APPLICATION

FOR **CERTIFICATION** OF A

VHF-FM PAGING RECEIVER

UNDER CFR 47, PART 15.109

GRANTEE: SHINWA COMMUNICATIONS OF AMERICA

FCC ID: JCA-SH780A

February 24, 1999

Prepared By:

Spectrum Technology, Inc.
209 Dayton Street
Edmonds, WA 98020
425 771-4482

— CHAPTER 3
TECHNICAL THEORY

1. GENERAL

THE KOREA KDK SH-780 NUMERIC DISPLAY PAGER IS A DOUBLE SUPERHETERODYNE FM RECEIVER WHICH USES DIGITAL SIGNALING SYSTEM FOR CALLING.
IT IS POWERED BY A " AAA " TYPE 1.5V BATTERY.

2. BLOCK DIAGRAM DESCRITION

THE CHAPTER 5 RECEIVER BOARD BLOCK DIAGRAM GIVES THE FUNCTION BLOCK DIAGRAM OF THE RECEIVER BOARD AND CHAPTER 5 DIGITAL BOARD BLOCK DIAGRAM GIVES THE FUNCTIONAL BLOCK DIAGRAM OF DIGITAL BOARD.

3. CIRCUIT DESCRIPTION

* RECEIVER BOARD

ANT

THE PAGER USES A METAL LOOP ANTENNA BUILT IN THE PAGER.
THIS ANTENNA PICK UP THE DESIGNATED SIGNALS AND CONNECTS THEM TO THE RF AMP. TUNING WITH THE FREQUENCY IS DETERMINED BY THE ANT TUNING CAPACITOR (CT1) CAPACITY.

RF AMP

THE SIGNALS RECEIVED BY THE LOOP ANTENNA ARE INPUT TO THE AMPLIFICATION CIRCUIT FORMED BY TWO TRANSISTORS.
THIS AMPLIFIER IS A LOW NOISE HIGH GAIN AMPLIFIER.

BPF1

THE EXTRANEOUS SIGNALS SUCH AS IMAGE AND SPURIOUS SIGNALS IN THE SIGNALS AMPLIFIED BY THE RF AMP ARE ATTENUATED BY PROXIMATELY 60 dB BY LC FILTER WITH LOW INSERTION LOSS CHARACTERISTICS.
IN ADDITIONS, EXTRANEOUS RADIATION FROM THE UNIT IS SUPPRESSED.

LOCAL OSC 1

IN THE LOCAL OSCILLATOR CIRCUIT A 3RD OVERTONE CRYSTAL IS OSCILLATED BY A COLPITTS CIRCUIT, AND THE TARGET FREQUENCY IS FILTERED BY BAND PASS FILTER.
THE CALCULATION METHOD IS AS FOLLOWS.

FL = FR - 21.4 [MHz]
WHERE FL : LOCAL FREQUENCY
FR : RECEIVING CARRIER FREQUENCY

MIXER 1

THE RF SIGNAL (RECEIVED SIGNALS) WHICH HAS PASSED THROUGH THE BPF 1 AND THE LOCAL OSCILLATOR SIGNAL ARE INPUT TO THE MIXER CIRCUIT AND CONVERTED TO 21.4 MHz (IF) REGARDLESS OF THE VALUE OF THE RECEIVING CARRIER FREQUENCY.

IF AMP

THE RECEIVED SIGNAL CONVERTED TO THE 1ST INTERMEDIATE FREQUENCY IS AMPLIFIED BY THE TRANSISTOR AMPLIFIER CIRCUIT.

BPF 2

BPF 2 IS A NARROW BAND X-TAL FILTER (APPROXIMATELY 21.4MHz).
ITS MAJOR FUNCTION IS TO ATTENUTE THE ADJACENT CHANNEL SIGNALS AND ASSURE SELECTIVITY CHARACTERISTICS.

LOCAL OSC 2

THE TARGET FREQUENCY OF LOCAL OSC 2 IS AS FOLLOWS.

FL2=21.4 - 0.455 [MHz] = 20.945 MHz
WHERE FL2 : 2ND LOCAL FREQUENCY

IF STAGE

THE IF SIGNAL AND 2ND LOCAL OSCILLATOR SIGNAL ARE INPUT TO THE 2ND MIXER CIRCUIT AND CONVERTED TO 455 KHz BY INTERNAL MIXER AND AMPLIFIED BY 455 KHz AMPLIFIER.
THE LIM/DISC (FREQUENCY LIMMITTER AND DISCRIMINATOR) USING QUADRATURE DETECTION IS USED TO CONVERT THE FREQUENCY DEVIATION QUANTITY INTO VOLTAGE CHANGE FOR DEMODULATION.
THE BASE BAND SIGNAL (SINE WAVE) IS COMPARED TO THE REFERENCE VOLTAGE WHICH IS THE INTEGRAL VALUE OF THE RECEIVED DATA IN ORDER TO CONVERT IT INTO A BINARY DIGITAL SIGNAL (SQUARE WAVE)

* DIGITAL BOARD

DECODER

THE FOLLOWING PROCESSES ARE PERFORMED BY DECODER. (U3)
(1) SELECTION INFORMATION AND JUDGEMENT FUNCTION OF 512/1200/2400BPS.
(2) BATTERY SAVING FUNCTION.
(3) FUNCTION ADJUSTMENT OF BIT RATE ERROR.
(4) SEARCHING ERROR AND MAKING CORRECTION (2 BIT).

CPU

THE FOLLOWING PROCESSES ARE PERFORMED BY CPU. (U1)
(1) STORAGE AND MANAGEMENT OF THE RECEIVED INFORMATION.
(2) LCD DRIVING AND ILLUMINATION CONTROL.
(3) LOW BATTERY ALERT CONTROL.
(4) DECODER CONTROL.
(5) CLOCK FUNCTION.

EEPROM

THIS EEPROM (U2) STORES THE FOLLOWING DATA :

(1) 4 ADDRESS.

(2) 10 LOCKED INFORMATION.

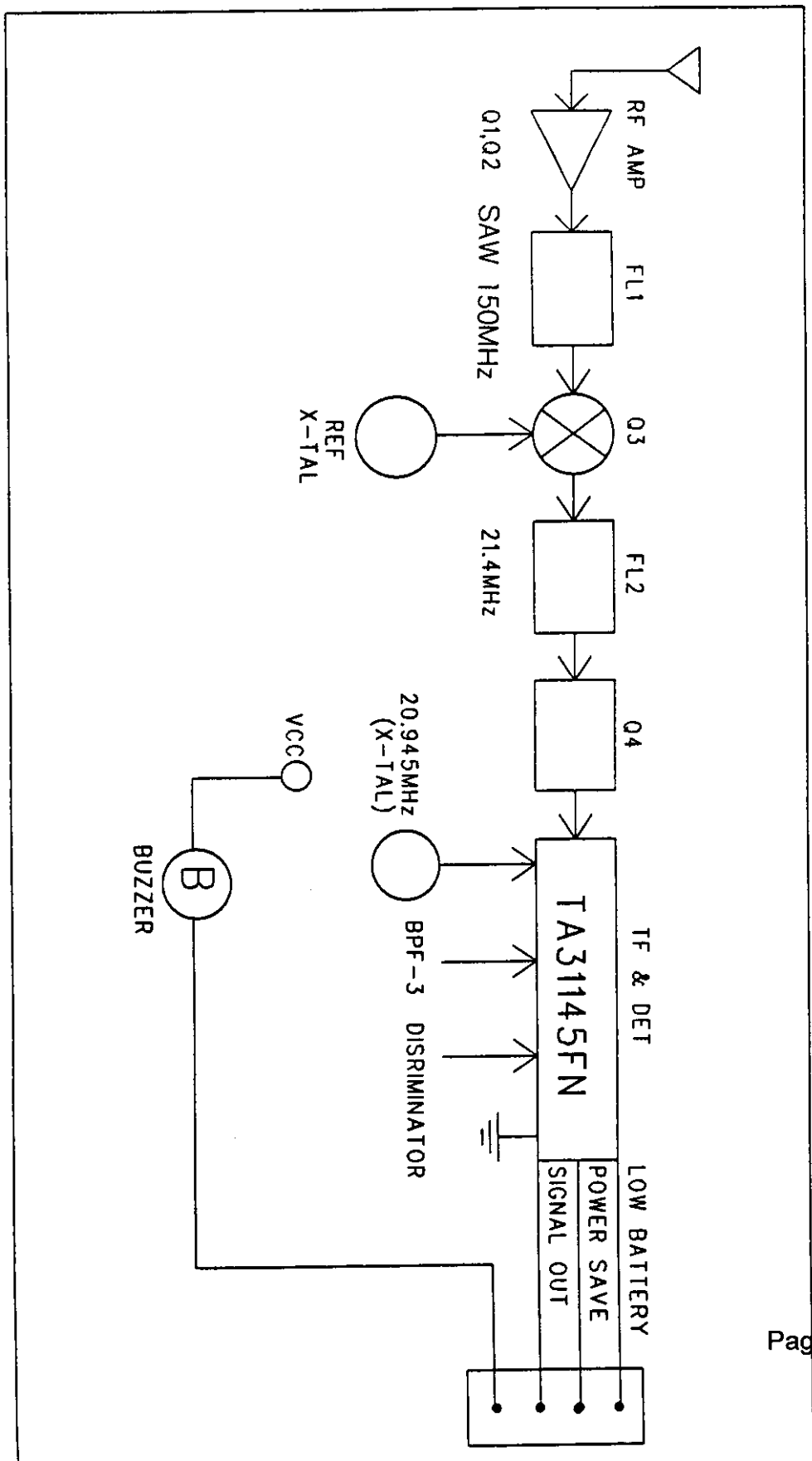
(3) SELECT MELODY.

(4) DECODER INITIAL DATA.

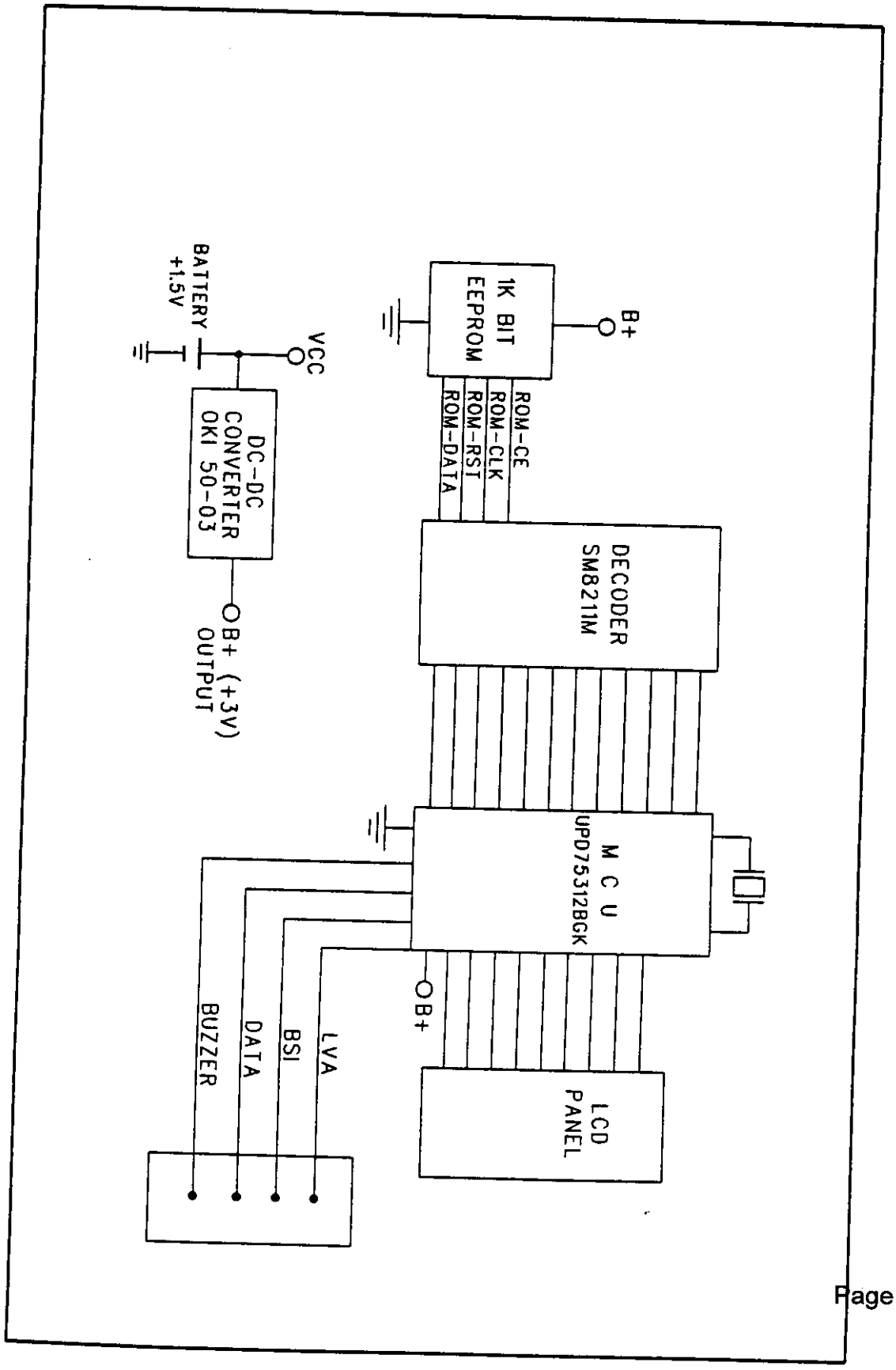
DC-DC CONVERTER

AS THE DIGITAL PART WHICH MANAGE THE RECEIVED INFORMATION DRIVES IN 3.0 VOLT, WE USED VOLTAGE REGULATOR (U4) THAT CAN EARN 3.0 [V] OUT-PUT BY IN-PUTTING 1.05 [V] ~ 1.7 [V].

1) RECEIVER PART



2) DIGITAL PART



TEST: **FIELD STRENGTH OF RADIATED EMISSIONS**

Grantee: Shinwa Communications of America, Inc.

FCC ID: JCA-SH780A Model: SH780A

Setup:

The equipment under test (EUT) was configured and operated in accordance with the applicable provisions of ANSI C63.4-1992, Section 6, 12. Measurements were made in accordance with applicable paragraphs of Section 8.2.3, Section 12.1.1.1 Appendix D, Section 12.1.4 and Appendix H3 and H4.

The EUT was placed on a 1 by 1.5 meter table located 40 cm above a 2 meter diameter non-metallic turntable that sits 40 cm above the 15 X 30 meter ground plane at Spectrum's Open Area Test Site. The bi-conical or log-periodic antenna was mounted on a tower spaced at a three meters distance, and arranged for adjustment in height (1-4 meters) and vertical/horizontal polarization to maximize the emissions levels when combined with turntable rotation of the EUT. The dual ridged guide antenna was mounted on a tripod at one meter height and adjusted for vertical or horizontal antenna orientation. An HP 8562A spectrum analyzer with an HP 8447F, Option H64 amplifier and an HP 83006A pre-amplifier were used for the peak measuring instrumentation.

Discussion:

The EUT is a VHF-FM Numeric superheterodyne Paging receiver. The receiver was powered with a single new AAA 1.5 Volt battery during measurements.

One set of measurements was made for each of the two sample receivers tested covering the 8.0 MHz wide frequency band of operation from 151-159 MHz. One sample was operating on a low channel, 151.00 MHz and the other on a high channel, 158.500 MHz.

Preliminary measurements were made as described in Section 8.3.11 and 12.1.4.1 with the receiver operating as described. The receiver was observed while positioned in three mutually orthogonal planes during which it appeared that the horizontal position, with the display facing upward, as the "worst case" position.

During preliminary measurements only a few emissions were detected. However, only with the use of an amplifier and when the receive antenna was placed in immediate proximity of the EUT. Using an HPamplifier and moving in to less than 50 cm EUT to antenna distance for frequencies from 1 to 2 GHz, no harmonics were observed.

The EUT placement on the table is detailed in the photograph included with this report.

The final set of measurements as detailed in Section 8.3.1.2 and 12.1.4.2 were made as specified. RBW and VBW of 100 kHz was used for measurements below 1 GHz. Above 1 GHz peak measurements were made with a RBW and VBW of 1 MHz. The pager position used was based on the preliminary measurements with the display side facing up and the back or FCC ID lable side facing down. We also endeavored to maximize emission levels of the EUT as approipriate, with rotation of the table and adjustment of antenna height and polarization.

Measurements were made over the frequency range of 30 - 2000 MHz in accordance with Section 15.33. No emissions were measurable at three meters during the final detailed radiated emissions measurements for either sample tested. An HP 8447F pre-amplifier was used during the measurements.

FCC Part 15.109(b) Field Strength of Radiated Spurious Emissions
Final Data

Grantee: Shinwa Communications of America, Inc.

10/15/98

FCC ID: JCA-SH780A

Radiated Emissions Measurements By Frequency

Freq MHz	Vert dBm	Horz dBm	Ant-F	dBuV/m	uV/m	dB +/- Limit	Limit uV/m @ 3 Meters

No measurable emissions at three meters

No receiver antenna conducted emissions measurements were made for the EUT. The antenna is a permanently attached loop antenna so we were unable to connect the spectrum analyzer to the receiver to recorded the antenna conducted spurious emissions.

Conclusion:

The Shinwa Communications of America, Inc., FCC ID: JCA-SH780A, when operated and measured as discussed above, meets the receiver radiated spurious emissions requirements under Title 47, CFR Part 15.109(a). **This receiver is not subject to the transition provisions of Part 15.37.**

OPEN-FIELD TEST SITE

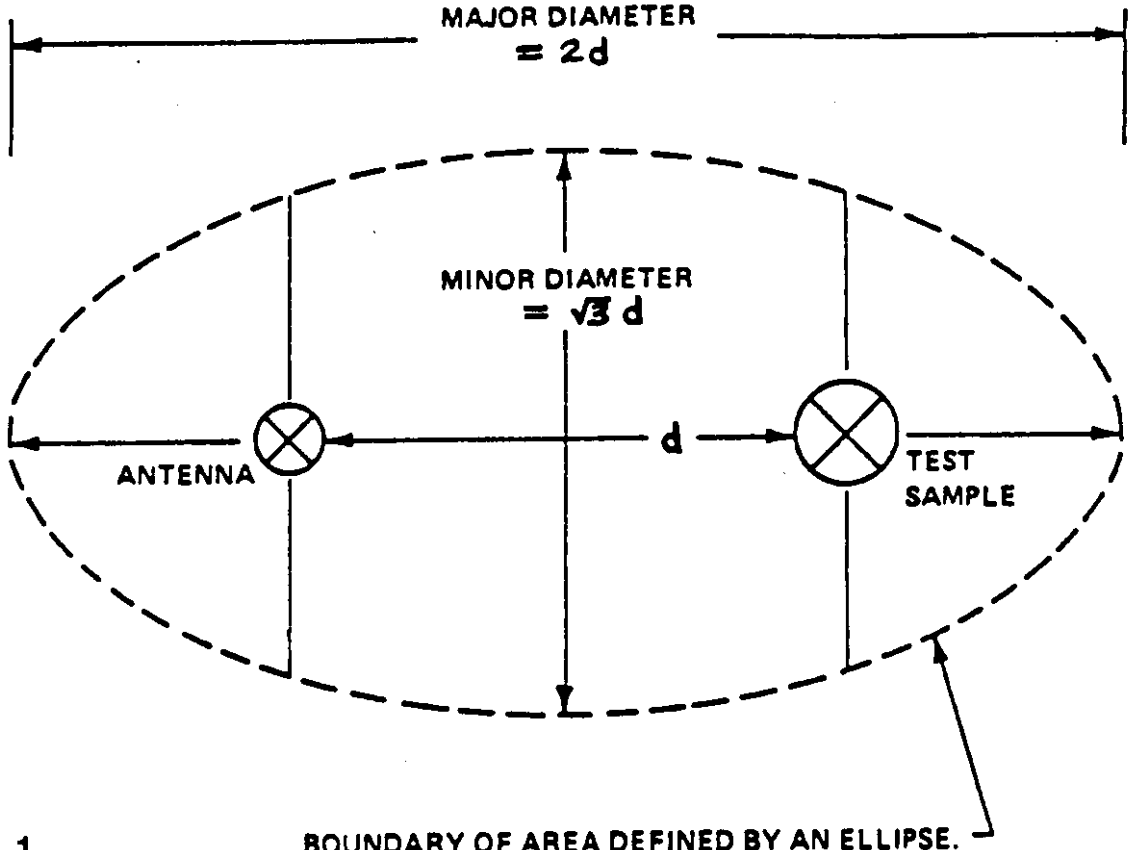


Figure 1

ANTENNA/EQUIPMENT ORIENTATION

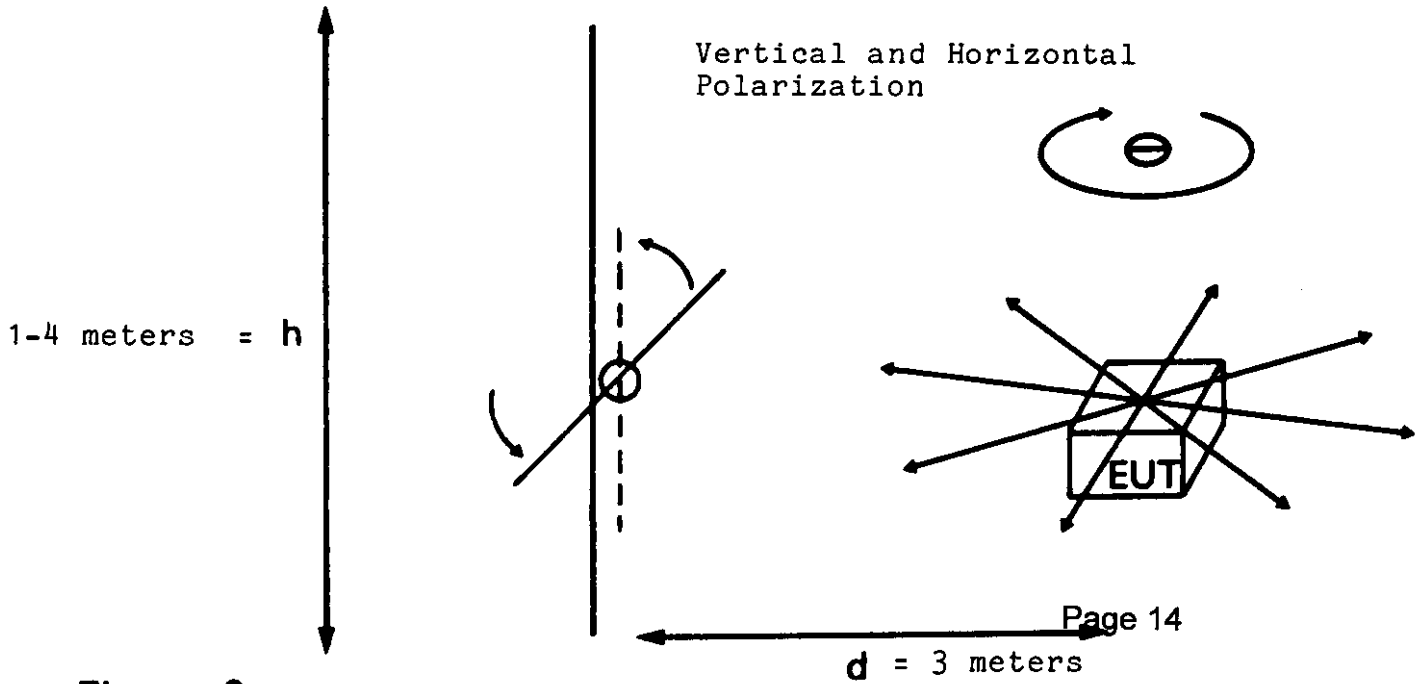
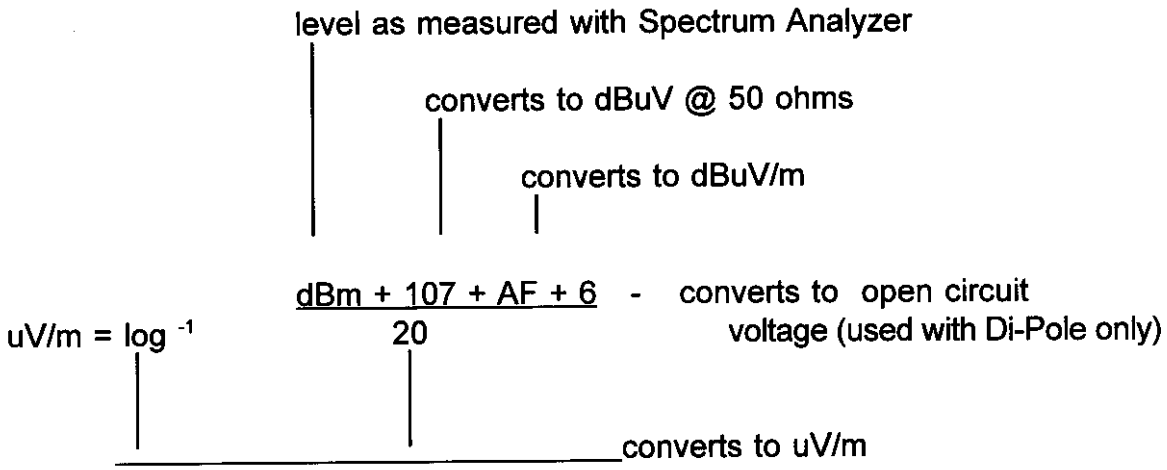


Figure 2

ANTENNA FACTORS FOR EMCO 3104 BICONICAL ANTENNA AND EMCO 3146 LOG PERIODIC ANTENNA INCLUDING CONVERSION TO OPEN CIRCUIT VOLTAGE.

Antenna Factor and Field Strength Formula



IF FREQ => 20	AND	FREQ =< 26.5	THEN ANTF = 12.5
IF FREQ => 26.5	AND	FREQ =< 28	THEN ANTF = 13.5
IF FREQ => 28.0	AND	FREQ =< 33	THEN ANTF = 14.5
IF FREQ => 33.0	AND	FREQ =< 35	THEN ANTF = 13.5
IF FREQ => 35.0	AND	FREQ =< 45	THEN ANTF = 13
IF FREQ => 45.	AND	FREQ =< 57	THEN ANTF = 12
IF FREQ => 57.0	AND	FREQ =< 63	THEN ANTF = 11
IF FREQ => 63.0	AND	FREQ =< 66	THEN ANTF = 10
IF FREQ => 66.0	AND	FREQ =< 75	THEN ANTF = 9
IF FREQ => 75.0	AND	FREQ =< 83	THEN ANTF = 8
IF FREQ => 83.0	AND	FREQ =< 86	THEN ANTF = 9
IF FREQ => 86.0	AND	FREQ =< 90	THEN ANTF = 10
IF FREQ => 90.0	AND	FREQ =< 95	THEN ANTF = 11
IF FREQ => 95.0	AND	FREQ =< 97.5	THEN ANTF = 12.5
IF FREQ => 97.5	AND	FREQ =< 101	THEN ANTF = 13.5
IF FREQ => 101.0	AND	FREQ =< 105	THEN ANTF = 14.5
IF FREQ => 105.0	AND	FREQ =< 108	THEN ANTF = 15.5
IF FREQ => 108.0	AND	FREQ =< 115	THEN ANTF = 16.5
IF FREQ => 115.0	AND	FREQ =< 123	THEN ANTF = 15.5
IF FREQ => 123.0	AND	FREQ =< 148	THEN ANTF = 14.5
IF FREQ => 148.0	AND	FREQ =< 151.5	THEN ANTF = 15.5
IF FREQ => 151.5	AND	FREQ =< 167.5	THEN ANTF = 17
IF FREQ => 167.5	AND	FREQ =< 182.5	THEN ANTF = 18
IF FREQ => 182.5	AND	FREQ =< 200	THEN ANTF = 19
IF FREQ => 200.0	AND	FREQ =< 202	THEN ANTF = 14.7
IF FREQ => 202	AND	FREQ =< 205	THEN ANTF = 14.5
IF FREQ => 205	AND	FREQ =< 215	THEN ANTF = 14.6
IF FREQ => 215	AND	FREQ =< 230	THEN ANTF = 14.55
IF FREQ => 230	AND	FREQ =< 235	THEN ANTF = 14.5
IF FREQ => 235	AND	FREQ =< 240	THEN ANTF = 14.8
IF FREQ => 240	AND	FREQ =< 242.5	THEN ANTF = 14.9

IF FREQ => 242.5	AND	FREQ =< 245	THEN ANTF = 15.1
IF FREQ => 245	AND	FREQ =< 247.5	THEN ANTF = 15.5
IF FREQ => 247.5	AND	FREQ =< 250	THEN ANTF = 15.7
IF FREQ => 250	AND	FREQ =< 252	THEN ANTF = 15.9
IF FREQ => 252	AND	FREQ =< 254	THEN ANTF = 16
IF FREQ => 254	AND	FREQ =< 256	THEN ANTF = 16.1
IF FREQ => 256	AND	FREQ =< 258	THEN ANTF = 16.2
IF FREQ => 258	AND	FREQ =< 260	THEN ANTF = 16.3
IF FREQ => 260	AND	FREQ =< 263.5	THEN ANTF = 16.4
IF FREQ => 263.5	AND	FREQ =< 265	THEN ANTF = 16.4
IF FREQ => 265	AND	FREQ =< 267.5	THEN ANTF = 16.6
IF FREQ => 267.5	AND	FREQ =< 271	THEN ANTF = 16.7
IF FREQ => 271	AND	FREQ =< 274	THEN ANTF = 16.8
IF FREQ => 274	AND	FREQ =< 276	THEN ANTF = 16.9
IF FREQ => 276	AND	FREQ =< 278	THEN ANTF = 17
IF FREQ => 278	AND	FREQ =< 280	THEN ANTF = 17.1
IF FREQ => 280	AND	FREQ =< 282	THEN ANTF = 17.3
IF FREQ => 282	AND	FREQ =< 284	THEN ANTF = 17.6
IF FREQ => 284	AND	FREQ =< 286	THEN ANTF = 18
IF FREQ => 286	AND	FREQ =< 288	THEN ANTF = 18.2
IF FREQ => 288	AND	FREQ =< 295	THEN ANTF = 18.4
IF FREQ => 290	AND	FREQ =< 295	THEN ANTF = 15.8
IF FREQ => 295	AND	FREQ =< 305	THEN ANTF = 18.6
IF FREQ => 305	AND	FREQ =< 310	THEN ANTF = 18.4
IF FREQ => 310	AND	FREQ =< 311	THEN ANTF = 18.3
IF FREQ => 311	AND	FREQ =< 312	THEN ANTF = 18.1
IF FREQ => 312	AND	FREQ =< 313	THEN ANTF = 18
IF FREQ => 313	AND	FREQ =< 340	THEN ANTF = 17.9
IF FREQ => 340	AND	FREQ =< 343	THEN ANTF = 18.1
IF FREQ => 343	AND	FREQ =< 350	THEN ANTF = 18.2
IF FREQ => 350	AND	FREQ =< 357	THEN ANTF = 18.3
IF FREQ => 357	AND	FREQ =< 360	THEN ANTF = 18.5
IF FREQ => 360	AND	FREQ =< 365	THEN ANTF = 18.6
IF FREQ => 365	AND	FREQ =< 375	THEN ANTF = 18.7
IF FREQ => 375	AND	FREQ =< 378	THEN ANTF = 19
IF FREQ => 378	AND	FREQ =< 381	THEN ANTF = 19.1
IF FREQ => 381	AND	FREQ =< 383	THEN ANTF = 19.2
IF FREQ => 383	AND	FREQ =< 385	THEN ANTF = 19.3
IF FREQ => 385	AND	FREQ =< 387.5	THEN ANTF = 19.4
IF FREQ => 387.5	AND	FREQ =< 390	THEN ANTF = 19.5
IF FREQ => 390	AND	FREQ =< 392	THEN ANTF = 19.7
IF FREQ => 392	AND	FREQ =< 394	THEN ANTF = 18.8
IF FREQ => 394	AND	FREQ =< 396	THEN ANTF = 19.9
IF FREQ => 396	AND	FREQ =< 398	THEN ANTF = 20
IF FREQ => 398	AND	FREQ =< 402	THEN ANTF = 20.1
IF FREQ => 402	AND	FREQ =< 405	THEN ANTF = 20.2
IF FREQ => 405	AND	FREQ =< 410	THEN ANTF = 20.3
IF FREQ => 410	AND	FREQ =< 415	THEN ANTF = 20.4
IF FREQ => 415	AND	FREQ =< 420	THEN ANTF = 20.6
IF FREQ => 420	AND	FREQ =< 425	THEN ANTF = 20.8
IF FREQ => 425	AND	FREQ =< 430	THEN ANTF = 21
IF FREQ => 430	AND	FREQ =< 435	THEN ANTF = 21.2
IF FREQ => 435	AND	FREQ =< 440	THEN ANTF = 21.3
IF FREQ => 440	AND	FREQ =< 445	THEN ANTF = 21.4
IF FREQ => 445	AND	FREQ =< 450	THEN ANTF = 21.5
IF FREQ => 450	AND	FREQ =< 455	THEN ANTF = 21.6
IF FREQ => 455	AND	FREQ =< 460	THEN ANTF = 21.8
IF FREQ => 460	AND	FREQ =< 465	THEN ANTF = 21.9
IF FREQ => 465	AND	FREQ =< 470	THEN ANTF = 22
IF FREQ => 470	AND	FREQ =< 472.5	THEN ANTF = 22.1
IF FREQ => 472.5	AND	FREQ =< 475	THEN ANTF = 22.2
IF FREQ => 475	AND	FREQ =< 477	THEN ANTF = 22.4
IF FREQ => 477	AND	FREQ =< 478	THEN ANTF = 22.5
IF FREQ => 478	AND	FREQ =< 481	THEN ANTF = 22.6

IF FREQ => 481	AND	FREQ =< 482.5	THEN ANTF = 22.7
IF FREQ => 482.5	AND	FREQ =< 485	THEN ANTF = 22.8
IF FREQ => 485	AND	FREQ =< 488	THEN ANTF = 22.9
IF FREQ => 488	AND	FREQ =< 515	THEN ANTF = 23.1
IF FREQ => 515	AND	FREQ =< 540	THEN ANTF = 23.3
IF FREQ => 540	AND	FREQ =< 560	THEN ANTF = 23.6
IF FREQ => 560	AND	FREQ =< 570	THEN ANTF = 23.7
IF FREQ => 570	AND	FREQ =< 580	THEN ANTF = 23.9
IF FREQ => 580	AND	FREQ =< 590	THEN ANTF = 24
IF FREQ => 590	AND	FREQ =< 610	THEN ANTF = 24.2
IF FREQ => 610	AND	FREQ =< 615	THEN ANTF = 24.4
IF FREQ => 615	AND	FREQ =< 620	THEN ANTF = 24.5
IF FREQ => 620	AND	FREQ =< 625	THEN ANTF = 24.6
IF FREQ => 625	AND	FREQ =< 630	THEN ANTF = 24.8
IF FREQ => 630	AND	FREQ =< 635	THEN ANTF = 24.9
IF FREQ => 635	AND	FREQ =< 640	THEN ANTF = 25
IF FREQ => 640	AND	FREQ =< 645	THEN ANTF = 25.1
IF FREQ => 645	AND	FREQ =< 647.5	THEN ANTF = 25.3
IF FREQ => 647.5	AND	FREQ =< 650	THEN ANTF = 25.4
IF FREQ => 650	AND	FREQ =< 652.5	THEN ANTF = 25.6
IF FREQ => 652.5	AND	FREQ =< 655	THEN ANTF = 25.7
IF FREQ => 655	AND	FREQ =< 660	THEN ANTF = 25.8
IF FREQ => 660	AND	FREQ =< 665	THEN ANTF = 26.1
IF FREQ => 665	AND	FREQ =< 670	THEN ANTF = 26.3
IF FREQ => 670	AND	FREQ =< 680	THEN ANTF = 26.6
IF FREQ => 680	AND	FREQ =< 690	THEN ANTF = 26.7
IF FREQ => 690	AND	FREQ =< 720	THEN ANTF = 26.9
IF FREQ => 720	AND	FREQ =< 760	THEN ANTF = 26.8
IF FREQ => 760	AND	FREQ =< 800	THEN ANTF = 27
IF FREQ => 800	AND	FREQ =< 802.5	THEN ANTF = 27.3
IF FREQ => 802.5	AND	FREQ =< 805	THEN ANTF = 27.5
IF FREQ => 805	AND	FREQ =< 807.5	THEN ANTF = 27.6
IF FREQ => 807.5	AND	FREQ =< 810	THEN ANTF = 27.7
IF FREQ => 810	AND	FREQ =< 815	THEN ANTF = 27.8
IF FREQ => 815	AND	FREQ =< 820	THEN ANTF = 27.9
IF FREQ => 820	AND	FREQ =< 840	THEN ANTF = 28.2
IF FREQ => 840	AND	FREQ =< 860	THEN ANTF = 28.4
IF FREQ => 860	AND	FREQ =< 870	THEN ANTF = 28.8
IF FREQ => 870	AND	FREQ =< 880	THEN ANTF = 29.3
IF FREQ => 880	AND	FREQ =< 890	THEN ANTF = 29.4
IF FREQ => 890	AND	FREQ =< 910	THEN ANTF = 29.6
IF FREQ => 910	AND	FREQ =< 920	THEN ANTF = 29.7
IF FREQ => 920	AND	FREQ =< 930	THEN ANTF = 29.9
IF FREQ => 930	AND	FREQ =< 940	THEN ANTF = 30
IF FREQ => 940	AND	FREQ =< 960	THEN ANTF = 30.2
IF FREQ => 960	AND	FREQ =< 970	THEN ANTF = 30.6
IF FREQ => 970	AND	FREQ =< 975	THEN ANTF = 30.8
IF FREQ => 975	AND	FREQ =< 980	THEN ANTF = 31
IF FREQ => 980	AND	FREQ =< 985	THEN ANTF = 31.1
IF FREQ => 985	AND	FREQ =< 990	THEN ANTF = 31.3
IF FREQ => 990	AND	FREQ =< 1000	THEN ANTF = 31.4

Serial Number 6225

ELECTO-METRICS
GAIN AND ANTENNA FACTORS
MODEL RGA-60

1 METER CALIBRATION

FREQUENCY MHz	14 FOOT CABLE LOSS FSJI-50A	ANTENNA FACTOR
1000	.84	23.21
1500	1.05	25.70
2000	1.22	27.15
2500	1.38	28.37
3000	1.53	29.93
3500	1.67	31.01
4000	1.80	32.45
4500	1.92	31.98
5000	2.04	33.33
5500	2.15	34.24
6000	2.27	34.48
6500	2.37	35.19
7000	2.48	36.05
7500	2.58	36.77
8000	2.68	37.33
8500	2.78	37.38
9000	2.87	37.14
9500	2.96	37.55
10000	3.06	38.33

TEST EQUIPMENT LIST A
SPECTRUM TECHNOLOGY, INC.

Equipment	Manufacturer	Serial Number	Cal Date/Due Date
Spectrum Analyzer	Hewlett-Packard 8562A	08562-60062	9/14/98 9/14/99
Amplifier 9 kHz-1300 MHz	Hewlett-Packard 8447F OPT H64	2727A02208	9/14/98 9/14/99
RF Signal Gen.	Fluke 6071A	2915016	8/11/98 5/11/99
Service Monitor	IFR FM/AM 500A	4103	---
Oscilloscope	Kikusui C055060	6132295	---
Power Supply	Astron VS35	8601266	---
Voltmeter	Fluke 8020A	N2420658	---
Multimeter	Fluke 25	3710310	---
Wattmeter	Bird 43	56227	---
RF Termination	Bird 8135	10004	---
Dual Phase LISN 50 ohm/50 uH	STI per MP-4	02	1/9/98 1/9/99
Dual Phase LISN 50 ohm/50 uH	Compliance Design	8012-50R-24-BNC	1/9/98 1/9/99
Audio Generator	Hewlett-Packard 205-AG	8689	---
Attenuators:	Texscan FP45-20 Texscan FP45-10 Weinshel 40-10-33 Mini-Circuits CAT30 Pomona 4108-10	 CZ682 8419 01 	
Thermometer	Fluke 52	3965185	---
Test Line Simulator	Teltone TLS-2	none	---
Turn Table, RC	EMCO 1060-2M	8912-1415	---
Antenna Mast, RC	Compliance Design, Inc.	M100	---
Antennas: DiPole Set Diploe Set	 EMCO Model: 3121C EMCO Model: 3121C	 1335 1336	 9/18/97 3/18/99 9/18/97 3/18/99
Bi-Conical Bi-Conical Log-Periodic Active Loop	EMCO 3104 EMCO 3104C EMCO 3146 EMCO 6502	3763 9401-4635 1754 9107-2645	reference only 6/20/97 1/20/99 6/15/98 6/15/99 reference only