



FCC ID: _____

TEST REPORT

Subject: Processing Gain For WaveLAN-IEEE PC CARD (Integrated)

Ref: FCC Rules 47 CFR Part 15, Section 5.247d

Report Prepared by:

Maarten Visee
Name

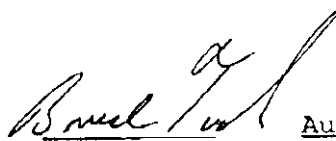

Signature

August 31, 1998
Date

Concurrence:

1. Director of Engineering

Bruce Tuch
Name


Signature

August 31, 1998
Date

2. Team Captain

Paul Siermann
Name


Signature

August 31, 1998
Date

Lucent WCND Confidential Information ©1998

1. Summary:

This document describes the Receiver Spreading Gain as measured for WaveLAN-II PC-Card Type 2 (Integrated) according to Ref. [2].

2. Conclusion:

The Lucent WaveLAN-II PC Card Type 2 (Integrated) product confirms to the minimum required 10 dB processing gain, as set forth by the FCC for operation in the 2.4 GHz ISM band.

3. References:

- 1- Document FCC 97-114, Appendix C, Guidance on Measurements for Direct Sequence Spread Spectrum Systems.
- 2- Hardware Functional Specification for WaveLAN-II/PC Card Type 2 Integrated, Doc. No. S-0000091 Rev. 1, Source Organization Lucent Technologies WCND Utrecht.
- 3- Viterbi, A. J., Principles of Coherent Communications, New York, McGraw-Hill 1966.
- 4- Proakis, J.G., Digital Communications, New York, McGraw-Hill 1989, page 270.

4. Measurement description:

4.1 Test introduction - FCC requirements:

Part of FCC certification for the Lucent WaveLAN IEEE 802.11 compliant Network Interface Card (NIC) is a Processing Gain test. This test proves that the receiver of the tested product employs a true spread spectrum device receiver structure, taking full advantage of the direct sequence spread spectrum modulation technique.

This test verifies the Receiver Processing Gain to be 10 dB or more, by monitoring the Bit Error Rate (BER) of the product under test while operating under strict defined received signal conditions. Since the product is capable of operation on either 2 Mbit/s or 1 Mbit/s the processing gain test is performed for both data rates.

Several methods of showing compliance to the rules are possible, from a stepped CW jammer to a continuous sweeping CW interferer. For this test the discrete stepped CW jammer method was chosen, as described in Ref. [1].

Therefore a receiver input signal is applied to the product under test, in the presence of a Continuous Wave (CW) interference source, also referred to as a CW jammer.

The test criteria for meeting the minimal spreading gain is such that it takes the theoretical calculated SNR for the

Lucent Confidential, ©1998

applied modulation technique and specified BER as a reference. From this given SNR the spreading gain is subtracted, yielding the CW Signal to Jammer ratio J/S. From reference [4], likewise as Ref. [3] consulted in Ref. [1], it is determined that for a BER of 10^{-8} the SNR (S/N)₀ equals 15 dB @ 2 Mbit/s and 13 dB @ 1 Mbit/s data rate (QPSK, coherent detection as applied in the WaveLAN IEEE). Thus the J/S ratio for a processing gain of 10 dB that must be met is calculated as:

$$-15 + 10 = -5 \text{ dB @ 2 Mbit/s, and}$$

$$-13 + 10 = -3 \text{ dB @ 1 Mbit/s.}$$

The test takes place at the product Functional Specification (Ref. [2]) specified conditions for BER rate measurements, specifying a BER equal or better than 10^{-8} at an receiver input level of -55 dBm.

Two types of correction are allowed for as described in Ref. [1]. The first taking into account 2 dB implementation losses, thus increasing the absolute J/S ratio by 2 dB.

The second correction allows for deleting the 20% worst-case frequencies in the processing gain test that cause the test at that CW interference to fail. This implies that for the 14 MHz wide measurement interval that is been considered the worst case 56 CW jammer frequencies that result in received data errors/missing frames can be ignored ($14 \times (1 \text{ MHz}/50 \text{ KHz}) + 1 = 281$).

4.2 Test sequence:

The measurements are performed at a 50 KHz CW raster. For each CW jammer frequency 10^8 bits are transmitted by the reference transmitter, and received by the product under test. For practical reasons 50,000 messages are transmitted. After blanking out frame overhead 1927 bits per frame are monitored. This results in $50,000 \times 1927 = 96,350,000$ transmitted bits for a BER test, which is a mere 1.4% less than the targeted 10^8 bits.

Though it would be more elegant to show BER compliance for at least say ten times 10^8 transmitted/received bits, the time involved with this grows significantly. Since the CW interferer is stepped in a 50 KHz raster, covering the receiver bandwidth of 14 MHz, it is considered that the BER requirement is sufficiently met since such a multitude of measurements are taken.

The total measurement is being performed under computer control, hereafter referred to as controller. It involves the control over the reference transmitter, CW-interference generator, receiver under test and received data error-checker/frame counter. The controller program flow chart is given in Annex C, FCC Processing Gain Controller Flowchart.

In the receiver at the inter-connection between the RF circuits and the Digital Signal Processor (DSP) the demodulated received RF signal is made available to an error

Lucent Confidential, ©1998

checker. This error checker is a dedicated piece of hardware that monitors real-time the received data, gating_out any other non-relevant information that is present in the received data (message header, message length field, CRC field, diagnostic information field etc.). For a chosen Tx message length of 230 bytes this yields 1927 useable bits.

The transmitted data pattern is fixed, and known at the receiver. Therefore the error checker compares the known transmitted data sequence with received data sequence. Received data errors and missing received frames information is retrieved by the controller.

The test sequence is as follows: the controller issues a request for transmit to the transmitter for 1000 frames. Once this number of frames has been transmitted the transmitter signals to the controller the finish of the controller request. The controller reads the number of received frames and number of erroneous received frames. If there are no missing frames or errors detected, the controller increases the CW interference level by 1 dB. Consequently it re-issues an transmit request. This sequence is repeated until errors or missing frames are detected by the controller. When this is detected, the controller lowers the CW interference level by 1 dB. Instead of a quick error scan using 1000 messages, 50000 messages are transmitted to check the BER.

The test continues by raising the jammer frequency by 50 KHz and re-setting the CW jammer level to the start value. For this new CW frequency the measurements are repeated as described above (see Annex C). The CW frequency and power levels are pre-programmed in a command-file that is read by the controller during test start-up.

Before measurements are started, the receiver input level and CW jammer level need to be calibrated. See figure 1 for the test set-up.

The test takes place at an arbitrarily chosen channel, being channel two (2417 MHz).

4.3 Receiver level calibration:

The receiver input level is calibrated using the RF power meter. For this purpose, the reference transmitter output attenuator is set to 0 dB. The CW jammer is disabled for this calibration. Using the RF power meter at the receiver input of the device under test, the received level at the receiver input is measured for a continuous active reference transmitter. The attenuator value is calculated to achieve a received level of -55 dBm. Finally the attenuator is adjusted to this value.

4.4 CW level calibration:

The CW jammer generator output level is set to 0 dBm, and the RF power meter value is read. The reference transmitter is disabled during this calibration. The difference in CW output level setting and RF power meter measured at receiver input of the device under test is the attenuation of the test set-up. This is the correction factor that needs to be applied for analysis of the measurements results.

5. Equipment used:

# Item needed	Description
1	Portable PC with WaveLAN-II NIC, Panasonic CF-V21P, SN-3JKSM01028, for transmitter.
1	Software 'Testware' <TW.EXE>, 208392 bytes, 06-12-98. Used for the transmitter.
1	Portable PC with WaveLAN-II NIC, NCR 3150, SN 17-26106224, for receiver.
1	Software 'Host test' <CERT21.EXE>, 116.492 bytes, 06-19-1998. Used for the receiver.
2	WaveLAN IEEE NIC.
1	PC + IEEE interface card, NCR PC6, SN 17-17039925 and CEC PC<>488 interface card.
1	Received error checker, wire-wrap prototype, Lucent WCND designed and built.
1	Power supply, Delta D030-1, for error checker.
1	Spectrum Analyzer, HP 9592B SN 3009U00102.
1	Power Meter, Rohde & Schwarz, Millivolt meter URV5, SN 893430/070
1	Power Sensor, Rhode & Schwarz, type NRV-Z2 828.3218.02, SN 860925/005.
1	CW jammer generator, Gigatronics 7200, SN 746604.
1	Variable attenuator, 0-70 dB, Midwest Microwave, Model 1044.
2	Fixed attenuator, 10 dB, Inmet Corp., model 18AH-10.
1	RF power splitter, ARRA 3-9200-2, SN 2001
1	Misc. IEEE cabling
1	Misc. SMA cabling
1	RF shielded cage

6. Measurement set_up:

The test set_up is given below in Figure 1, measurement test set-up. To avoid interference that can disrupt the measurement, the whole test is performed within the shielded RF cage.

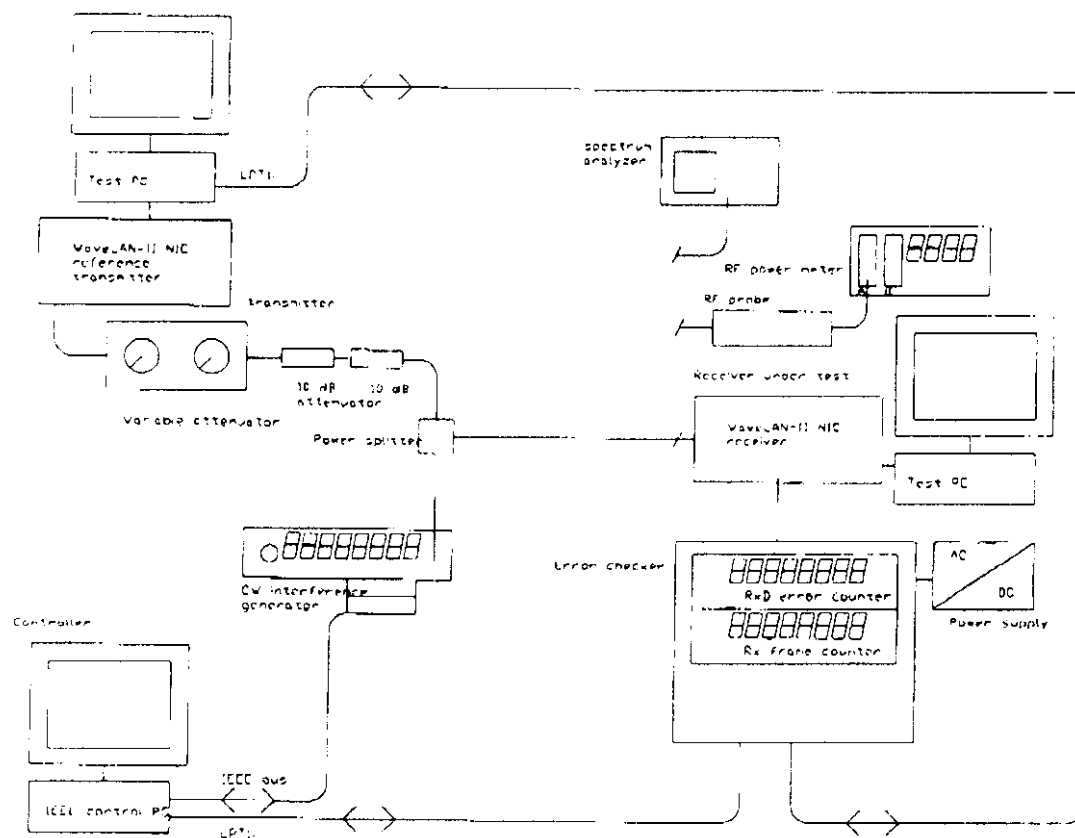


Figure 1, measurement test set-up.

7. Measurement results:

Calibrations:

Receiver calibration: For 0 dB total attenuator setting (variable and fixed = 0) the received level at the receiver input equals +10 dBm. Test setting: the fixed attenuator is chosen to be 20 dB, the variable attenuator is set to 45 dB, attenuation.

CW jammer generator calibration: For a 0 dBm output level at the generator the received level at the receiver input is -5 dBm.

Processing Gain Measurement Results:

Annex A lists the measurement results tests taken for a data rate of 2 Mbit/s, while Annex B lists the results for a data rate of 1 Mbit/s.

For each frequency between $F_c \pm 8$ MHz a BER measurement is taken. Note that for verification of the spreading gain the measurement results are taken for $F_c \pm 7$ MHz, being the receiver bandwidth.

The J/S ration is given at the top of the table, as well as the CW-correction factor.

For each CW measurement frequency the jammer level is varied from -65 dBm to -57 dBm at the receiver input, yielding a J/S ratio of -10 to -2 dB.

As can be seen, for some CW frequencies received data errors/missing frames are detected.

Applying the rule of discarding the 20% worst-case jamming/signal points (Ref.[1]), results in zero received errors for both 2 Mbit/s and 1 Mbit/s. Respectively 3.2% and 3.9% of the total CW frequencies were found to cause data errors and/or missing frames.

Therefore, a J/S ratio better or equal to -5 dB @ 2 Mbit/s dB and -3 dB @ 1 Mbit/s is measured.

Therefore it can be concluded the tested product complies to the required Processing Gain of 10 dB, as set forth in Ref[1].

Annex A, 2 Mbit/s, FCC Processing Gain Measurements Results, Lucent Confidential, ©1998

Annex A: Measurement results, 2 Mbit/s

Measurement of output noise b

2 dB TX

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

1000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

2000 Hz

Level error

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Percentage

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

五、

Case No.	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407
----------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

Address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	
---------	---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

Annex A, 2 MBit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

Account Number	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452	1453
----------------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

Annex B, Measurement results for 1 Mbit/s.

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

References

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

[illegible]

Annex B, 1 Mbit/s, FCC Processing Gain Measurements Results,
Lucent Confidential, ©1998

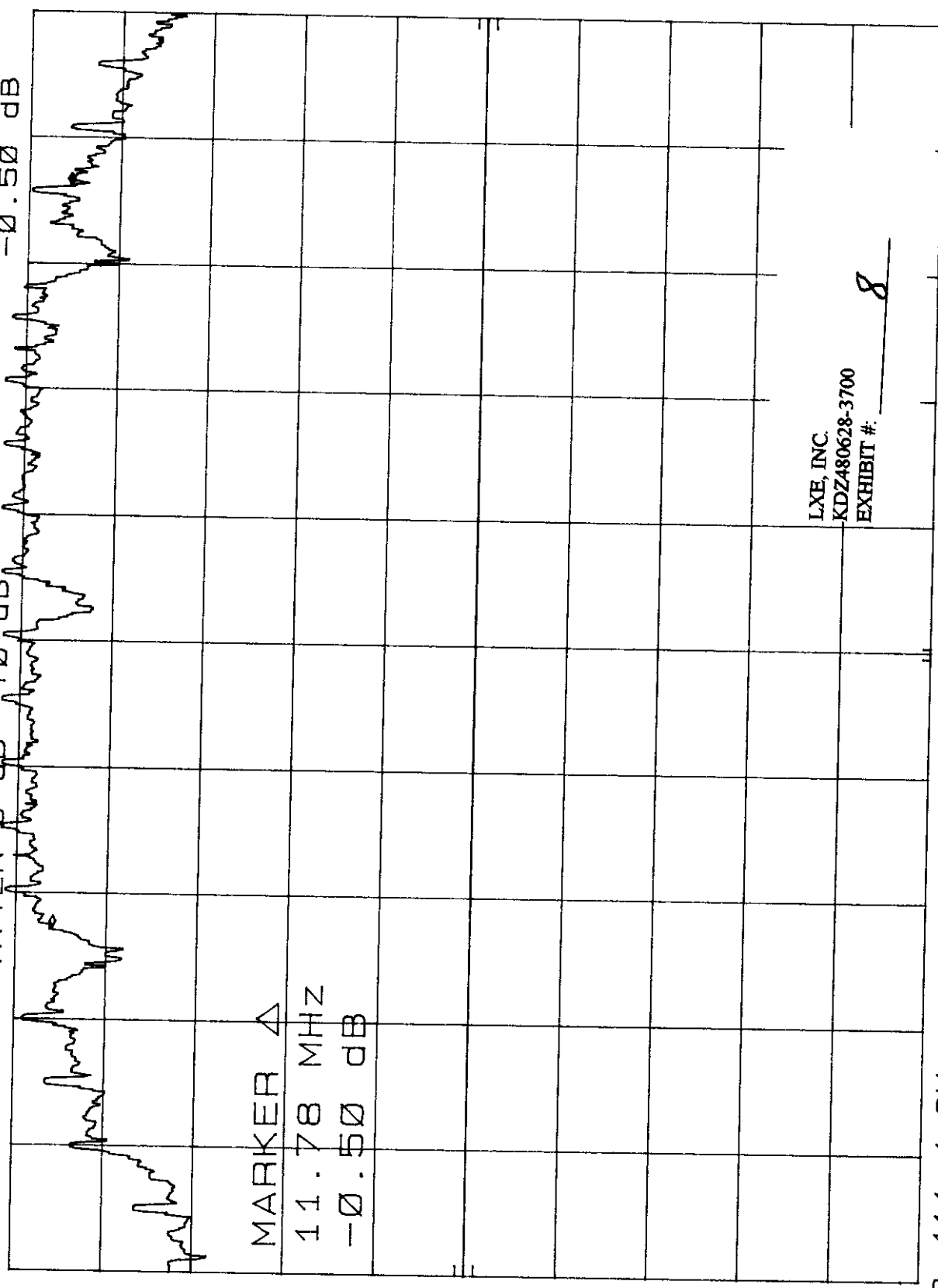
[illegible]

7p REF -45.0 dBm MKR Δ 11.78 MHz
10 dB/ -0.50 dB

ATTEN 0 dB +0 dB

OFFSET
-35.0
dB
DL
-95.0
dBm

MARKER Δ
11.78 MHz
-0.50 dB



LXE, INC.
KDZ480628-3700
EXHIBIT #: 8

CENTER 2.411 4 GHz RES BW 100 KHz (i) VBW 300 KHz SPAN 20.0 MHz SWP 20.0 msec

MKR Δ 11.58 MHz
-1.20 dB

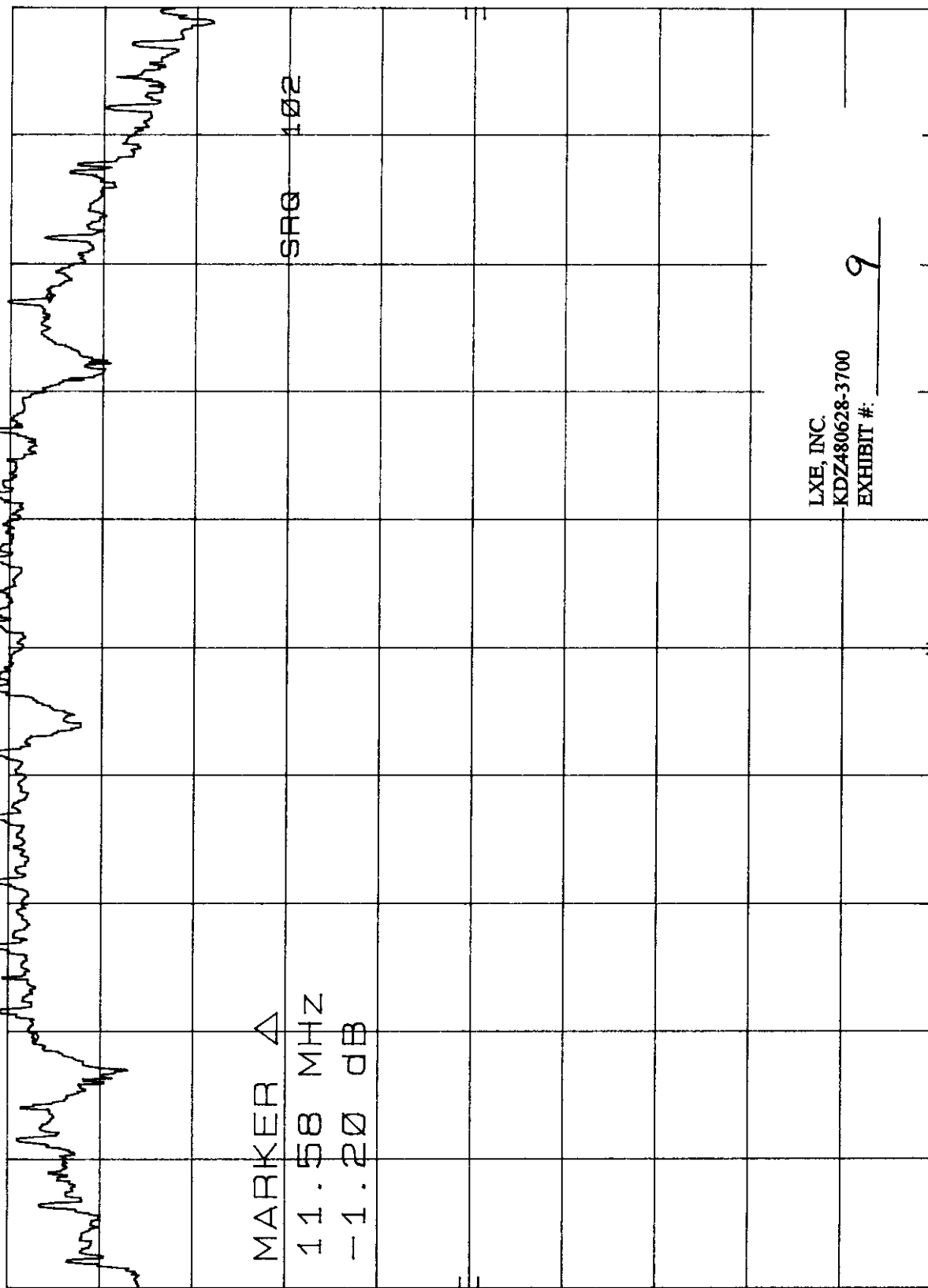
ATTEN 0 dB

REF -45.0 dBm

70

10 dB/

OFFSET
-35.0
dB



CENTER 2.443 1 GHz
RES BW 100 KHz (i) VBW 300 KHz
SPAN 20.0 MHz
SWP 20.0 msec

70 MKR Δ 13.50 MHz
10 dB/ -0.70 dB

REF -45.0 dBm ATTN 0 dB +0 dB

OFFSET
-35.0
dB

MARKER Δ
13.50 MHz
-0.70 dB

SRQ 102

LXE, INC.
KDZ480628-3700
EXHIBIT #: 10

CENTER 2.466 4 GHz

RES BW 100 KHz (i) VBW 300 KHz

SPAN 20.0 MHz
SWP 20.0 msec

HP MKR 2.412 656 GHz
-65.20 dBm

REF -45.0 dBm ATTN 0 dB +0 dB

10 dB/

OFFSET
-35.0
dB

LXE, INC.
KDZ480628-3700
EXHIBIT #: 11

SWEET TIME

500 sec

CENTER 2.412 71 GHz
RES BW 3 kHz (i)

VBW 300 kHz

SPAN 1.50 MHz
SWP 500 sec

MKR 2.442 656 GHz
-65.50 dBm

REF -45.0 dBm ATTN 0 dB +0 dB

70

10 dB/

LXE, INC.

KDZ480628-3700

EXHIBIT #: 12

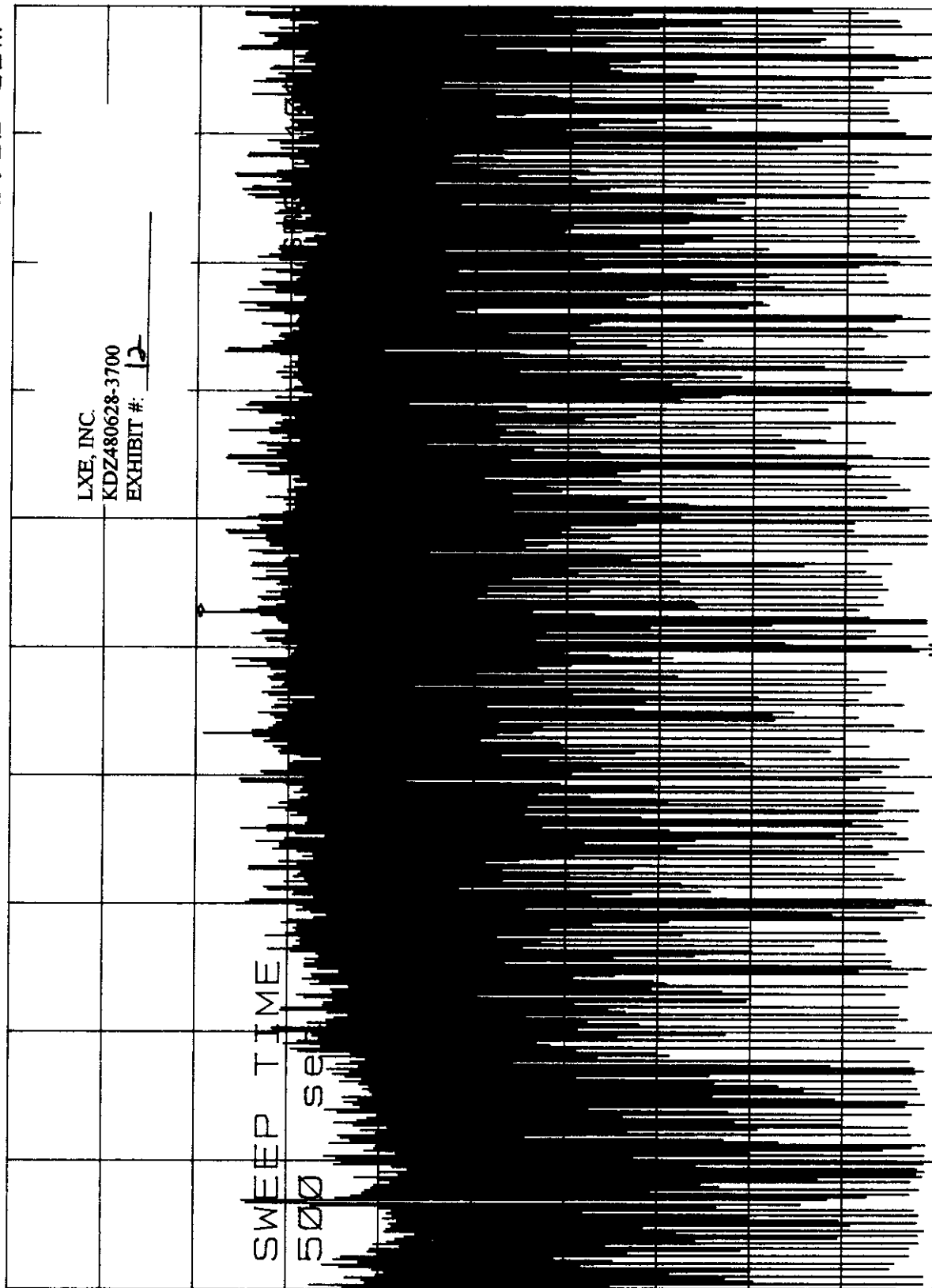
OFFSET

-35.0

dB

SWEEP TIME

500 sec



CENTER 2.442 61 GHz

RES BW 3 kHz (i)

VBW 300 kHz

SPAN 1.50 MHz

SWP 500 sec

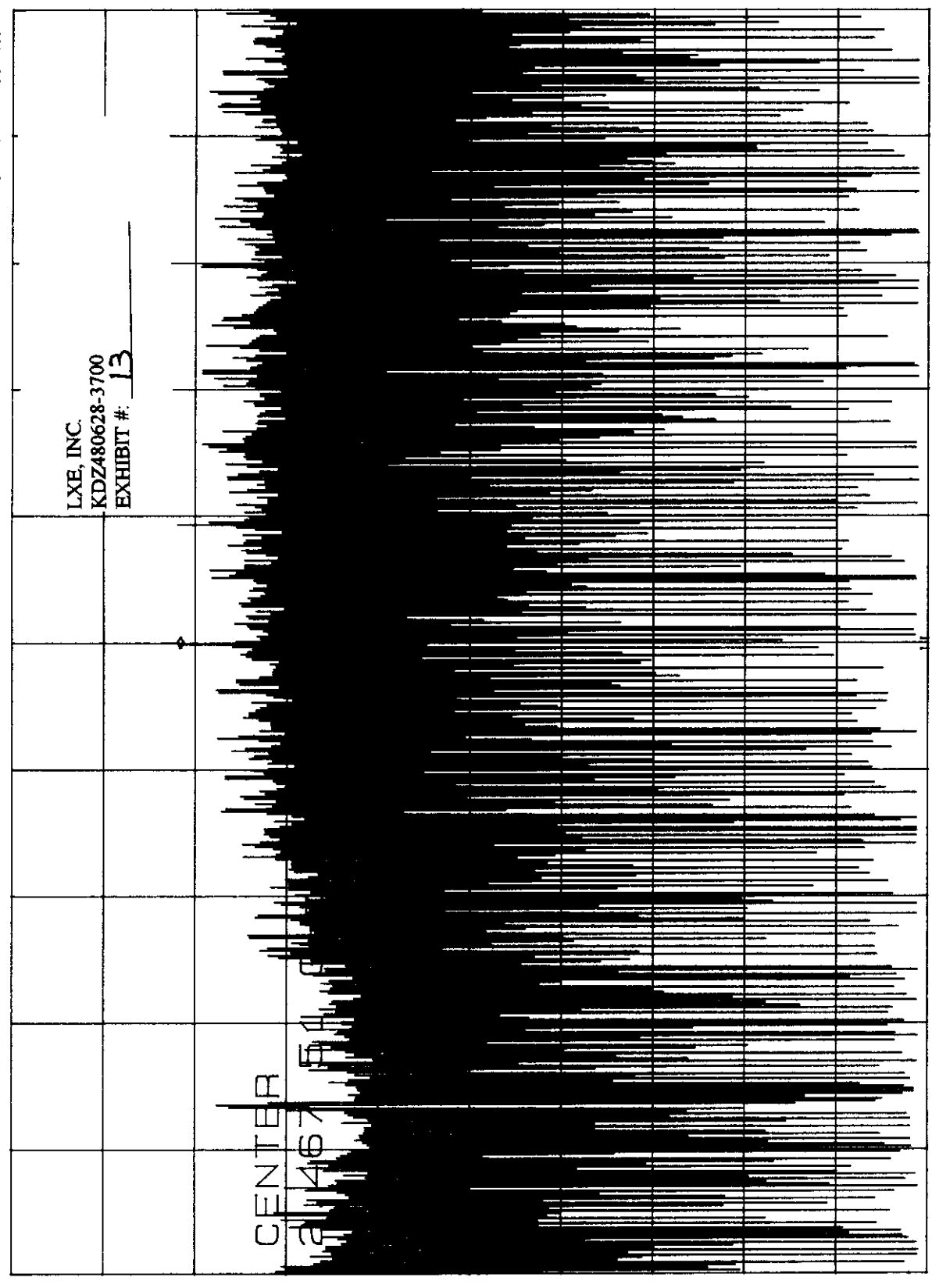
MKR 2.467 514 GHz
-63.40 dBm

hp REF -45.0 dBm ATTN 0 dB +0 dB

10 dB/

OFFSET
-35.0
dB

LXE, INC.
KDZ480628-3700
EXHIBIT #: 13



CENTER 2.467 51 GHz
RES BW 3 KHz (i)
SPAN 1.50 MHz
SWP 500 sec
VBW 300 KHz

MKR 5.24 MHz
138 μ V

ATTEN 10 dB + 10 dB

REF 7.00 mV

h₀

10 dB/

LXE, INC.
KDZ480628-3700
EXHIBIT #: 14

OFFSET

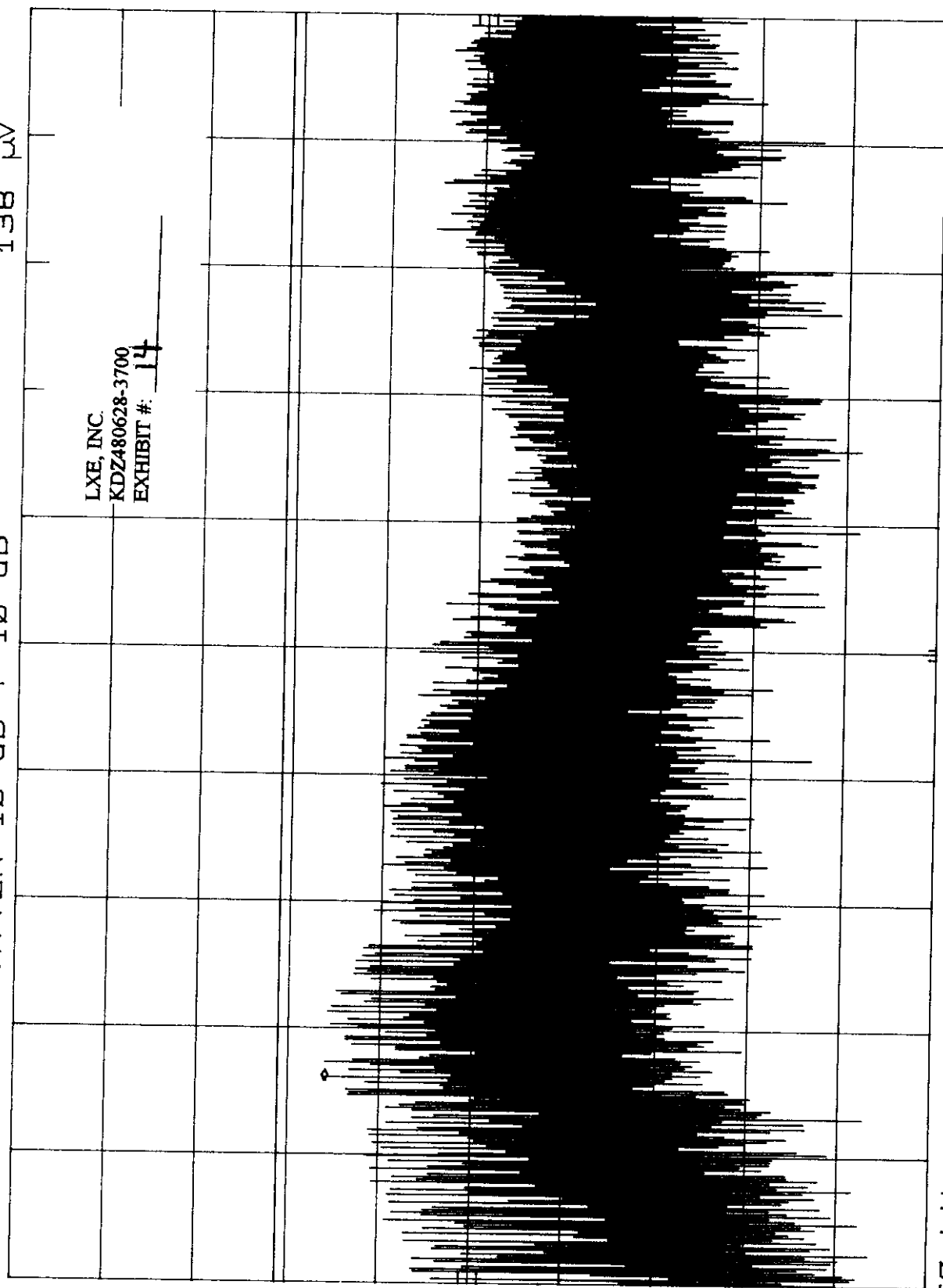
-10.0

dB

DL

251

μ V



START 450 KHZ

RES BW 10 KHZ (1)

VBW 10 KHZ

STOP 30.0 MHz

SWP 2.30 sec

MKR 4.82 MHz
132 μ V

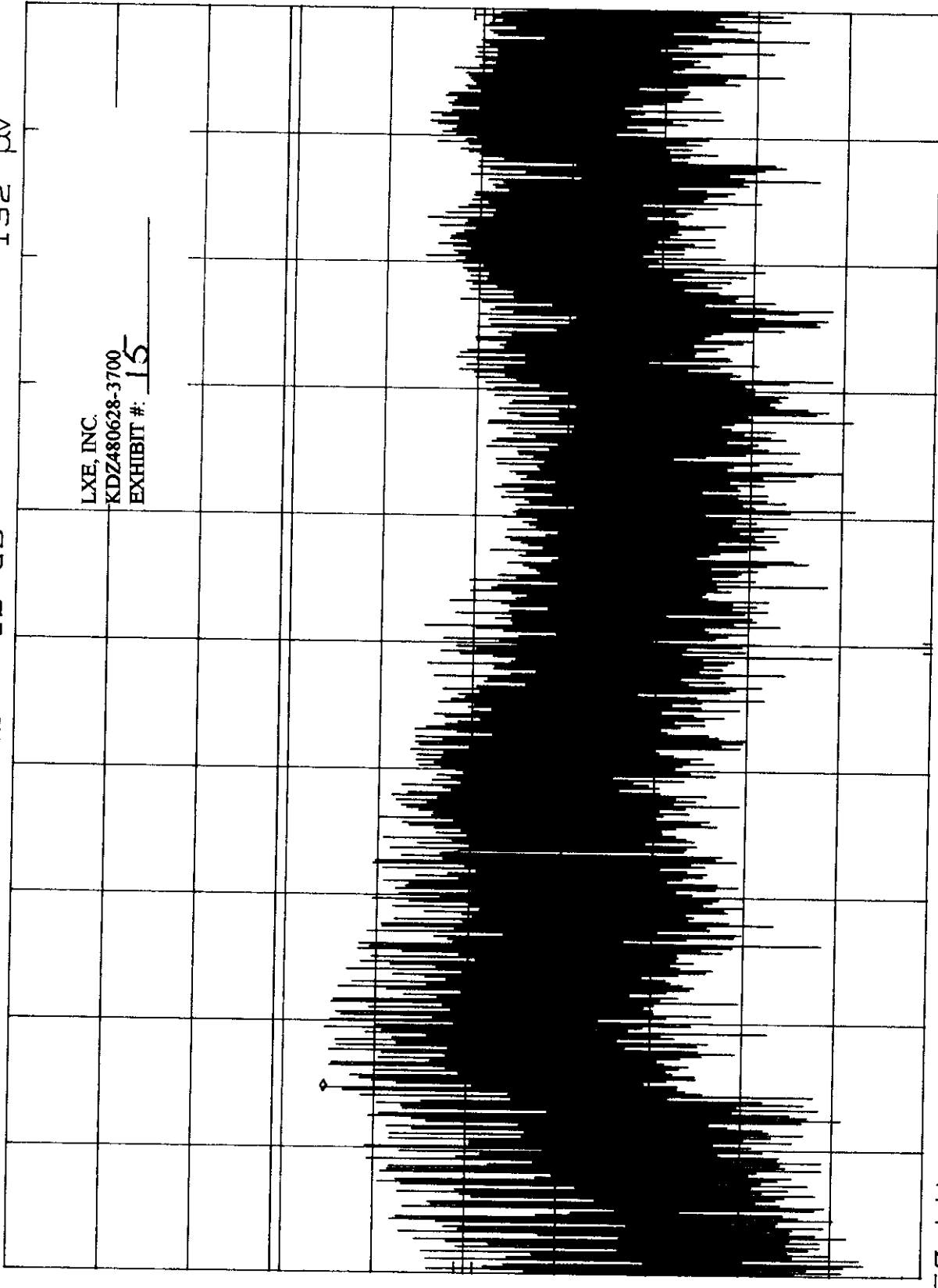
h_p REF 7.00 mV
ATTEN 10 dB + 10 dB

10 dB/

OFFSET
-10.0
dB

DL
251
 μ V

LXE, INC.
KDZ480628-3700
EXHIBIT #: 15



START 450 KHZ
RES BW 10 KHZ (i) VBW 10 KHZ
STOP 30.0 MHz
SWP 2.30 sec

APPLICANT: LXE, IC.
FCCID : KDZ480628-3700

TEST EQUIPMENT LIST

1. Spectrum Analyzer: Hewlett Packard 8566B - Opt 462, w/ preselector 85685A, & Quasi-Peak Adapter HP 85650A, & HP 8449B - OPT H02 Cal. 6/26/98
2. Signal Generator, Hewlett Packard 8640B, cal. 6/26/98
3. Eaton Biconnical Antenna Model 94455-1
20-200 MHz Serial No. 0997 Cal. 5/15/98
4. Electro-Metric Dipole Kit, 20-1000 MHz, Model TDA 25 cal. 5/15/97
5. Electro-Metric Horn 1-18 GHz, Model RGA-180, Cal. 8/15/98
6. Electro-Metric Antennas Model TDS-25-1, TDS-25-2, 5/15/97
7. Electro-Metric Line Impedance Stabilization Network Model
No. EM-7821, Serial No. 101; 100KHz-30MHz 50uH. 12/3/97
8. Electro-Metric Line Impedance Stabilization Network Model
No. EM-7820, Serial No. 2682; 10KHz-30MHz 50uH. 12/3/97
9. Special low loss cable was used above 1 GHz
No. EM-7021, 50uH. 5/21/97
10. Peak Power Meter HP 8900C With Peak Power Sensor HP 84811A

TEST PROCEDURE

GENERAL: This report shall NOT be reproduced except in full without the written approval of TIMCO ENGINEERING, INC. Shielded interface cables were used in all cases except for cables connecting to the telephone line and the power cords. A test program was run which simulated a normal data transmission on a network.

POWER LINE CONDUCTED INTERFERENCE: The procedure used was ANSI STANDARD C63.4-1992 using a 50uH LISN. Both lines were observed with the UUT transmitting. The bandwidth of the spectrum analyzer was 10kHz with an appropriate sweep speed. The ambient temperature of the UUT was 76°F with a humidity of 55%.

BANDWIDTH 6.0dB: The measurements were made with the spectrum analyzer's resolution bandwidth(RBW)=100KHz and the video bandwidth(VBW)=300KHz and the span set as shown on plot.

POWER OUTPUT: The RF power output was measured at the antenna feed point using a peak power meter.

ANTENNA CONDUCTED EMISSIONS: The RBW=100KHz, VBW=300KHz and the span set to 100MHz and the spectrum was scanned from 30MHz to the 10th Harmonic of the fundamental.

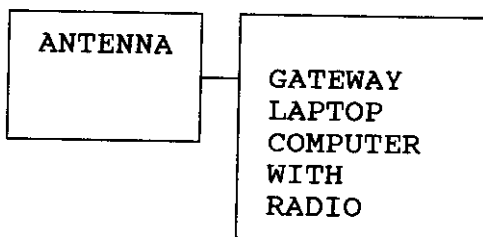
RADIATION INTERFERENCE: The test procedure used was ANSI STANDARD C63.4-1992 using a HEWLETT PACKARD spectrum analyzer with a preselector. The bandwidth(RBW) of the spectrum analyzer was 100kHz up to 1GHz and 1.0MHz above 1GHz with an appropriate sweep speed. The VBW above 1.0GHz was = 10Hz. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The ambient temperature of the UUT was 84°F with a humidity of 66%.

FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 3

APPLICANT: LXE, Inc.
FCC ID: KDZ480628-3700

PRODUCT DESCRIPTION:

The KDZ480628-3700 is a direct sequency spread spectrum radio that operates in the 2400-2483.5MHz band. The unit plugs into a PCMCIA SLOT. The radio is used with three(3) different types of antennas, an ONMI directional, a bi-directional patch, and a Yagi.



APPLICANT: LXE, Inc.
FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 4

APPLICANT: LXE, Inc.
FCC ID: KDZ480628-3700 - ASSEMBLY #1 AND #3
NAME OF TEST: POWER LINE CONDUCTED INTERFERENCE
RULES PART NUMBER: 15.107(a)
REQUIREMENTS: .45 - 30 MHz 250 uV OR 47.96 dBuV
TEST PROCEDURE: ANSI STANDARD C63.4-1992. The spectrum
was scanned from .45 to 30 MHz.
TEST DATA:

THE HIGHEST EMISSION READ FOR LINE 1 WAS 138uV @ 5.24MHz.

THE HIGHEST EMISSION READ FOR LINE 2 WAS 132uV @ 4.82MHz.

THE FOLLOWING GRAPHS REPRESENT THE EMISSIONS TAKEN FOR THIS
DEVICE.

TEST RESULTS: Both lines were observed. The measurements indicate
that the unit DOES appear to meet the FCC requirements for this class
of equipment.

APPLICANT: LXE, Inc.
FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 5

APPLICANT: LXE, Inc.
FCC ID: KDZ480628-3700
NAME OF TEST: 6.0dB BANDWIDTH
RULES PART NUMBER: 15.247(a)(2)
REQUIREMENTS: The 6.0dB bandwidth must be greater than 500KHz.
MEASUREMENT:

The 6.0dB bandwidth measured @ 2411.40MHz was 11.78MHz.
The 6.0dB bandwidth measured @ 2443.10MHz was 11.58MHz.
The 6.0dB bandwidth measured @ 2466.4MHz was 13.50MHz.

MEASUREMENT DATA: See plots, Exhibits #12, 13, & 14.

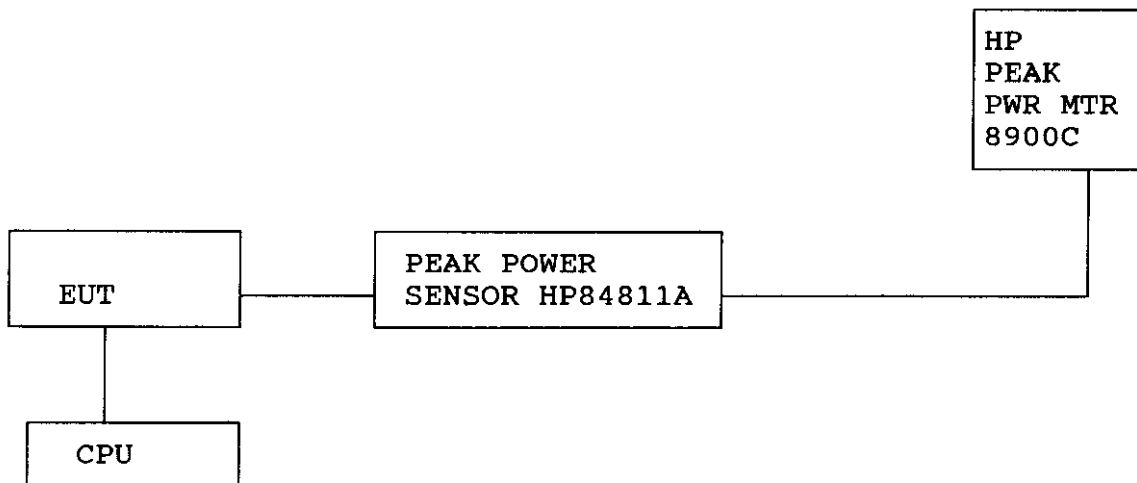
NAME OF TEST: POWER OUTPUT

RULES PART NUMBER: 15.247(b)

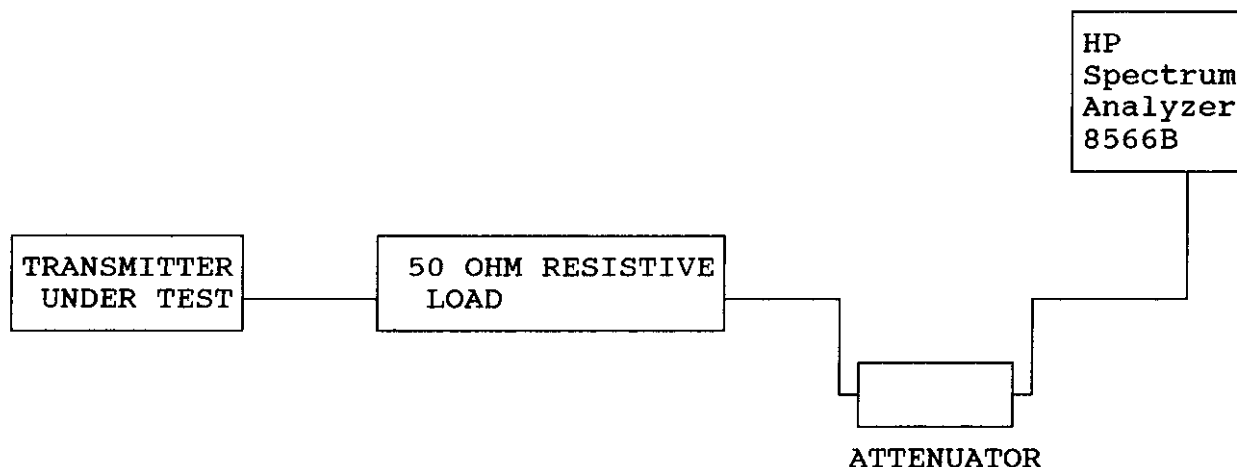
MEASUREMENT: 42.0 mWATTS or 16.0dBm @ 2412.0MHz

15.247(c) Method of Measuring RF Power output:

The Peak power Sensor was connected in place of the antenna.



APPLICANT: LXE, Inc.
FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 6



NAME OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

REQUIREMENTS: Emissions must be at least 20dB down from the highest emission level within the authorized band as measured with a 100KHz RBW.

	EMISSION FREQUENCY MHz	dB BELOW CARRIER
LOW END		
	2412.4	00.0
	4823.8	-40.5
	7236.2	-58.0
	9648.6	-65.2
MIDDLE OF BAND		
	2441.0	0.0
	4843.6	-32.2
	7328.0	-50.2
	9723.0	-63.1
HIGH END OF BAND		
	2468.0	0.0
	4934.0	-37.4
	7402.0	-53.9

NOTE: THE SPECTRUM WAS SCANNED TO THE TENTH HARMONIC.

APPLICANT: LXE, Inc.
 FCCID: KDZ480628-3700
 REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
 PAGE #: 7

15.247(c),15.205 15.209(b) Field strength spurious emissions:

REQUIREMENTS:

FIELD STRENGTH	FIELD STRENGTH	§15.209
of Fundamental:	of Harmonics	30 - 88 MHz 40 dBuV/m @3M
902-928MHz		88 -216 MHz 43.5
2.4-2.4835GHz		216 -960 MHz 46
127.38dBuV/m @3m	54 dBuV/m @3m	ABOVE 960 MHz 54dBuV/m

EMISSIONS RADIATED OUTSIDE OF THE SPECIFIED FREQUENCY BANDS, EXCEPT FOR HARMONICS, SHALL BE ATTENUATED BY AT LEAST 50 dB BELOW THE LEVEL OF THE FUNDAMENTAL OR TO THE GENERAL RADIATED EMISSION LIMITS IN 15.209, WHICHEVER IS THE LESSER ATTENUATION.

REQUIREMENTS: Emissions that fall in the restricted bands (15.205) must be less than 54dBuV/m otherwise the spurious and harmonics must be attenuated by at least 20dB.

TEST DATA:

EMISSION FREQUENCY MHz	METER READING @ 3m dBuV	COAX LOSS dB	ACF dB	FIELD STRENGTH dBuV/m	MARGIN dB	ANT.
62.69	23.70	0.80	7.48	31.98	8.02	H *
114.55	10.30	0.80	8.90	20.00	23.50	V *
123.38	15.90	0.80	10.75	27.45	16.05	V *
157.48	13.00	0.90	16.68	30.58	12.92	H *
167.10	15.70	0.90	18.02	34.62	8.88	H *
168.03	15.90	0.90	18.21	35.01	8.49	H *
171.82	13.30	0.90	17.90	32.10	11.40	H *
186.15	14.30	0.90	14.09	29.29	14.21	H *
192.01	13.50	0.90	13.46	27.86	15.64	H *
207.73	13.00	1.20	12.15	26.35	17.15	H *
210.84	18.30	1.20	12.24	31.74	11.76	H *
225.56	19.60	1.20	12.67	33.47	12.53	H *
226.57	18.20	1.20	12.70	32.10	13.90	H *
250.63	16.30	1.40	13.39	31.09	14.91	H *
270.63	14.70	1.40	13.97	30.07	15.93	V *
275.67	16.70	1.40	14.14	32.24	13.76	H *
300.70	14.30	1.40	15.67	31.37	14.63	H *
308.39	16.90	1.40	15.40	33.70	12.30	V *
350.81	14.40	1.40	15.57	31.37	14.63	H *

Onmi directional Antenna

2411.20	62.50	1.09	29.03	92.62	34.76	H
4824.00R	16.00	1.45	33.93	51.38	2.62	H
2442.00	62.80	1.10	29.10	93.00	34.38	H
4884.00R	14.90	1.46	33.99	50.35	3.65	H
7326.80R	8.50	1.83	36.74	47.07	6.93	H
2468.00	60.80	1.10	29.17	91.07	36.31	H
4936.00R	14.70	1.47	34.05	50.22	3.78	H
7402.00R	5.10	1.84	36.83	43.77	10.23	H

REPORT #: F:\CUS\L\LXE\LXE287U8.RPT

PAGE #: 8

15.247(c),15.205 & 15.209(b) Field strength of spurious emissions:

TEST DATA CONTD.:

EMISSION FREQUENCY MHz	METER READING @ 3m dBuV	COAX LOSS dB	ACF dB	FIELD STRENGTH dBuV/m	MARGIN dB	ANT.
XERTEX 4/6dB Bi-Directinal Patch Antenna						
2413.60	73.20	1.09	29.03	103.33	0.0	H
4824.00R	15.60	1.45	33.93	50.98	3.02	H
7237.60	-1.00	1.82	36.64	37.46	45.87	V
2444.00	71.70	1.10	29.11	101.91	25.47	H
4888.00R	15.10	1.46	34.00	50.56	3.44	V
7328.00R	8.00	1.83	36.74	46.57	7.43	V
2466.40	73.30	1.10	29.17	103.57	23.81	H
4934.00R	14.9	1.47	34.05	50.42	3.58	H
7399.60R	2.30	1.84	36.82	40.97	13.03	V
Yagi Antenna						
2412.00	61.10	1.09	29.03	91.22	36.16	H
4824.00R	15.60	1.45	33.93	50.98	3.02	H
7236.00	1.40	1.82	36.64	39.86	14.14	H
2442.00	61.60	1.10	29.10	91.80	35.58	H
4884.00R	14.60	1.46	33.99	50.05	3.95	H
7326.00R	5.00	1.83	36.74	43.57	10.43	H
2466.40	64.40	1.10	29.17	94.67	32.71	H
4932.80R	14.8	1.47	34.05	50.32	3.68	H
7401.60R	7.50	1.84	36.83	46.17	7.83	H

* designates digital emission.

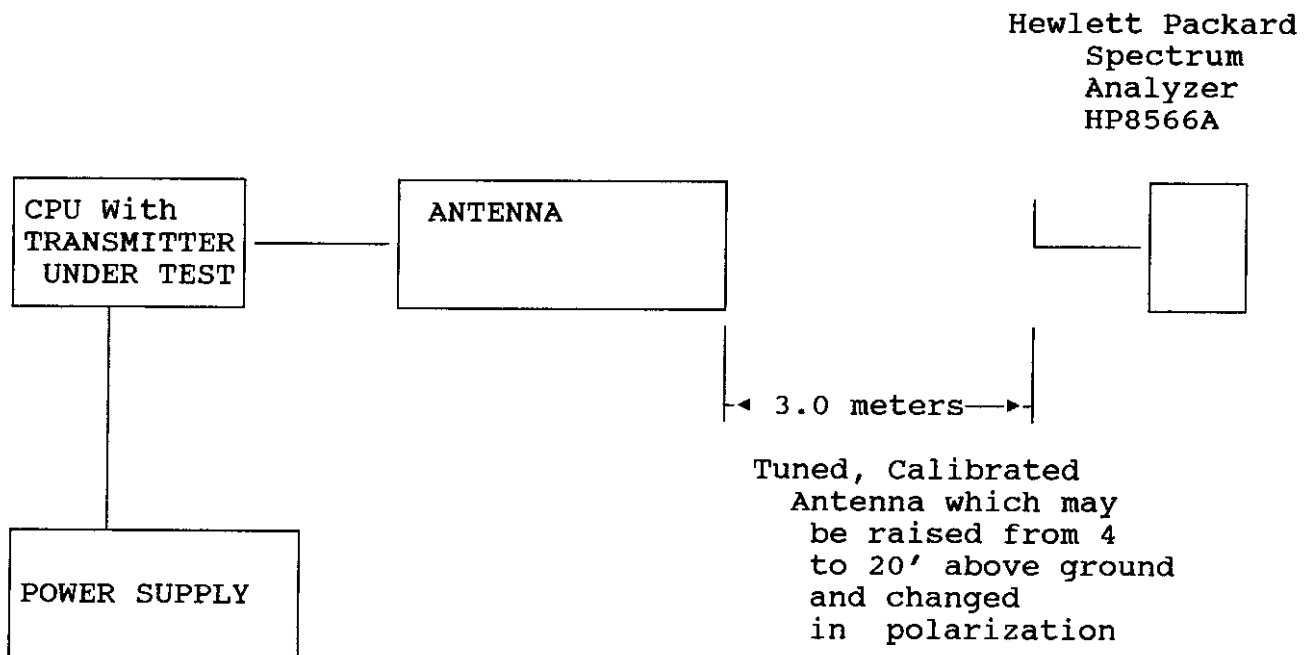
METHOD OF MEASUREMENT: The procedure used was ANSI STANDARD C63.4-1992 except the spread spectrum portion was connected to its custom antenna at a height of 1.5 meters. The spectrum was scanned from 30MHz to at least the tenth harmonic of the fundamental. Above 1.0GHz the RBW was 1.0MHz and the VBW was 10Hz. The case was opened and the power removed from the radio in order to determine which emissions were digital. Measurements were made at the open field test site of TIMCO ENGINEERING INC. located at 6051 N.W. 19th LANE, GAINESVILLE, FL 32605.

APPLICANT: LXE, Inc.
 FCCID: KDZ480628-3700
 REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
 PAGE #: 9

2.993(a)(b)

2.993(a)(b) Continued Field strength of spurious emissions:

Method of Measuring Radiated Spurious Emissions



Equipment placed 4' above ground
on a rotatable platform.

APPLICANT: LXE, Inc.
FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 10

APPLICANT: LXE, Inc.
FCC ID: KDZ480628-3700
NAME OF TEST: POWER SPECTRAL DENSITY
RULES PART NUMBER: 15.247(d)
REQUIREMENTS: The peak level measured must be no greater than
+8.0dBm.
DATA: THE PLOTS ARE SHOWN IN EXHIBITS 15, 16, & 17.

The level at 2412.65MHz was -15.2dBm.
The level at 2442.65MHz was -15.5dBm.
The level at 2467.51MHz was -13.4dBm.

APPLICANT: LXE, Inc.
FCCID: KDZ480628-3700
REPORT #: F:\CUS\L\LXE\LXE287U8.RPT
PAGE #: 11

APPLICANT: LXE, Inc.

FCC ID: KDZ480628-3700

NAME OF TEST: PROCESSING GAIN

RULES PART NUMBER: 15.247(e)

REQUIREMENTS:

DATA: The processing gain information supplied by the
manufacturer is 10.5dB.

APPLICANT: LXE, Inc.

FCCID: KDZ480628-3700

REPORT #: F:\CUS\L\LXE\LXE287U8.RPT

PAGE #: 12

Attachment 2: Lower Bandedge Plot

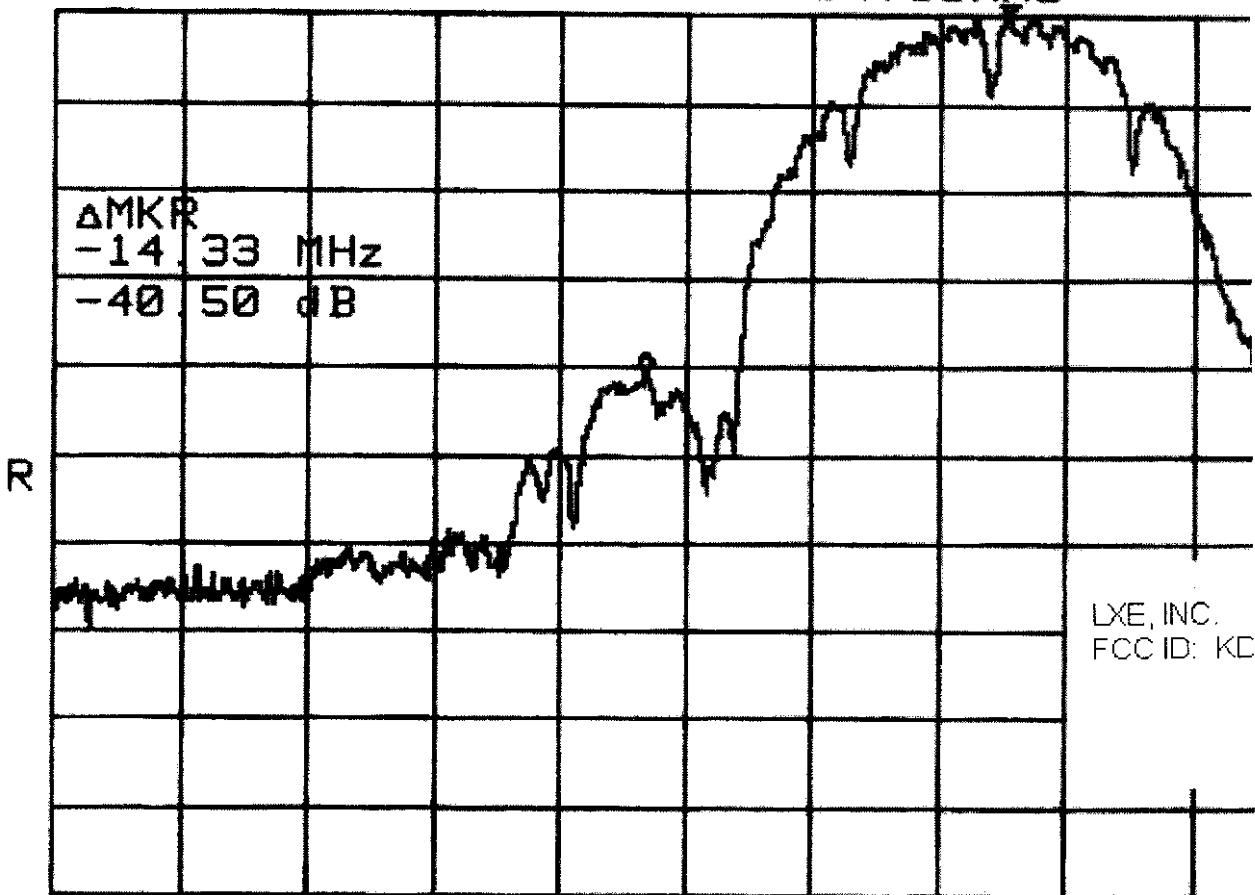
*ATTEN 10dB

RL 2.0dBm

10dB/

 Δ MKR -40.50dB

-14.33MHz



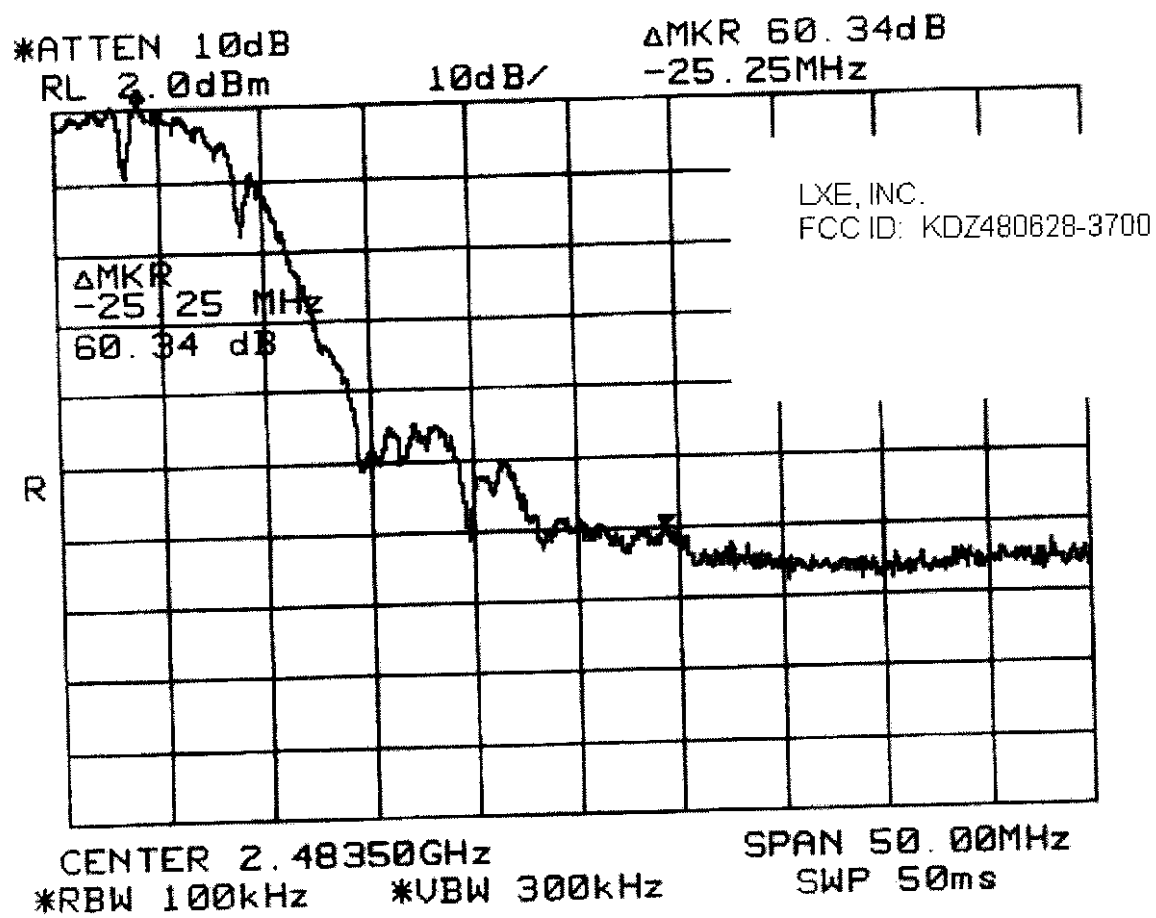
CENTER 2.40000GHz

SPAN 50.00MH

*RBW 100kHz

*VBW 300kHz

SWP 50ms

Attachment 3: Upper Bandedge Plot

Attachment 4: Antenna Information and MPE Calculation**I. Antenna Information**LXE, INC.
FCC ID: KDZ4801

The following antennas were submitted with the 480628-3700 radio for						
MANUFACTURER	MODEL	LXE PART NUMBER	TYPE	EQUIPMENT USED WITH	GAIN	Max. EIRP* (mW)
EMS	Spire	155581-0001	Omni	Access Point	6dB	158
EMS	Spire	155582-0001	Omni	Access Point	3dB	79.4
Cushcraft	None	153325-0001	Omni	Access Point	0dB	42.0
Cushcraft	None	481246-2400	Patch	Access Point	6dB	158
Cushcraft	None	153600-0001	Omni	Access Point	3dB	79.4
Lucent Technologies	None	480426-0425	Omni	Access Point	2.5dB	70.8
Cushcraft	None	153180-0001	Omni	1380/90 VMT	0dB	42.0
Xeterx	Bi-Directional	480424-3411	Patch	Access Point	4&6	158
Lucent Technologies	None	155520-0001	Patch	Amity-VP and P1510	0dB	42.0
LXE	None	155522-0001	Omni	2330 VHHT	0dB	42.0
LXE	None	155526-0001	Patch	2330 VHHT	0dB	42.0

* Max EIRP was determined by the following formula:

$$\text{EIRP}_{\text{MAX}} = \text{EIRP}_{\text{RADIO}} + \text{Antenna Gain}$$

Where $\text{EIRP}_{\text{RADIO}}$ was found to be 16dBm or 42 mW as given in the FCC test report**EXAMPLE WITH THE 6dB SPIRE:**

$$\text{EIRP}_{\text{MAX}} = 16\text{dBm} + 6\text{dB} = 22\text{dBm} \text{ or } 158\text{mW}$$

II. Intended Uses

The theory of operation of the 480628-3700 is to establish a wireless LAN environment in a commercial or industrial environment. The two major applications for LXE with this type of equipment is inventory control healthcare as described below.

Inventory control

The first application is inventory control in a warehouse setting in which a ruggedized Vehicle Mount PC Terminal(VMT) equipped with a PCMCIA bus, is fitted with the radio. The operator of the VMT can manipulate and track inventory and then transmit the information back to the Accesspoint, or base station, via the RF link. The Accesspoint is tied into a wired LAN via Ethernet for which the information is transferred to a main server for processing. The Accesspoint terminals are the base station devices, or Hubs, that portable terminals(Terminals mentioned above other than Access points) communicate through. The Access points and the portables are compatible and use the same plug-in radio module(480628-3700) to communicate to one another.

In this application, an Accesspoint is normally mounted to a wall such that sufficient coverage is maintained. Depending on the facility, one of the above mentioned antennas is chosen for maximum range and coverage. This antenna is connected to the radio via a custom designed connector with a nominal length of cable(Typically not longer than 1 meter) and an Ethernet connection is provided from the access point to the main server.

As mentioned above, the VMT's are merely ruggedized 386 PC's with PCMCIA interfaces. The VMT's are equipped with one of the antennas above via a non-standard connector(RTNC). Each VMT and Accesspoint are loaded with some specialized software and are then able to communicate.

Healthcare

Another popular application is in the healthcare field. The same premise mentioned above applies however with slightly different types of terminals. The terminals in this case are off the shelf pen type PC terminals(PC's) which are operated with a pen stick as opposed to a keyboard. Again, an Accesspoint is located in a central location(Such as a main hall), and nurses and doctors use the terminals as data collection terminals(This eliminates the old charting method). This data is then sent via the RF link to the access point where it is then transferred to the PC via Ethernet. Due to the difference in terminals, other antennas(as listed above)

downloaded into the PC via Ethernet. Due to the differences in terminals, special adapters need to be used. In each case a specialized connector is used to couple the antenna to the radio.

III. MPE Calculations

In this section, worst case calculations are offered to demonstrate compliance with the Limits of Maximum Permissible Exposure. Calculations were made with reference to OET bulletin 65, Edition 97-01, August 1

After evaluation of the document, Equation 5 in section 2 is determined to be relevant to LXE equipment. equation is given as :

$$S = EIRP/4\pi R^2 = (1.64)ERP/4\pi R^2 = (0.41)ERP/\pi R^2$$

Where

S = Power Density(mW/cm²)
 EIRP = Equivalent(or effective) isotropically radiated power
 ERP = Power referenced to a half-wave dipole radiator
 R = Distance from center of radiation pattern to the point of interest

Given:

- Radio ERP = 42 mW or 16 dBm as measured and given in page 6 of FCC test report for the 480628-radio.
 - EIRP = 1.64xERP

The results obtained by these calculations were compared to the limits given in Table 1 of Appendix A of : document.

Access Point Antennas

EMS 6dB Spire(155581-0001)

This antenna will be used in various applications requiring placement of it in a variety of settings. However typical use of this antenna is thought to be worst case as it will be mounted vertically and flush with an indoor ceiling.

Assuming

The average person is 6 feet or 1.829 meters tall
 The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 13.2cm

Therefore

R = 3.05m(Ceiling Height) - 1.829m(Average Person Height) - .132m(Antenna Length) = 1.089m
 $ERP_T = 16dBm(Radio ERP) + 6dBi(Antenna Gain) = 22dBm$ or 158mW

Result

$S = (0.41)ERP/\pi R^2 = (0.41)158mW/\pi(108.9cm)^2$
 $S = .002mW/cm^2$

The above result is well below the specified 5mW/cm² for Occupational/Controlled Exposure environment well below the 1mW/cm² for General Population/Controlled Exposure environments.

LXE, INC.
 FCC ID: KDZ480628-3700

LXE, INC.

FCC ID: KDZ480628-3700

Xertex 46dB Patch(480424-3411)

This antenna is a flat patch antenna and will be used in various applications requiring placement in a variety of settings. However, the typical use of this antenna is thought to be worst case as it will be mounted such that it hangs from an indoor ceiling. The antenna has a height of 4 inches and includes a 3 inch mounting bracket that causes the antenna to hang vertically from the ceiling a total of 7 inches.

Assuming

The average person is 6 feet or 1.829 meters tall

The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 4 inches or 10.2 cm

Antenna Mount = 3 inches or 7.62 cm

Therefore

$R = 2.06m(\text{Ceiling Height}) - 1.829m(\text{Average Person Height}) - .330m(\text{Antenna Length}) = .891m$

$ERP = 16dBm(\text{Radio ERP}) + 6dB(\text{Antenna Gain}) = 22dBm \text{ or } 158mW$

Result

$S = (0.41)ERP/R^2 = (0.41)158mW/(.892cm)^2$

$S = .065mW/cm^2$

$R = 11.2 \text{ cm}$

The above result is well below the specified $5mW/cm^2$ for Occupational/Controlled Exposure environments, and well below the $1mW/cm^2$ for General Population/Controlled Exposure environments.

Portable Terminals**Cushcraft 0dB Omni(153180-0001)**

This antenna is used on the Ruggedized Vehicle Mount Terminal(VMT) PC. The PC is mounted on a fork lift truck, approximately .5m in front and .3m above the drivers head. Simple Trigonometry yields an R distance of 58.3 cm from the radiating element to the point of interest, the drivers head.

Therefore

$R = 58.3cm$

$ERP = 15dBm(\text{Radio ERP}) + 0dB(\text{Antenna Gain}) = 15dBm \text{ or } 42mW$

Result

$S = (0.41)ERP/R^2 = (0.41)42mW/(58.3cm)^2$

$S = .002mW/cm^2$

$R = 5.8 \text{ cm}$

The above result is well below the specified $5mW/cm^2$ for Occupational/Controlled Exposure environments, and well below the $1mW/cm^2$ for General Population/Controlled Exposure environments.

Lucent Technologies 0dB Patch Antenna(155520-0001)

This antenna is used in the Pen Terminal type PC's mentioned above. The antenna is mounted on the front edge of the PC in an outward direction from the user. The antennas are located approximately 15cm, but not closer than 10cm. In the spirit of worst case scenario, 10cm will be used for the calculations.

Therefore

$R = 10.0cm$

$ERP = 15dBm(\text{Radio ERP}) + 0dB(\text{Antenna Gain}) = 15dBm \text{ or } 42mW$

Result

$S = (0.41)ERP/R^2 = (0.41)42mW/(10.0cm)^2$

$S = .054mW/cm^2$

The above result is well below the specified $5mW/cm^2$ for Occupational/Controlled Exposure environments, and well below the $1mW/cm^2$ for General Population/Controlled Exposure environments.

$R = 5.8 \text{ cm}$

for $S = 1 \text{ mW/cm}^2$

LXE, INC.
FCC ID: K**LXE 0dB Patch Antennas(155522-0001 and 155526-0001)**

These antennas are used in a diversity scheme in a handheld PC terminal. the device, and in the recommended use of the terminal the antennas are at from the users hand.

Therefore

$$R = 6.35\text{cm}$$

$$\text{ERP}_T = 16\text{dBm(Radio ERP)} + 0\text{dBi(Antenna Gain)} = 16\text{dBm or } 42\text{mW}$$

For $S = 1\text{mW/cm}^2$
 $R = 5.8\text{cm}$

Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)42\text{mW}/\pi(6.35\text{cm})^2$$

$$S = .140\text{mW/cm}^2$$

The above result is well below the specified 5mW/cm^2 for Occupational/Cor well below the 1mW/cm^2 for General Population/Controlled Exposure envirc

LXE, INC.

FCC ID: KDZ480628-3700

EMS 3dB Spire(155582-0001)

This antenna will be used in various applications requiring placement of it in a variety of settings. However typical use of this antenna is thought to be worst case as it will be mounted vertically and flush with an indoor ceiling.

Assuming

The average person is 6 feet or 1.829 meters tall

The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 3.81cm

Therefore

$$R = 3.05\text{m}(\text{Ceiling Height}) - 1.829\text{m}(\text{Average Person Height}) - .0381\text{m}(\text{Antenna Length}) = 1.183\text{m}$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 3\text{dBi}(\text{Antenna Gain}) = 19\text{dBm or } 79.4\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)79.4\text{mW}/\pi(118.3\text{cm})^2$$

$$S = .740\mu\text{W}/\text{cm}^2$$

The above result is well below the specified $5\text{mW}/\text{cm}^2$ for Occupational/Controlled Exposure environment well below the $1\text{mW}/\text{cm}^2$ for General Population/Controlled Exposure environments.

Cushcraft 15dB Yagi(460601-3020)

This antenna is used to create a wireless bridge between large distances. They are usually used in pairs mounted outside on the respective buildings roof. Minimum height is typically at 10m.

Assuming

The average person is 6 feet or 1.829 meters tall

Therefore

$$R = 10\text{m}(\text{Roof Height}) - 1.829\text{m}(\text{Average Person Height}) = 8.171\text{m}$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 15\text{dBi}(\text{Antenna Gain}) = 31\text{dBm or } 1259\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)1259\text{mW}/\pi(817.1\text{cm})^2$$

$$S = .025\mu\text{W}/\text{cm}^2$$

The above result is well below the specified $5\text{mW}/\text{cm}^2$ for Occupational/Controlled Exposure environment well below the $1\text{mW}/\text{cm}^2$ for General Population/Controlled Exposure environments.

Cushcraft 0dB Omni(153325-0001)

This antenna will be used in various applications requiring placement of it in a variety of settings. However typical use of this antenna is thought to be worst case as it will be mounted vertically and flush with an indoor ceiling.

Assuming

The average person is 6 feet or 1.829 meters tall

The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 21.6cm

Therefore

$$R = 3.05\text{m}(\text{Ceiling Height}) - 1.829\text{m}(\text{Average Person Height}) - .261\text{m}(\text{Antenna Length}) = .960\text{m}$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 0\text{dBi}(\text{Antenna Gain}) = 16\text{dBm or } 42\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)42.0\text{mW}/\pi(96.0\text{cm})^2$$

$$S = .005\mu\text{W}/\text{cm}^2$$

0.000177/cm²

The above result is well below the specified 5mW/cm² for Occupational/Controlled Exposure environments
well below the 1mW/cm² for General Population/Controlled Exposure environments.

LXE, INC.

FCC ID: KDZ480628-3700

Cushcraft 3dB Omni(153600-0001)

This antenna will be used in various applications requiring placement of it in a variety of settings. However, typical use of this antenna is thought to be worst case as it will be mounted vertically and flush with an indoor ceiling.

Assuming

The average person is 6 feet or 1.829 meters tall

The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 33.0cm

Therefore

$$R = 3.05\text{m}(\text{Ceiling Height}) - 1.829\text{m}(\text{Average Person Height}) - .330\text{m}(\text{Antenna Length}) = .891\text{m}$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 0\text{dBi}(\text{Antenna Gain}) = 16\text{dBm or } 42\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)42.0\text{mW}/\pi(89.1\text{cm})^2$$

$$S = .690\mu\text{W}/\text{cm}^2$$

The above result is well below the specified $5\text{mW}/\text{cm}^2$ for Occupational/Controlled Exposure environment well below the $1\text{mW}/\text{cm}^2$ for General Population/Controlled Exposure environments.

Cushcraft 6dB Patch(15481246-2400)

This antenna is a flat patch antenna and will be used in various applications requiring placement in a varie settings. However, the typical use of this antenna is thought to be worst case as it will be mounted flush a a wall and next to an indoor ceiling.

Assuming

The average person is 6 feet or 1.829 meters tall

The average height of an indoor ceiling in commercial environment is 10 feet or 3.05 meters.

Known

Antenna Length = 10.2cm

Therefore

$$R = 3.05\text{m}(\text{Ceiling Height}) - 1.829\text{m}(\text{Average Person Height}) - .330\text{m}(\text{Antenna Length}) = .891\text{m}$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 6\text{dBi}(\text{Antenna Gain}) = 22\text{dBm or } 158\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)158\text{mW}/\pi(10.2\text{cm})^2$$

$$S = .198\text{mW}/\text{cm}^2$$

The above result is well below the specified $5\text{mW}/\text{cm}^2$ for Occupational/Controlled Exposure environmen well below the $1\text{mW}/\text{cm}^2$ for General Population/Controlled Exposure environments.

Lucent Range Extender 2.5 (480426-0425)

This antenna is a desktop type antenna for use in either the Accesspoint or a portable terminal. Howeve use of this antenna is thought to be worst case as it will likely be located on a desk next to an Accesspoir

Assuming

The antenna is located at arms length-30 inches or 76.2cm

Therefore

$$R = 76.2\text{cm}(\text{Antenna at Arms Length})$$

$$\text{ERP}_T = 16\text{dBm}(\text{Radio ERP}) + 2.5\text{dBi}(\text{Antenna Gain}) = 18.5\text{dBm or } 70.8\text{mW}$$
Result

$$S = (0.41)\text{ERP}/\pi R^2 = (0.41)70.8\text{mW}/\pi(76.2\text{cm})^2$$

$$S = .002\text{mW}/\text{cm}^2$$

$R = 7.5\text{cm}$

The above result is well below the specified $5\text{mW}/\text{cm}^2$ for Occupational/Controlled Exposure environments well below the $1\text{mW}/\text{cm}^2$ for General Population/Controlled Exposure environments.