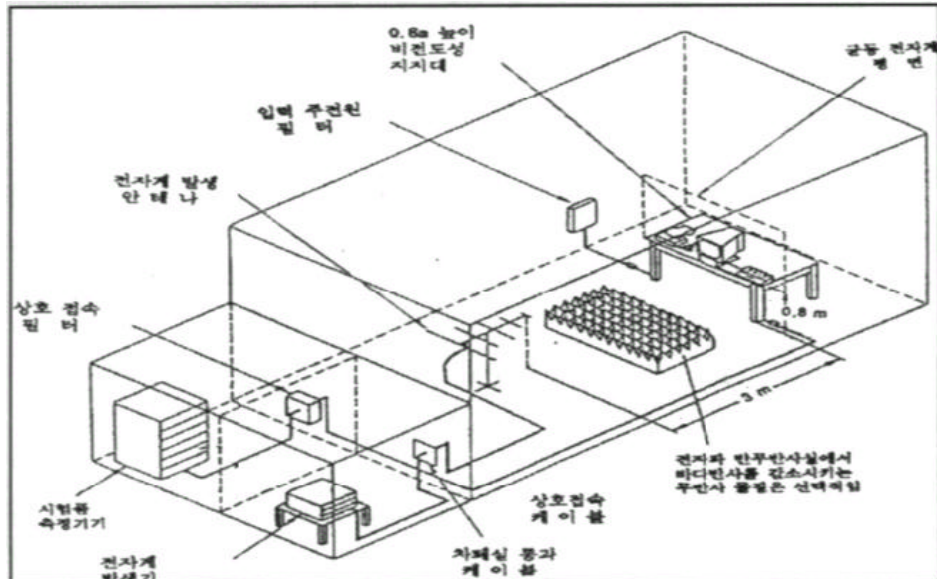
(75%)

.



2-3.

●



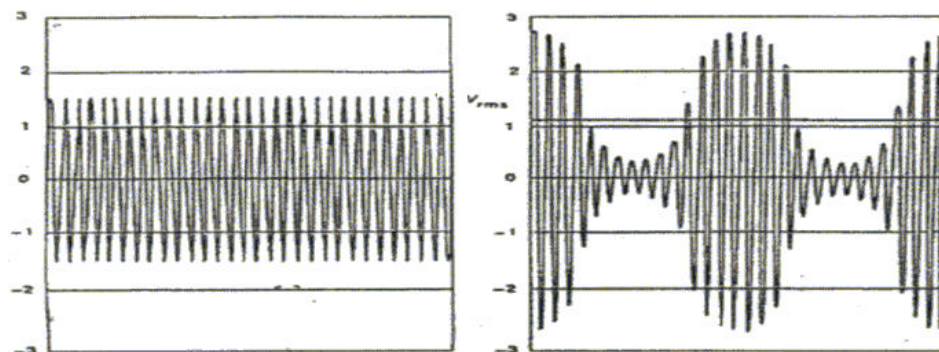
2-4.

80cm

10cm

가

(2-6)



가. 무변조 RF 신호
 $V_{p-p} = 2.8V$, $V_{rms} = 1V$

니, 변조된 RF 신호 80% 변조
 $V_{p-p} = 5.1V$, $V_{rms} = 1.12V$

2-5.

•

(1) 0.8m EUT Table

•

(2) 20 300MHz Biconical Antenna(M9600) 20
0 2000MHz Double Regid Guide Horn Antenna(M96002)

•

(3) Biconical
, Regid Guide
1m Biconical
, Regid Guide

•

(4) Electric Field Measurement Probe(FP2000) EUT Table

•

(5) Probe DC

•

(6) EMS Test System

10

•

(7)

,

(8) EMS Test System 30 1000MHz 10V/m AM 1kHz
80% ,

•

(9)

•

3

.

.

1.

가.

2-4

4 , (PCS) 6 , 9

19

.

.

.

2-4.

			()
	1751.25 1868.75MHz	QPSK OQPSK	0.16W (0.2W , ± 50%)
	824.04 893.97MHz	QPSK OQPSK	0.3W (0.3W , ± 50%)
	146 160MHz	FM	3W 5W (5W ,+20% - 50%)
	222 223MHz	FM	2W 4.8W (5W ,+20% - 50%)
	430 470MHz	FM	3W 4W (5W ,+20% - 50%)
	144 146MHz	FM	4.8W (5W ,+20% - 50%)

•

가 5cm, 10cm,

20cm, 30cm, 40cm, 50cm, 80cm, 100cm, 200cm, 300cm

, .

- : EMI
- : HP (8566B)
- : Peak
-
- 220MHz, 440MHz
- PCS Double Ridged waveguide horn Ant.
- 80cm
-

(Ant. Factor)

..

•

(1)

(monopole ant.)

(whip ant.) , , 3/8 , 1/4
가 .

가

가 $k=7.0$

가

E[V/m] (1) .

$$E = (k \times \sqrt{P}) / d = (7 \times \sqrt{P}) / d \tag{1}$$

,
 E (rms)(V/m)
 P (ERP:effective radiated power)
 k , 7
 d (m)

가

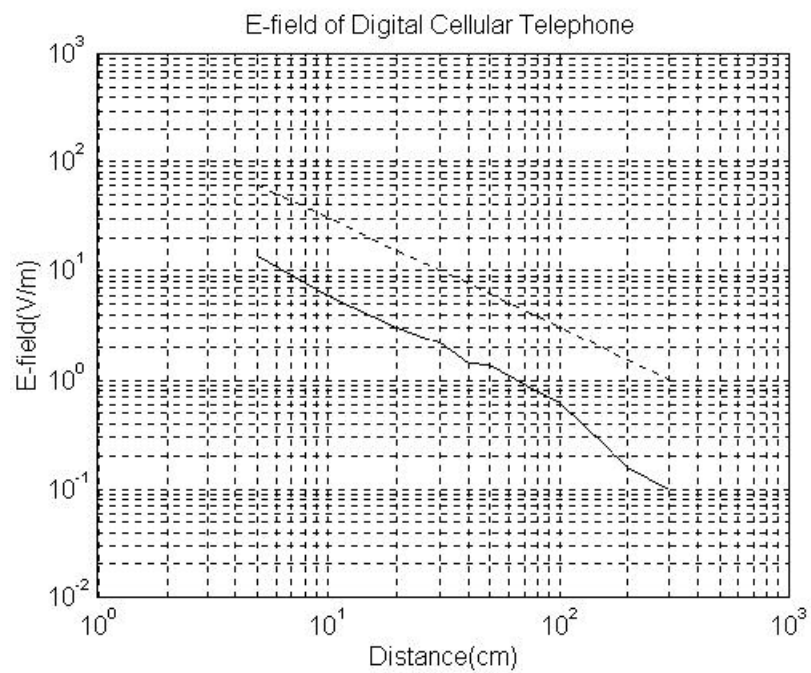
가
 - 2dB

2- 6 2- 7
 PCS (1)
 - 2dB

가 1 36cm, PCS
 17cm 1

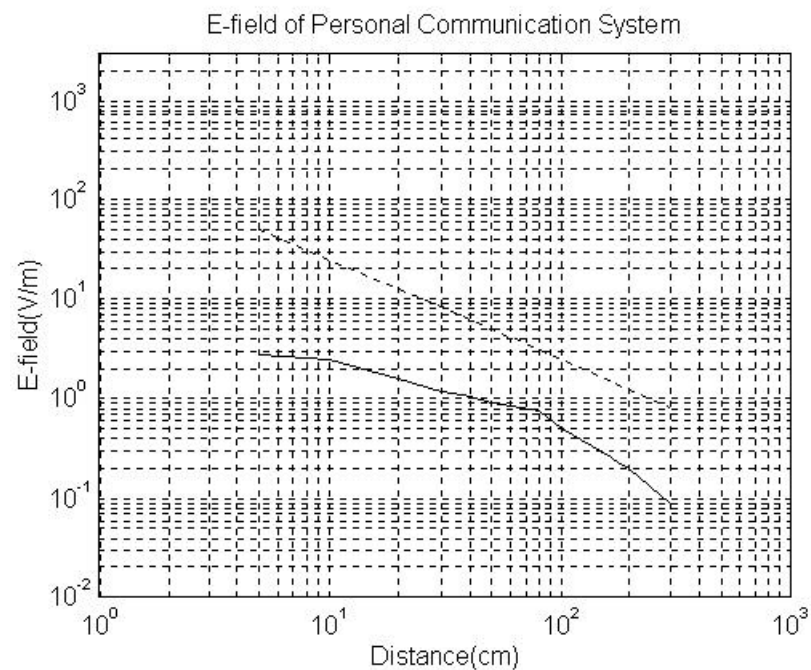
2- 6 2- 7 PCS

PCS 5cm
 13.57V/m, 2.75V/m , 300cm
 0.1V/m, 0.19V/m



2-6.

(5cm 13.57V/m)



2-7. (PCS)

(5cm 2.75V/m)

(2)

가

	ERA		EDF
	VHF	UHF	
6	0.5W	12W	
	가 k=0.45	k=3.35	,
	가 1/4	가 k=3.0	
	E[V/m]	(2)	

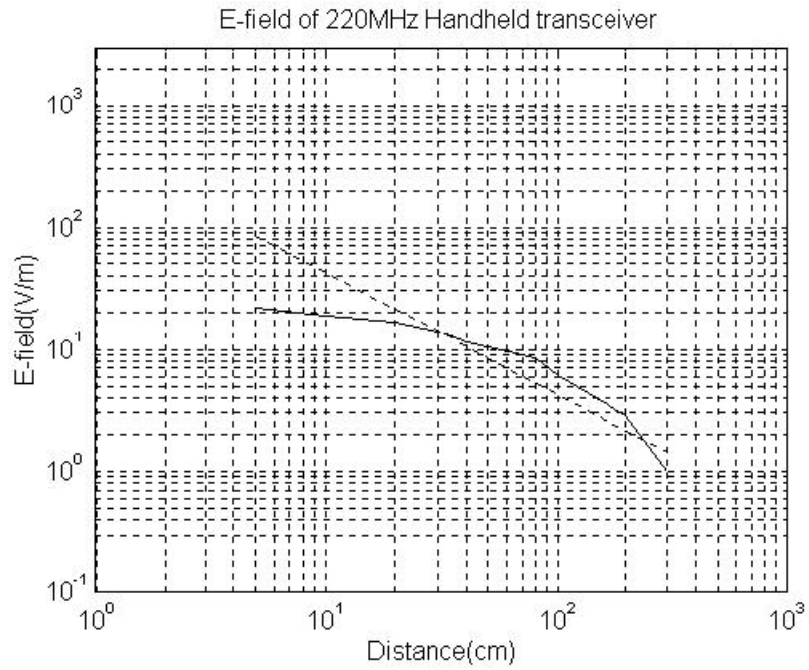
$$E = (k \times \sqrt{P}) / d = (3 \times \sqrt{P}) / d \quad (2)$$

,
E (rms)(V/m)
P (ERP:effective radiated power)
k , 3
d (m)

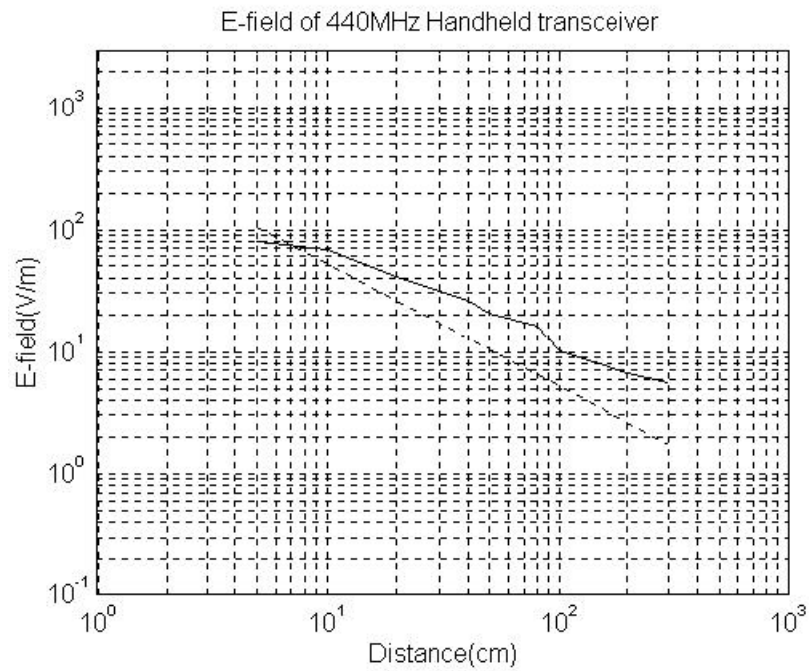
2- 8 2- 9 220MHz, 440MHz
(2)

가 1/2 220MHz 22cm, 440MHz
11cm

rms (root - mean - square :)
(Peak)
220MHz 440MHz 5
cm 21.64V/m, 79.43V/m ,
300cm 1.01V/m, 5.50V/m .



2- 8. 220MHz
 (5cm 21.64V/m)

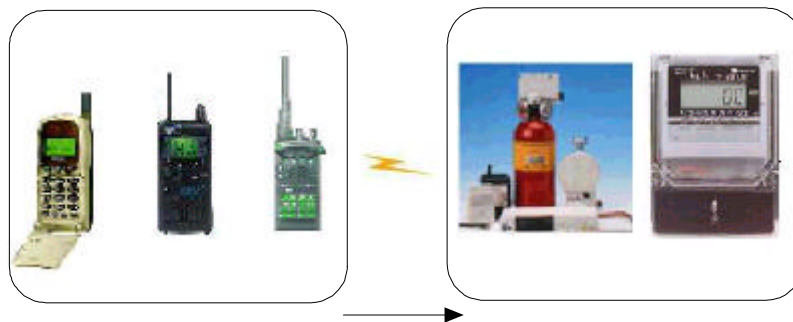


2- 9. 440MHz
 (5cm 79.43V/m)

2.

,
.
0.3W 800MHz, 0.2W 1.7GHz PCS, 5W 146MHz
, 2W 220MHz 3W 440MHz, 5W 146MHz
MHz 6 19

2- 10



2- 10.

2

4, hook on, hook off,

PCS, CDMA Mobile/Cellular Radio
Test Set Loop 가
가
, Power on/off, on/ off, ringing, dialing loop (),

가
가
,
(, ,)
.

(1) ,
0.8m(0.1m) EUT
T able .

(2) Field Probe(FP2000) 3 EUT T able .

(3) .
.
.

146MHz
222MHz
444MHz
146MHz

(PCS)

(4) 가
.

(5) 가
.

3.

가

가 가

.

가

2-5

,

.

"A "

.

가

.

2-5.

.

가

A	
B	
C	
D	

3 .

1

, 가 , ,

· , 1999
 , ,
가 , , 6 61
가
4 42
1997- 42 30
MHz 1000MHz 10V/m 1kHz 80% AM
4 42 3 10 (23.8%)
가 B
2 , C 8 3- 1 .

3- 1.

		: 10V/m 1kHz 80% AM : 30MHz 1000MHz				
						가
		42	3	2	7	30
		32 (76.2%)	-	2(100%)	5(71.4%)	25(83.3%)
		10 (23.8%)	3(100%)	-	2(28.6%)	5(16.7%)
	가	C :3		-	A :5 B :2	A :25 C : 5

3-2 가

가 120

390MHz 가

가

가

가 146/222MHz

3-2. 10V/m 1kHz 80% AM

	(MHz)	
(1)	122 - 124	가
(2)	122 - 176 206 - 270 330 - 406 671 - 740	가
(3)	242 - 255 387	가
(1)	122 - 176	
(2)	210 - 230	
가 (1)	122 - 220	가
가 (2)	194 - 197 200 - 259	가
가 (3)	230 - 331	가
가 (4)	253 - 290	가
가 (5)	223 - 250	가

MHz (2) 1 122MHz 390
 . 가
 가
 . 가
 . 가
 3- 1 .
 (A) (B)
 (C)
 . (C)
 가 ,
 .

3- 1.

A :

B :

C : 가

2

, , 가 , , 6 61 800MHz 4 , 1700MHz PCS 6 146/ 222/ 444MHz 9

146MHz

가 60cm, 222MHz

가 70cm, 440

MHz

40cm

3-3 .

3-3.

	(MHz)	800/ 1700	146	220	440
	(W)	0.16/0.3	3 5	3 4.8	3 4
	()	10	4	3	2
()		61	61	61	61
	()		31 (50.8%)	25 (41.0%)	55 (90.2%)
	()	.	30 (49.2%)	36 (59.0%)	6 (9.8%)
	(cm)	.	60cm	70cm	40cm

가 3-3 TDMA FDMA

CDMA ,

0.6W 0.8W

0.3W \pm 50% PCS 0.2W \pm 50% ,

가

1

3-3 6 61

146MHz 30 (49.2%)

60cm, 220MHz 36 (59.0%) 70cm

, 440MHz 6 (9.8%)

40cm 가

.

3

1.

3-3

3-2

3-2

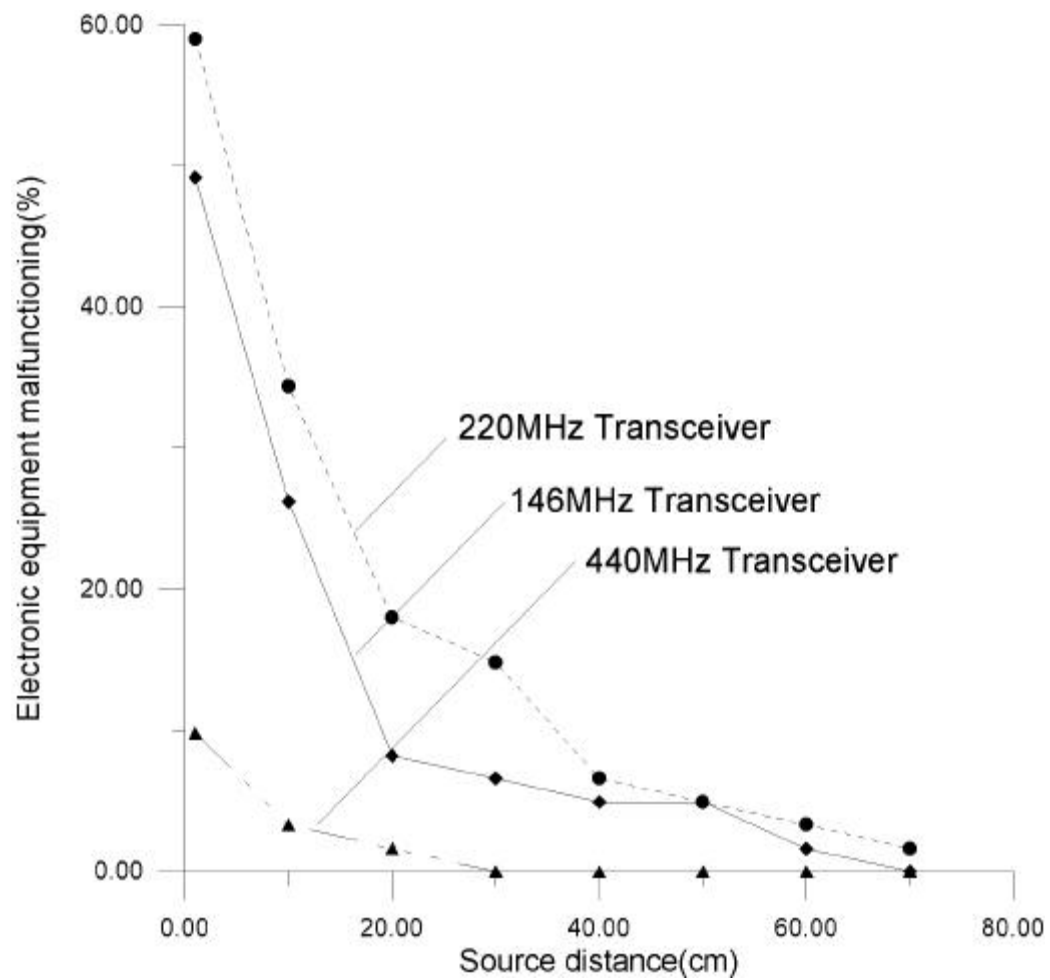
가

222MHz

60%, 146MHz

50%, 440MHz

10%



3-2.

3-3.

4

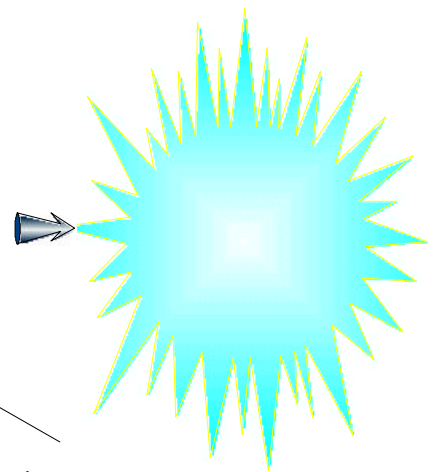
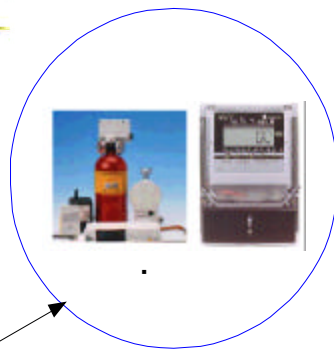
1

4- 1 ,

가

가

가



Immunity가

: 10V/m

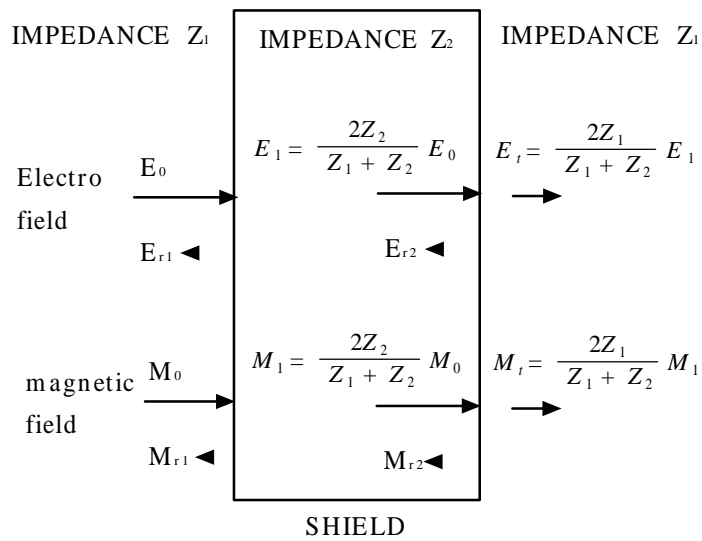
4- 1.

2 (shield)

(CRT)

(Transformer)

4-2



4-2.

4-2

(4)

$$S = 20 \log_{10} \frac{E_0}{E_t} = A + R + B \text{ [dB]} \quad (4)$$

E_0 :

E_t :

A :

R :

B :

, (4) (A), (R),
(B) (5), (6), (7) .

$$A = 20 \frac{t}{\log_{10} e} = 8.69 \frac{t}{\log_{10} e} \text{ [dB]} \quad (5)$$

, t : 가
9dB가 .

$$R = 20 \log \frac{|Z|}{4|Z_s|} \text{ [dB]} \quad (|Z_s| = |Z|) \quad (6)$$

(Far-field) (Plane wave)
(Z) E/H = 377 , (Near-field)

$(|Z|_e) \quad 1/(2\pi f \epsilon r) > 377$,
 $(|Z|_m) \text{가} \quad (2\pi f \mu r) < 377$, (conductor)

$$Z_s = \sqrt{(j\omega\mu)/(\sigma + j\omega\epsilon)} = \sqrt{(\omega\mu)/(2\sigma)} (1+j)$$

.

$$B = 20 \log (1 - e^{-\frac{2t}{\tau}}) \text{ [dB]} \quad (7)$$

가 (A)가 9dB
(B) .

3 (Ground)

4- 1 , , , .

4- 1.

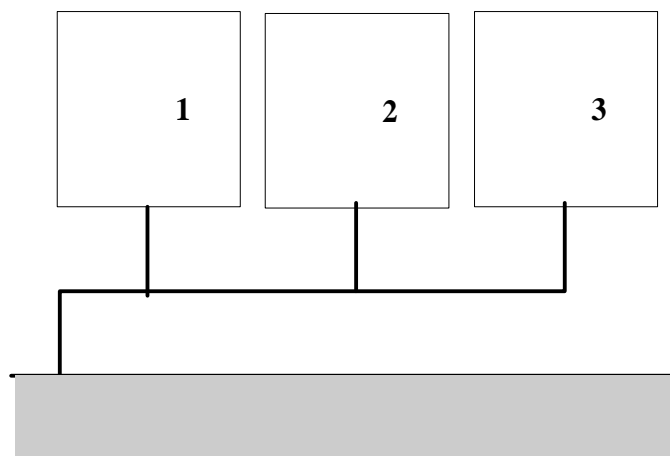
	<ul style="list-style-type: none">• (Earth potential)• (Chassis) (enclosure)• 가 (Green line)
	<ul style="list-style-type: none">•••

1.

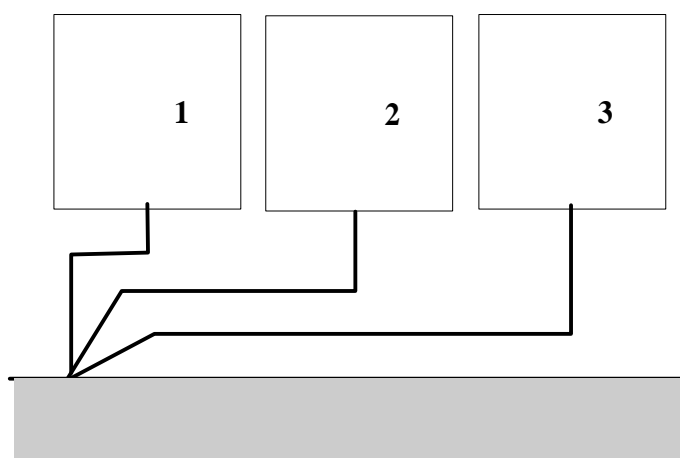
가 1MHz 1MHz
10MHz 가 1/ 12
4- 2

4- 2.

		<ul style="list-style-type: none">• 가• non - critical• 4- 3 1	4- 3
		<ul style="list-style-type: none">• 가	4- 4



4-3.



4-4.

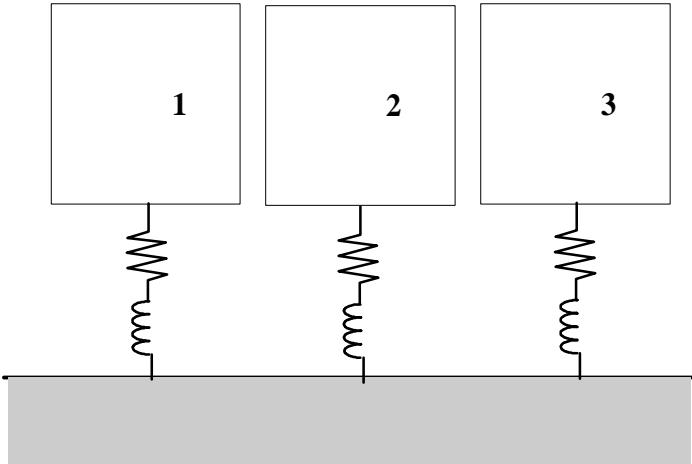
2.

가 1MHz 10MHz
가 1/20 10MHz
가 (Common Impedance plane)

4-3

4-3.

	<div><div></div><div></div></div>	4-5



4-5.

3.

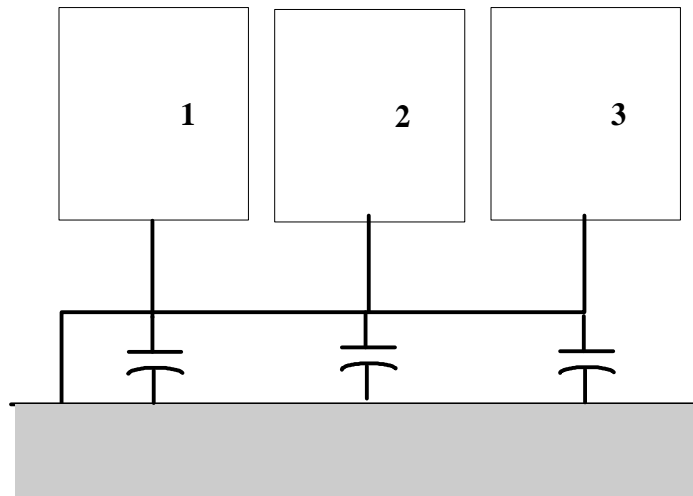
가

,

4-4

4-4.

	<div><div><div></div><div></div></div><div>:</div></div>	4-6



4-6.

4 (Filter)

,
, (Ferrite beads),
ZNR . 가 .

1.

가.

,
.
AC 60Hz
(Low pass filter) .
가 (Normal
mode)
.
가
(MP) .
MP
0.25mA 5mA Y-
4700pF .

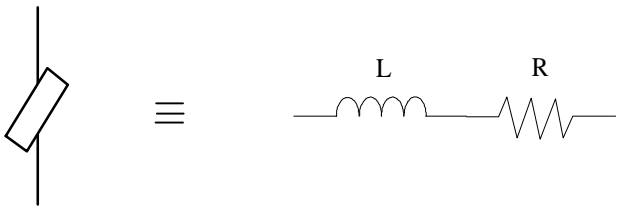
.

EMI ,

가 .
EMI 가
, 3
, 4-8
,
.

2. (Ferrite beads)

(Ferrite beads) ,
(Parasitic resonance)
(oscillation) ,
(short circuit) (attenuator) ,
(saturation)가 .
4-7 가



4-7. 가

4-7 가 (Z) (8)

$$Z = R + j\omega L \tag{8}$$

R ()
L (H) .

. R-C L-C .

3. ZNR

ZNR -
, 가 가 가 , ,
가 .

ZNR 가 가
-

.

5

가 , , 6 61 , LCD , PCB , 4-5 .

4- 5.

	60cm	· LCD	· · (50cm 5cm)
	30cm	· · RF	· · (20cm 5cm)
	10cm	·	·
가	70cm 가	· LCD	·

6

가

가

,

.

4 42

3 10 (23.8%)

가 B 2 , C 8

.

6 61 (, PCS)

, 146MHz 30 (49.2%)

60cm, 220MHz 36 (59.0%)

70cm , 440MHz 6

(9.8%)

40cm 가

.

5W

70cm

.

.

EMC

.

.

[1]地方電気通信管理局, "不要電波障害に 關する 苦情・常談等 申告現況", 郵政省, Apr., 1999.

[2] , , , , “
”, , pp1224- 1227, Aug., 29. 2000.

[3] , " EMC ", *EM C Korea 2000 EMI/EM C*
, , pp.233- 247, Sep., 2000.

[4] , , " 가 . “, 2000
, , Aug., 29, 2000

[5]IEC, "IEC 61000-4-3 1.1 “, IEC, Nov., 1998.

[6] , “ 1997- 42 ()” ,
June, 1997.

[7] , “EMC ”, ‘98 ,
, pp31- 52, Sep., 2000.

[8] , “EMC ”, ‘98 , ,
pp31- 52, Sep., 2000.