5.0 - ELECTROMAGNETIC COMPATIBILITY TEST DATA

5.1 - General

Electromagnetic compatibility testing is divided into sections, as follows:

a) HP141T Spectrum Analyzer Detector,
b) IFR Spectrum Aalyzer
c) Site Calibration
d) Receiver Tests
e) Transmitter Tests
    1) Antenna Conducted Spurious Emissions a
    2) Case Radiated Spurious Emissions

Measurements were made from 30 Mhz to 40 Ghz on the receiver and transmitter, using an IFR A-7550 Spectrum Analyzer, SN 2347 and an HP141T Spectrum Analyzer, SN 2205A21383 with calibrated mixers. The IFR A-7550 was used for measurements below 1000 Mhz.

5.2 - Hewlett Packard 141 T Spectrum Analyzer Detecter

The HP141T Spectrum Analyzer system 3 Db IF bandwidth or resolution bandwidth was set to 10 Khz for all measurements. The FCC requires a bandwidth of 4 Khz. Therefore the observed data is 10 log (10/4) = 4.0 Db too high.

The noise bandwidth, for the HP141T system, as defined by Hewlett Packard Application Note 150-4, April 1974, is 1.2 times the three Db bandwidth. Therefore the observed data is an additional 10 log (1.2) = 0.8 Db too high.

From the previously mentioned application note it is stated that "the detected signal is smaller than its true rms value. This correction for the log display mode combined with the detector characteristics gives a total correction of 2.5 Db, which should be added to any random noise measured in the log display mode. "

The summation of corrections is as follows:

- 4.0 Db	**Bandwidth**
- 0.8 Db	**Noise bandwidth**
+ 2.5 Db	**Detector characteristics**
- 2.3 Db	**Total**

The observed power levels are therefore 2.3 Db too high for noise or noise like random signals, for the HP analyzer.

5.3 - IFR A7550 Spectrum Analyzer Detectors

For site calibration data from 30 - 1000 Mhz the peak detector was utilized, 200 Khz resolution bandwidth.

The guidelines for Verification are set by the American National Standards Institute (ANSI)in C63.4-1992. These guidelines were originally set by the Comite International Special Pertubations Radioelectroniques (CISPR) and call for quasi-peak detection.

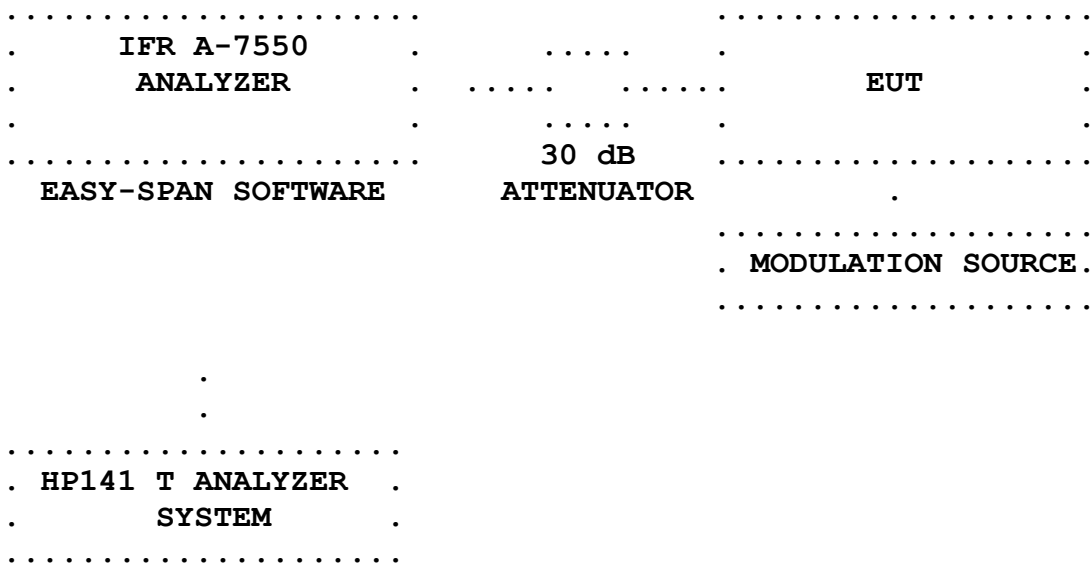
On the A7550 Quasi-Peak measurements is valid only in the Linear Mode, with proper bandwidth. The quasi-peak detector utilized had a bandwidth of 120 Khz. The signal amplitude (in dbuv) is calculated from the formula A = T + X where:

A = value in dbuv
T = top of scale
X = value from table, attached

In conformance with the operating manual the A7550 was first used with the EUT turned off to null out the ambient spectrum. The ambient spectrum was nulled in steps of 30-100, 100 -200, 200-300 Mhz etc, as well as first looking at the entire band. We then stored the trace and subtracted it from the spectrum with the EUT on. Quasi-peak measurements were then made.

KQ9LRU REQUEST FOR CERTIFICATION

FIGURE 3 - MODULATION TEST SETUP



A-7550 SIGNAL AMPLITUDE VALUES IN LINEAR MODE

Table D-1 contains values calculated for measuring Signal Amplitudes in linear mode, in .05 division intervals. Table D-1 values for X are computed from the formula: $X = 20 \log (D \div 8)$; and are applied to the following formula to compute the Signal Amplitude (A): $A = T + X$.

T is the Top of Screen value in dBm, dBμW, dBV, dBmV or dBμV. D is the number of divisions from the bottom graticule of the screen.

Div	X	Div	X	Div	X	Div	X
8.00	0.00	6.00	-2.50	4.00	-6.02	2.00	-12.04
7.95	-0.05	5.95	-2.57	3.95	-6.13	1.95	-12.26
7.90	-0.11	5.90	-2.64	3.90	-6.24	1.90	-12.49
7.85	-0.16	5.85	-2.72	3.85	-6.35	1.85	-12.72
7.80	-0.22	5.80	-2.79	3.80	-6.47	1.80	-12.96
7.75	-0.28	5.75	-2.87	3.75	-6.58	1.75	-13.20
7.70	-0.33	5.70	-2.94	3.70	-6.70	1.70	-13.45
7.65	-0.39	5.65	-3.02	3.65	-6.82	1.65	-13.71
7.60	-0.45	5.60	-3.10	3.60	-6.94	1.60	-13.98
7.55	-0.50	5.55	-3.18	3.55	-7.06	1.55	-14.26
7.50	-0.56	5.50	-3.25	3.50	-7.18	1.50	-14.54
7.45	-0.62	5.45	-3.33	3.45	-7.31	1.45	-14.83
7.40	-0.68	5.40	-3.41	3.40	-7.43	1.40	-15.14
7.35	-0.74	5.35	-3.49	3.35	-7.56	1.35	-15.46
7.30	-0.80	5.30	-3.58	3.30	-7.69	1.30	-15.78
7.25	-0.86	5.25	-3.66	3.25	-7.82	1.25	-16.12
7.20	-0.92	5.20	-3.74	3.20	-7.96	1.20	-16.48
7.15	-0.98	5.15	-3.83	3.15	-8.10	1.15	-16.85
7.10	-1.04	5.10	-3.91	3.10	-8.23	1.10	-17.23
7.05	-1.10	5.05	-4.00	3.05	-8.38	1.05	-17.64
7.00	-1.16	5.00	-4.08	3.00	-8.52	1.00	-18.06
6.95	-1.22	4.95	-4.17	2.95	-8.67	0.95	-18.51
6.90	-1.28	4.90	-4.26	2.90	-8.81	0.90	-18.98
6.85	-1.35	4.85	-4.35	2.85	-8.96	0.85	-19.47
6.80	-1.41	4.80	-4.44	2.80	-9.12	0.80	-20.00
6.75	-1.48	4.75	-4.53	2.75	-9.28	0.75	-20.56
6.70	-1.54	4.70	-4.62	2.70	-9.43	0.70	-21.16
6.65	-1.61	4.65	-4.71	2.65	-9.60	0.65	-21.80
6.60	-1.67	4.60	-4.81	2.60	-9.76	0.60	-22.50
6.55	-1.74	4.55	-4.90	2.55	-9.93	0.55	-23.25
6.50	-1.80	4.50	-5.00	2.50	-10.10	0.50	-24.08
6.45	-1.87	4.45	-5.09	2.45	-10.28	0.45	-25.00
6.40	-1.94	4.40	-5.19	2.40	-10.46	0.40	-26.02
6.35	-2.01	4.35	-5.29	2.35	-10.64	0.35	-27.18
6.30	-2.07	4.30	-5.39	2.30	-10.83	0.30	28.52
6.25	-2.14	4.25	-5.49	2.25	-11.02	0.25	-30.10
6.20	-2.21	4.20	-5.60	2.20	-11.21	0.20	-32.04
6.15	-2.28	4.15	-5.70	2.15	-11.41	0.15	-34.54
6.10	-2.36	4.10	-5.81	2.10	-11.62	0.10	-38.06
6.05	-2.43	4.05	-5.91	2.05	-11.83	0.05	-44.08
						0.01	-58.06

Table D-1 A-7550 Signal Amplitude (A) Values for $X = 20 \text{ Log } (D \div 8)$

5.4 - OATS Size & Location

The OATS measured 8.5 meters by 14.6 meters. The OATS was constructed on a plywood platform, covered by a metal ground plane. It was located in a field adjacent to the Sercel Cable Manufacturing Plant. Sercel has three facilities on Park Row, in Houston, Texas.

The coordinates, as taken by a Differential GPS and referenced to NAD83, were: 40:25:19.9 North Latitude by 086:52:19.1 West Longitude. Dates of testing were March 09, 10, 12, 13 & 14, 15 th, 2002. Hours of testing were 6:30 AM to 6:30 PM. We chose to work on Saturday and Sunday as rain was forecasted and did occur on Monday. The temperature at the site was roughly 62 degrees Fahrenheit/ 16.7 degrees Centigrade throughout the test period.

5.41 OATS Calibration Test Procedure

Two Bicon Log Periodic Antennas were utilized. One an Emco 3143 calibrated to 1.7 Ghz by Emco. The second antenna was also a Bicon Log Periodic built by Antenna Research, model LPB 2520/A, rented from Teology.

We picked up the EMCO 3143, 2075-2 motorized mast and 2090 Fiber-optic Controller at EMCO in Texas and drove to the site. The 2075-2 and 2090 were rented from EMCO.

Three meter separation was kept between the centerline of the two antennas.

The mutal impedance correction factors for broadband antennas equals zero.

Attenuators were not found to be necessary to minimize cable reflections. In actuality we would have had to borrow coaxial attenuators because United Parcel Service (UPS) temporarily misplaced our tray of coaxial attenuators. We decided to try it without and found we were able to achieve the desired results.

A Marconi 2022E Signal generator was utilized to feed the Antenna Research LPB 2520/A Bicon Log Peridic Antenna. This antenna was kept at a fixed height of 2 meters above the ground plane for the Horizontal Polarization, while the receive antenna was scanned from 1 to 4 meters in height, at three meters center - center of the two antennas. For Vertical Polarization the antenna was kept 1.0 meters off the ground plane while the receive antenna was varied from 1 to 4 meters in height.

The equation used to calculate values was:

An = Vdirect - Vsite - TXfactor - RXfactor

where: An = Normalized Site Attenuation (db)

Vdirect = reading with the two cables disconnected from the antenna and connected to each other via an adapter, in this case male to male type N.

Vsite = reading re-connected to their respective antennas and with the receive antenna scanned in height from 1-4 meters, maximum reading recorded.

Txfactor = Transmit Antenna Factor

Rxfactor = Receive Antenna Factor

Pictures of the OATS are attached as well as calibration data.

PHOTO 3

TEST SITE CALIBRATION PHOTO

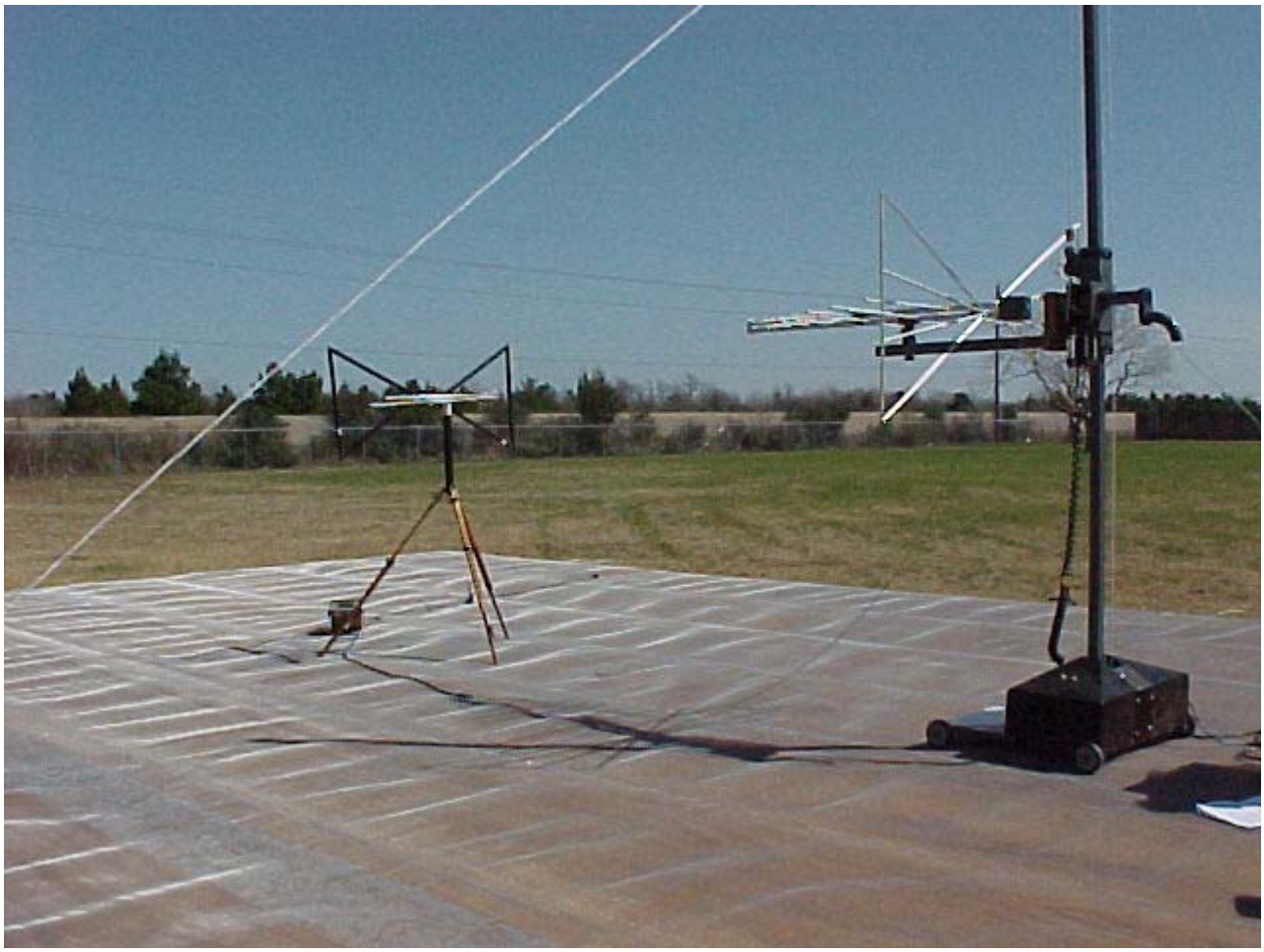


PHOTO 4

PICTURE OF TEST SITE TAKEN FROM A DISTANCE

Power Lines 65 Feet from Edge

(1) Frequency (MHz)	(2) Polarization H or V	(3) V_{DIRECT} dB (μV)	(4) V_{SITE} dB (μV)	(5) ΔAF_{TOT} See Table 4 dB	(6) Adjusted Site Attenuation dB	(7) AF_{TX} dB (1/m)	(8) AF_{RX} dB (1/m)	(9) A_N (NSA) Measured dB $(1/m)^2$	(10) A_N (NSA) Theoretical dB $(1/m)^2$	(11) Deviation dB
30	H	78	31	Ø	47	20.2	14.2	12.6	11.0	+1.6
35			34.5		43.5	20.2	13.9	9.4	8.8	+0.6
40			46		32	15.6	9.6	6.8	7.0	-0.2
45			50		28	14.6	8.8	4.6	5.5	-0.9
50			54		24	13.6	5.9	4.5	4.2	+0.3
60			58		20	13.8	5.4	0.8	2.2	-1.4
70			62		16	6.3	8.0	1.7	0.6	+1.1
80			61		17	7.3	9.2	0.5	-0.7	+1.2
90			60		18	11.1	8.3	-1.4	-1.8	+0.4
100			64		14	9.8	7.6	-3.4	-2.8	-0.6
125			63		15	11.1	7.9	-4.0	-4.7	+0.7
150			62		16	11.4	10.8	-6.2	-6.3	+0.1
175			66		12	10.1	9.1	-7.2	-6.9	-0.3
200			66		12	9.8	10.6	-8.4	-8.4	0.0
250			64		14	12.9	12.0	-10.9	-10.6	-0.3
300			60		18	16.5	14.1	-12.6	-12.3	-0.3
400			60.5		17.5	17.4	15.9	-15.8	-14.9	-0.9
500			60.5		17.5	17.3	17.3	-17.1	-16.7	-0.4
600			57		21	20.2	19.3	-18.5	-18.3	-0.2
700			56		22	21.1	20.5	-19.6	-19.7	+0.1
800			57		21	21.0	20.8	-20.8	-20.8	0.0
900	↓	↓	54	↓	24	22.7	22.9	-21.6	-21.8	+0.2
1000			54		24	23.8	23.7	-23.5	-22.7	-0.8

Note:
(6)=(3)-(4)-(5)
(9)=(6)-(7)-(8)
(10)=See Tables 1-3
(11)=(10)-(9)

REMARKS:

BROADBAND ANTENNAS - HORIZONTAL - SITE WITHIN ±4dB SPEC.

SITE CALIBRATION

Fig A1
Site Attentuation Worksheet

(1) Frequency (MHz)	(2) Polarization H or V	(3) V_{DIRECT} dB (μV)	(4) V_{SITE} dB (μV)	(5) ΔAF_{TOT} See Table 4 dB	(6) Adjusted Site Attenuation dB	(7) AF_{TX} dB (1/m)	(8) AF_{RX} dB (1/m)	(9) A_N (NSA) Measured dB $(1/m)^2$	(10) A_N (NSA) Theoretical dB $(1/m)^2$	(11) Deviation dB
30	V	78	40	ϕ	38	18.5	13.0	6.5	8.2	+1.7
35			40		38	18.5	12.8	6.7	6.9	-1.2
40			46		32	15.0	9.2	7.8	5.8	+2.0
45			54		24	13.1	8.0	2.9	4.9	-2.0
50			52		26	13.0	6.9	6.1	4.0	+2.1
60			57		21	12.6	5.7	2.7	2.6	+0.1
70			65		13	5.2	6.6	1.2	1.5	-0.3
80			65		13	5.8	7.6	-0.4	0.6	+1.0
90			62		16	9.3	7.0	-0.3	-0.1	-.2
100			63		15	8.4	6.5	+0.1	-0.7	-0.8
125			63		15	9.2	6.6	-0.8	-1.6	+0.8
150			60		18	10.3	8.2	-0.5	-1.8	+1.3
175			64.2		13.8	8.3	7.1	-1.6	-1.4	-0.2
200			64.5		13.5	8.7	8.4	-3.6	-3.6	0.0
250			64.2		13.8	11.2	9.7	-7.1	-7.7	+0.6
300			60		18	14.8	14.0	-10.8	-10.5	-0.3
400			60		18	15.4	15.1	-12.5	-14.0	+1.5
500			62		16	16.3	16.4	-16.7	-16.4	-0.3
600			60		18	18.0	18.2	-18.2	-16.3	-1.9
700			55		23	19.8	19.8	-16.6	-18.4	-1.8
800			57		21	20.6	20.0	-19.6	-20.0	+0.4
900			57		21	21.5	21.8	-22.3	-21.3	-1.0
1000			55		23	22.6	23.1	-22.7	-22.4	-0.3

Note:
(6)=(3)-(4)-(5)
(9)=(6)-(7)-(8)
(10)=See Tables 1-3
(11)=(10)-(9)

REMARKS:

BROADBAND ANTENNAS - VERTICAL - SITE WITHIN ±4DB

SITE CALIBRATION

Fig A1
Site Attentuation Worksheet

5.5 - Receiver Emissions Verification

Verification was performed on the receiver at 3 meters radius per 15.111 (a) which states in effect a shielded and resistive termination equal to the impedance specified for the antenna may be utilized, if the power at the antenna terminal at any frequency within the range of measurements specified in Sec. 15.33 shall not exceed 2.0 nanowatts." This calculates to -86.989 dbw.

As measured as the output of the receiver the levels were:

Frequency (Mhz)	Level (dbw)	FCC Limit (dbw)
303.5	-90	-86.989
786.4	-89	-86.989
800.0	-92	-86.989

From FCC rule part 15.33 (b) (1) the maximum upper frequency measuremment for a receiver in the 108 - 500 Mhz is 2000 Mhz.

This level was observed with a peak filter over the range 30 to 18 Ghz. Well exceeding the 2000 Mhz limit.

It should be noted that a calibrated coaxial cable was used from 30 - 1000 Mhz and semirigid line from 1- 18 Ghz. The line loss was added to the spectrum analyzer level to obtain the above readings.

The unit does not connect to the power lines therefore testing with a Line Impedance Stabilization Network is not required.

5.6 - OATS Actual Measurements

No signals, that could not be resolved, were noted due to the EUT in the receiver mode when the EUT was terminated in a load equal to the antenna, on a three meter OATS.

The measurements were made with the CISPR Quasi-Peak filter over the frequency range 30 to 1000 Mhz. A peak filter was used for measurement from 1 to 40 Ghz, but no emissions were noted, in either frequency range.

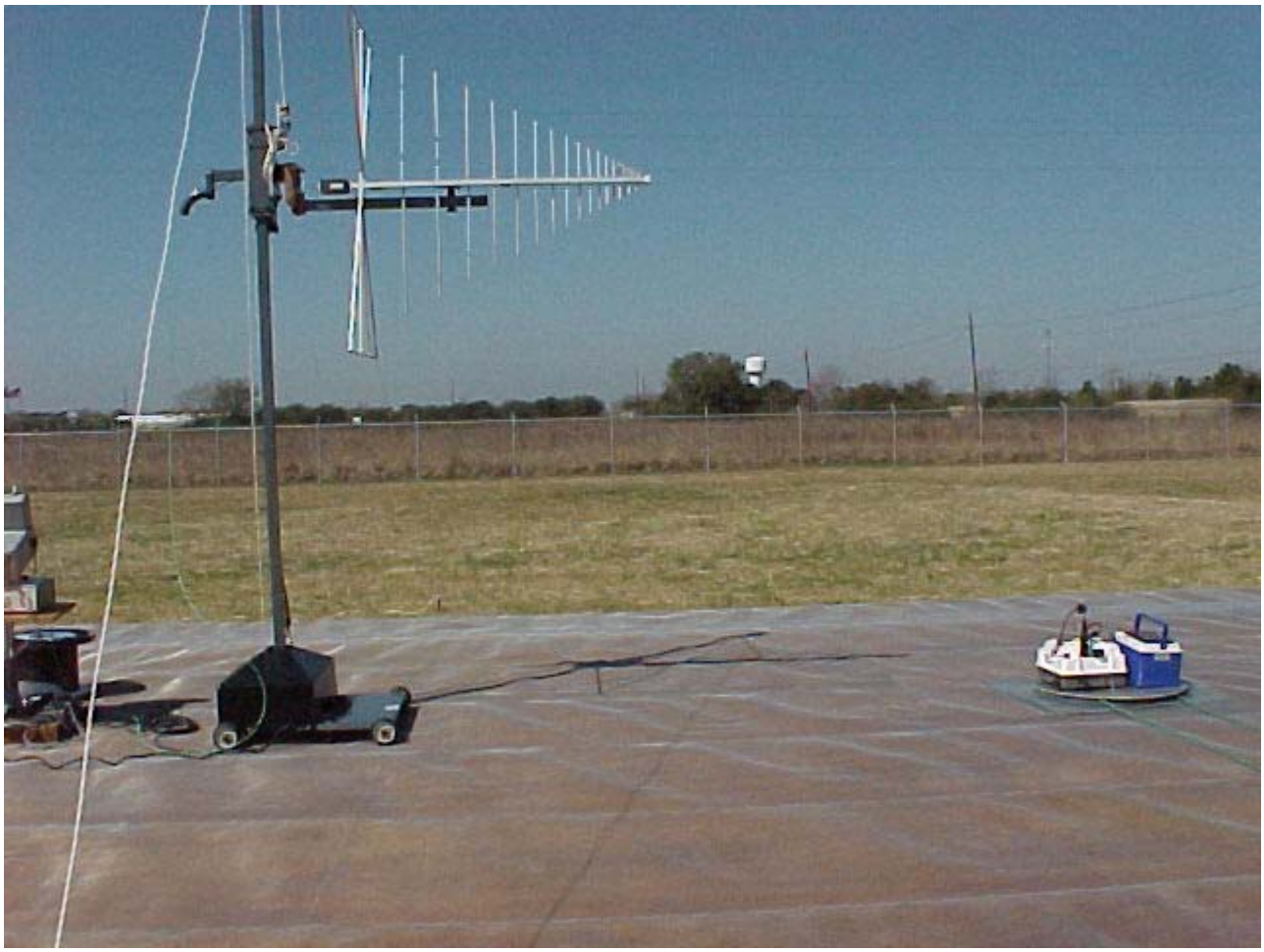
The turntable was rotated was slowly rotated so we could make continuous observations.

From 30 Mhz - 1700 Mhz we scanned from 1 - 4 meters with a custom calibrated EMCO 3143 antenna. We realized we would have had to null out any cable losses above 1 Ghz with a generator but we did not see any. We further looked at the spectrum above 1700 Mhz with a EMPIRE APN101A. This antenna is calibrated from 1 Ghz to 10 Ghz. We used the APN101A at a fixed height of one meter above the ground plane and connected it with semi-rigid cable. No emissions were seen with the antenna pointed directly at the EUT.

We thought we saw an emission at 300 Mhz but deleted said emission by the use of copper tape over the output load.

We continued our investigation of the output spectrum until 40 Ghz using standard gain horns at 1 meter high with the apertures pointing directly to the EUT. No signals were noted in this range.

ACTUAL SITE MEASUREMENT SHOWING EUT ON TURNTABLE



6.0 TRANSMITTER MEASUREMENTS

6.1 - Antenna Conducted Spurious Emissions

The test equipment was setup as shown in Figure 6. The Spectrum Analyzer was first tuned for a reference carrier level at the fundamental operating frequency. The output spectrum was then slowly scanned upward from 30 Mhz to 40 Ghz and back down again. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

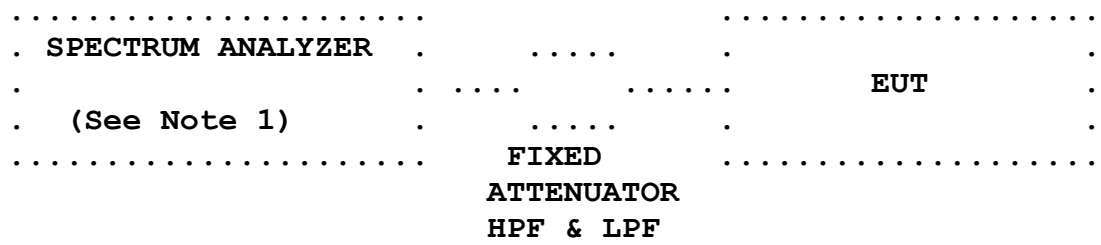
The FCC limit for Antenna Conducted Spurious Emissions is 43 + 10 log P below the main carrier. For the KQ9LRU with P = 6 watts, nominal (37.7815 Dbm), this corresponds to 50.7815 Db below the main carrier or a relative level of -13 Dbm. No emissions were detected within 20 Db of the FCC limit.

Please note that we were concerned about overloading the front end of our analyzer. We set the analyzer to see a range of 82 db below the carrier reference. We could not notch out or 216 Mhz because the size of the resulting filter would be impractical. We basically scanned 31.2 db beyond the FCC limit. Below 2 Ghz no signals were seen. This is not to say there were no signals present beyond said level.

Above 2 Ghz we had a filter and were able to allow maximum sensitivity on the spectrum analyzer. No signals were seen between 2 - 40 Ghz range.

KQ9LRU REQUEST FOR CERTIFICATION

FIGURE 6 - ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST SETUP



NOTES:

1.0 - IFR A-7550 SPECTRUM ANALYZER, SN 2347 AND HP141T SPECTRUM ANALYZER, SERIAL NUMBER 2205A21383.

6.2 - Case Radiated Spurious Emissions

Case Radiated Spurious Emission tests were conducted on the "characterized platform" utilizing the test setup shown in Figure 7. Observations were made at one meter from the unit. All Signals were recorded at maximum strength in terms of antenna polarization. In determining the maximum strength of emission the KQ9LRU was rotated on a turntable. The output spectrum, as received at one meter, was slowly scanned upward from 30 Mhz to 40 Ghz and back down again. Special attention was given to those frequencies which corresponded to possible harmonics and sub-harmonics.

A radiated reference level can be calculated using the formula:

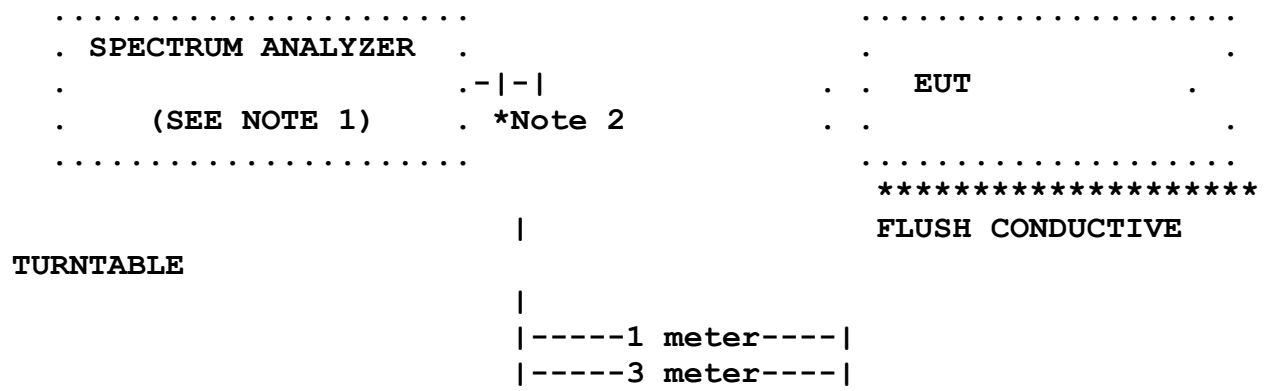
$$E = SQR(30 \times G \times P)/R$$

where:

G = Power gain of antenna (ratio),
P = Transmitter power in watts and
R = distance from radiator at which field intensity is measured.

KQ9LRU REQUEST FOR CERIFICATION

FIGURE 7 - CASE RADIATED SPURIOUS EMISSIONS TEST SETUP
& VERIFICATION TEST SETUP



NOTES:

1.0 - IFR A-7550 SPECTRUM ANALYZER, SN 2347 AND AN HP141T SPECTRUM
ANALYZER, SERIAL NUMBER 2205A21383.

2.0 - ANTENNAS & MAST UTILIZED

EMCO 3143 BICONILOG
APN101A PYRAMIDAL LOG PERIODIC
NARDA 56K1
MR STANDARD GAIN HORN
WAVELINE 799 HORN
WAVELINE 1099 HORN
EMCO 2075 MOTORIZED WITH EMCO 2090 CONTROLLER
MAST 1-4 METERS HEIGHT VARIATION

in this case:

G = 1.64 (gain of dipole over isotropic),
P = 6 watts and
R = 1 meters

therefore:

e = SQR(30 x 1.64 x 6)/1 = 17.18138 volts/meter
= 144.702 Dbuv/m.

The FCC rules require case radiated signals to be attenuated by a factor of 43 + 10 log p or 43 + 10 log 6 = 50.7815 Db. Thus 144.702 Dbuv/m attenuated 50.7815 Db equals 93.92 Dbuv/m, or approximately 94 Dbuv/m.

In the transmit mode, the KQ9LRU had the following case radiated emissions, at one meter.

They are as follows:

216 Mhz – Fundamental Not Applicable 34 Dbuv/m – added Copper tape to minimize.
303 Mhz – 18 Dbuv/m
800 Mhz – 19 Dbuv/m

One must remember that the KQ9LRU is watertight and thus must have a gasket that influences the electromagnetic spectrum.

7.0 - SUMMARY OF FCC CERTIFICATION DATA

FCC ID:		**KQ9LRU**
APPLICANT:		**SERCEL, INC.** **17200 PARK ROW** **HOUSTON, TEXAS 77084**
FREQUENCY RANGE:	**(US)**	**216 – 218 and 219 – 220 Mhz**
	(CANADA)	**217 - 218 and 219 - 220 MHZ**
FREQUENCY TOLERANCE:		**PLUS AND MINUS .00025 PERCENT**
RF POWER OUTPUT:		**6.0 WATTS, NOMINAL**
EMISSION DESIGNATOR:		**250K0D1D & 1M0D1D**
DESCRIPTION OF EMISSION:		**THE MODULATING TECHNIQUE FOR THE KQ9LRU IS QPSK. FOR 250K0D1D THE DATA RATE IS 256 KILO BITS PER SECOND. FOR 1M0D1D THE DATA RATE IS 1024 KILO-BITS PER SECOND.**
USE:		**FOR GEOLOGICAL EXPLORATION UNDER FCC RULE PART 90.259.**
OPERATING TEMPERATURE:		**- 30 TO + 55 DEGREES CENTIGRADE**

8.0 - STATEMENT

This equipment has been tested in accordance with the requirements contained in the appropriate commission regulations and American National Standards Institute. To the best of my knowledge, these tests were performed using measurement procedures consistent with industry and commission standards and demonstrate that the equipment complies with the appropriate standards. The manufacturer has been informed and understands that each unit marketed shall be manufactured to conform to the sample tested within the variations that can be expected due to quantity production and testing on a statistical basis. All measurements were performed and witnessed under the direction of Consolidated Spectrum Services, at Sercel Inc, 17200 Park Row, Houston, Texas 77084 and on the OATS previously described.

Respectfully Submitted,

Howard Epstein

Howard Epstein,
President
Consolidated Spectrum Services
22 Merrill Drive
Atkinson, NH 03811

On Behalf of:

Sercel INC.
17200 Park Row
Houston, Texas 77084