NATIONAL CERTIFICATION LABORATORY
8370 Court Avenue, Suite B-1
Ellicott City MD 21043
(410) 461-5548

CENELEC EMI MEASUREMENT REPORT

for

Berkeley Varitronics Systems
255 Liberty Street
Metuchen, NJ 08840

The Gator Transmitter

April 27, 2000

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1.0 Purpose of Test

The purpose of this series of tests was to verify compliance of the **Gator** (EUT) with the limits and standards of IEC 1000-4-2,3, and 4 and EN55022.

2.0 Description of Test Sample

The EUT is a stable synthesized signal source used for measuring PCS, Cellular, GSM and LMR band signal propagation, antenna position, or network area coverage. The Gator Transmitter covers the 935 - 960 MHz European band, and provides 25 watts of RF power. The system utilizes Class A amplifier. Other features include adjustable RF power output, LCD panel, RS-232 interface, 120 VAC powered, microcontroller.

3.0 References

IEC 1000-4-2.....	Part 2: Electrostatic discharge requirements, Second edition, 1991-04
IEC 1000-4-3.....	Part 3: Radiated electromagnetic field requirements, 1984, 3rd Impression 1991
IEC 1000-4-4.....	Part 4: Electrical fast transient/ burst requirements, 1988, 3rd Impression 1991
EN55022	EMI emissions requirements, CISPR 22, 1998 version

4.0 List of Required Tests

The following tests were performed in accordance with Berkeley Varitronics Systems:

5.0 Test Site

Testing was performed at **National Certification Laboratory** in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

6.0 Modifications to EUT

No modifications were made to the equipment under test, in order to comply with the standards in Section 4.0.

7.0 Modifications to Test Standard

No modifications were made to the test standards referenced in this report.

8.0 Test Configuration

The **Gator** was configured in accordance with the manufacturer's instructions and operated in a manner representive of the typical usage of the equipment. The equipment was tested with the following Host equipment:

1. 50 ohm cellular omni antenna
2. RS-232 Serial Cable

The EUT was set to full power, and tuned to a specific mid-band channel during testing.

9.0 Results Summmary

The tests referenced on page 3 were performed in accordance with the applicable standards. The severity levels used for immunity testing were chosen according to the anticipated installation environment of the EUT.

The acceptable performance criteria is determined through agreement between manufacturer and end user or client. The acceptance is based on the actual severity levels chosen for normal installation of the EUT.

Based on the above explanations, we state that the EUT (**Berkeley Varitronics Systems Gator Transmitter**) as supplied to **National Certification Laboratory**, complied with all requirements stated in this report.

Signature

Steven Dayhoff

Printed

Chief Engineer, NCL

Title

Rita Davis

Secretary

9.1 IEC 801-2 Electrostatic Discharge Requirements

Introduction

The requirements of this test call out Electrostatic Discharge (ESD) test levels and procedures. The intent of this test is to determine the effect of electrostatic discharge events on equipment operation. ESD is the result of potential build-up and the subsequent rapid discharge and equalization of that potential. The result of the discharge is a transient waveform that produces peak voltages up to tens of kilovolts, peak currents of a few amperes, and rise times on the order of a few nanoseconds (ns). This energetic discharge may produce malfunction and damage to sensitive electronic equipment.

This test requires an "air discharge" and "contact discharge" test to evaluate the immunity of electronic equipment to ESD.

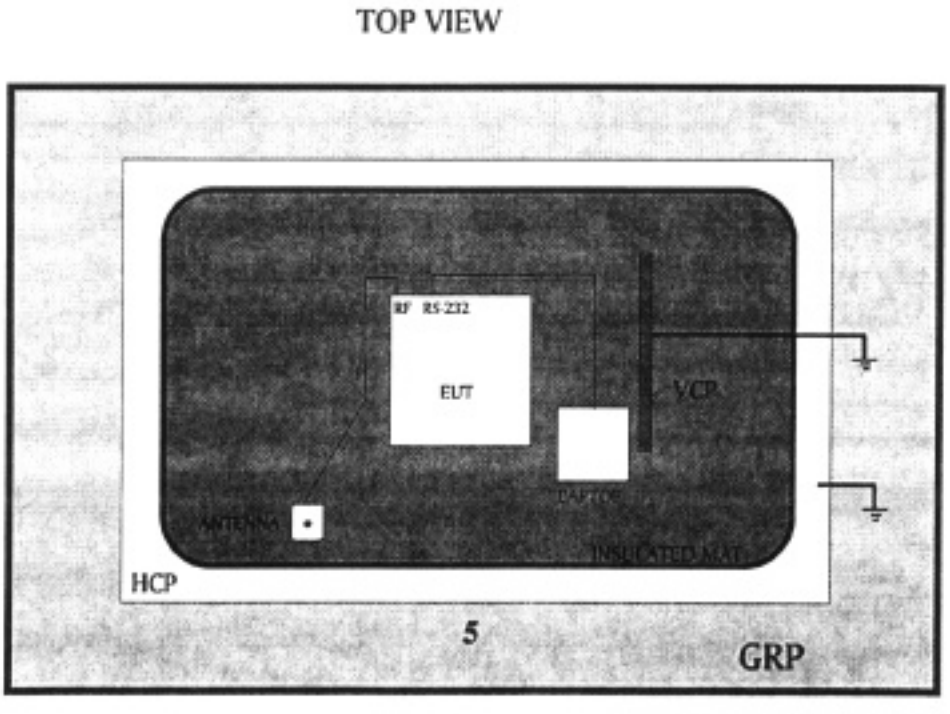
The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device. The severity levels for both contact and air discharge ESD are located in the standard.

Configuration

The EUT is situated on a .5 mm thick non-conductive mat which was placed on a horizontal coupling plane (HCP). The HCP is composed of a sheet of copper metal, the size being 1.6 m X 0.8 m, mounted to a table top. The table stands 0.8 m in height and is centered on a metallic ground reference plane (GRP), measuring 2.2 X 2.2 m. The GRP is more than 0.25 mm thick as required by IEC 801-2, Section 7.1.

A vertical coupling plane (VCP) measuring 0.5 X 0.5 m, and comprised of copper sheet is placed 0.1 m from the EUT. The HCP and VCP are connected to the GRP via two series 470 K resistors. The GRP is safety grounded with the laboratory A.C. mains network.

FIGURE 1 - IEC 1000-4-2



Procedure

The EUT was set to full power, and tuned to a specific mid-band channel during testing.

The ESD gun is repeatedly charged to the required voltage and air-discharged at all locations on the EUT that are accessible to human contact. The ESD gun was also discharged at least ten times on the HCP and at the center of the left vertical edge of the VCP. The test was repeated with the VCP facing the front, back, left side, and right side of the EUT. The functionality of the EUT was determined after each discharge.

Technique

Direct Discharge -

These discharges are made directly to the unit in the air and contact discharge modes. All tests are performed in the single discharge mode and with a negative and positive ESD pulse. On the preselected points at least ten discharges are applied with, approximately, a one second interval between discharges.

For repeatability, the ESD generator is held perpendicular to the surface of each discharge point.

The test voltage is set at a lower level than the predetermined severity level and increased until the EUT fails or until the predetermined test voltage is reached. If the EUT fails before the proper test voltage is reached then the voltage the unit failed at should be noted as the threshold.

Contact Discharge -

The tip of the discharge point should touch the EUT before the ESD discharge is made. If the surface of the EUT is painted and the coating is not declared by the manufacturer as an insulator, then the tip of the ESD generator should penetrate the coating before the discharge. If the coating is declared as an insulator by the manufacturer then the contact discharge is not applied to this surface.

Air Discharge -

The tip of the discharge point does make contact with the EUT and the discharge is made as the tip is held close to the EUT.

Indirect Discharge -

This test is done to simulate discharges made by objects installed near the EUT and is done in the contact discharge mode only (see above). It is done to the HCP and VCP as determined earlier.

HCP -

At least 10 discharges should be made to the plane at several points around the EUT and at a distance of 0.1 m from the EUT.

VCP -

At least 10 discharges should be made to the center of one of the side edges of the plane. The VCP should be 0.5 m x 0.5 m and placed parallel to the EUT and perpendicular to, but isolated by 0.5 mm from, the HCP. The discharges should be made to the plane, with the plane 0.1 m from the EUT and at different positions on the four sides of the EUT so the EUT is completely illuminated.

If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

Test Equipment/Conditions

EQUIPMENT	SERIAL NUMBER
AH Associates ESD 254 - ESD Simulator	1030
CLIMATIC CONDITIONS	MEASURED
Temperature	15 C to 35 C
Humidity	30 % to 60 %
Atmospheric Pressure	68 kPa to 106 kPa

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to Severity Level 3 as described below, which is appropriate for a Class 3 installation.

LEVEL	CONTACT DISCHARGE VOLTAGE	AIR DISCHARGE VOLTAGE
3	6 kV	8 kV

Discharge to Coupling Planes:

Performance of the EUT complied to performance criterion 1 while air discharges were applied to **Severity Level 3** to both the vertical and horizontal coupling planes a minimum of 10 times on each of four sides.

Discharge to EUT:

Performance of the EUT complied to performance criterion 1 while contact discharges were applied to all conductive surfaces on the exterior of the EUT to **Severity Level 3** a minimum of 10 times.

9.2 IEC 801-3 Radiated Electromagnetic Field

Introduction

The requirements of this test call out radiated susceptibility test levels and procedures. The intent of this test is to determine the effect of radiated RF energy on equipment operation. Radiated RF energy from other devices in the facility or from ambient RF energy (i.e. radio and TV broadcast stations) can cause equipment to malfunction.

The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device.

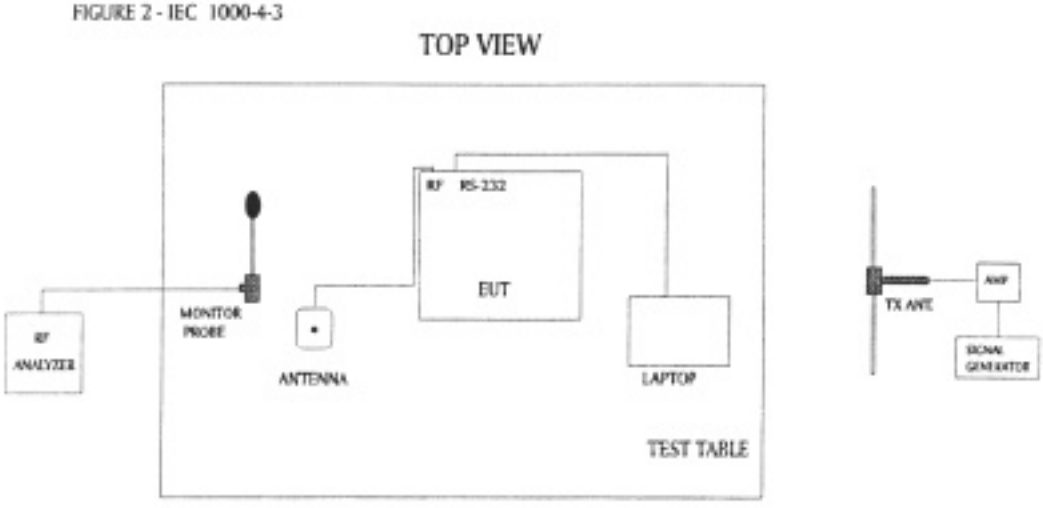
Configuration

This basic test setup applies to both types of equipment, floor standing and desktop. The equipment under test (EUT) is setup in a shielded room, so test personnel and equipment are protected from the radiated fields. If the EUT requires external interconnecting cables, they should be of the length specified by the manufacturer. If the manufacturer's specified length is greater than 3 m then the cabling should be reduced to a 3 m length by non-inductive bundling. The cables are also placed uniformly in the field.

A transmit antenna is placed 1 m from the EUT and at a height of 1 m. The antenna is then connected to the test equipment outside the shielded room via the room bulkhead. On the external end of the bulkhead a power amplifier is connected. A signal generator is then connected to the input of the power amplifier, so the necessary field can be produced. The field probe for measuring the radiated field is also placed inside the shielded room. The probe is placed as close to the EUT as possible without disturbing the radiated field. The probe is then connected, through a bulkhead, to a monitoring device outside the room.

The EUT and cables are placed on a 0.8 m high non-conductive table at a distance of 1m from the transmit antenna. The antenna height is adjusted between 1 and 2 m so that the center of the antenna aligns with the center of the EUT.

FIGURE 2 - IEC 1000-4-3



Procedure

The EUT was set to full power, and tuned to a specific mid-band channel during testing.

The signal source is swept through the frequency range of 80 to 1000 MHz, at a rate no faster than .0015 decades/s as recommended in IEC 801-3, Section 7. During testing, the amplitude of the signal generator is adjusted to maintain at least the required field strength. At a minimum of three points per octave, the achieved field strengths were recorded.

Throughout the test, the EUT is closely monitored for signs of susceptibility. The testing is performed with the antennas oriented in both horizontal and vertical polarization. If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

Test Equipment

EQUIPMENT	SERIAL NUMBER
Boonton 102F Signal Generator	43628
EMCO Model 3110 Biconical Antenna	1235
EMCO Model 3146 Log Periodic Antenna	1222
Sahand IID RF Field Probe	
ENI Model 604L RF Amplifier	47569
Advantest Model R4131D Spectrum Analyzer	54378A

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to **Severity Level 2** as described below, which is appropriate for a Class 2 installation:

LEVEL	TEST FIELD STRENGTH (V/m)
2	3

Final

Performance of the EUT complied to performance criterion 1 while subjected to Electromagnetic fields were generated to Severity Level 2 in both the vertical and horizontal polarizations of the antennae.

Tabular data follows:

Freq. MHz	Pol.	Limit V/m	Monitor V/m	Compliance
80	H	3	3.4	COMPLIES
80	V	3	3.2	COMPLIES
100	H	3	3.6	COMPLIES
100	V	3	3.5	COMPLIES
120	H	3	3.3	COMPLIES
120	V	3	4.1	COMPLIES
150	H	3	3.9	COMPLIES
150	V	3	4	COMPLIES
175	H	3	3.1	COMPLIES
175	V	3	3.2	COMPLIES
200	H	3	3.1	COMPLIES
200	V	3	3.6	COMPLIES
266	H	3	4.3	COMPLIES
266	V	3	4.1	COMPLIES
300	H	3	4.2	COMPLIES
300	V	3	4.2	COMPLIES
366	H	3	3.7	COMPLIES
366	V	3	3.7	COMPLIES
400	H	3	3.5	COMPLIES
400	V	3	3.1	COMPLIES
466	H	3	3.8	COMPLIES
466	V	3	3.5	COMPLIES
500	H	3	4.5	COMPLIES
500	V	3	4.6	COMPLIES
525	H	3	4.4	COMPLIES
525	V	3	4.1	COMPLIES
600	H	3	4.8	COMPLIES
600	V	3	4.9	COMPLIES
650	H	3	4.5	COMPLIES
650	V	3	4.3	COMPLIES
700	H	3	4.2	COMPLIES
700	V	3	4.1	COMPLIES
800	H	3	4.1	COMPLIES
800	V	3	4.7	COMPLIES
914	H	3	4.8	COMPLIES
914	V	3	4.9	COMPLIES
1000	H	3	4.5	COMPLIES
1000	V	3	4.4	COMPLIES

9.3 IEC 1000-4-4 Electrical Fast Transients Requirements

Introduction

The requirements of this test call out Electrical Fast Transient (EFT) test levels and procedures. The intent of this test is to determine the effect of EFT's on equipment operation. EFT's are the result of switching inductive loads or relay contact bounce. This energetic discharge may produce malfunction and damage to sensitive electronic equipment.

This test requires a "coupling/decoupling network" for AC/DC supply lines and "capacitive clamp" for signal or control lines.

The specification limit depends on the designated "severity level," which is determined by the intended area of installation of the device.

Configuration

The EUT is placed on a 0.8 m high non-conductive table and the table is placed on a metallic ground reference plane (GRP), measuring 2.2 X 2.2 m. The EFT/B generator and the coupling clamp are mounted to the GRP and bonded to the protective grounding system.

Power is supplied to the EUT through the EFT/B generator, and all I/O cables exceeding 2 m in length were placed in the coupling clamp, which is also connected to the EFT/B generator. The coupling clamp is terminated into a 50 ohm impedance.

The EFT/B generator is programmed to produce an output test signal with the following parameters:

PRF ..... 5 kHz for output < 2kV, 2.5 kHz for output > 2kV

Burst Duration ..... 15 ms

Burst Period ..... 300 ms

Test Time ..... 60 s

Procedure

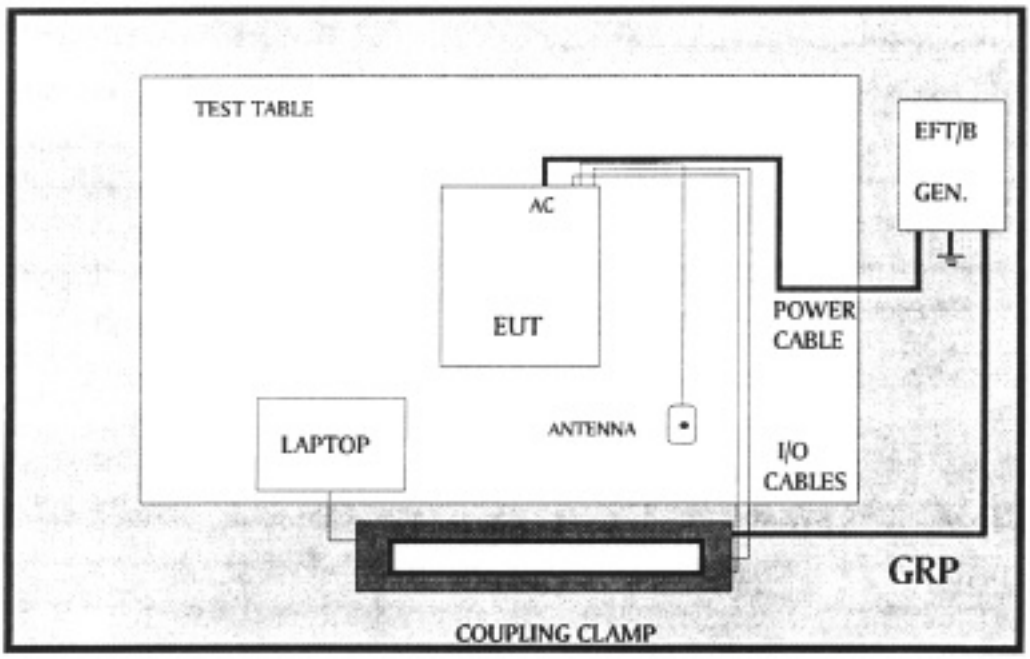
The EUT was set to full power, and tuned to a specific mid-band channel during testing.

The EFT/B generator is operated to couple the transient bursts onto the EUT I/O lines and the A.C. power input line for a period not less than one minute. This test is performed with positive transients first, and subsequently with negative transients.

Throughout the test, the EUT is closely monitored for signs of susceptibility. If during any of the above tests the unit does not meet the previously specified function criteria, the EUT does not comply.

FIGURE 3 - IEC 1000-4-4

TOP VIEW



Test Equipment

EQUIPMENT	SERIAL NUMBER
Compliance Design EFT Generator	3150129
Compliance Design Coupling Clamp	161-34

Results

The EUT was evaluated according to the following criteria.

Performance Criteria:

1. Normal performance within the spec. limits.
2. Temporary degradation or loss of function or performance which is self-recoverable.
3. Temporary degradation or loss of function or performance which requires system reset.
4. Degradation or loss of function which is not recoverable due to damage of equipment.

The EUT was subjected to **Severity Level 2** as described below, which is appropriate for a Protective Environment installation:

LEVEL	TEST VOLTAGE on A.C.	TEST VOLTAGE on I/O
2	1 kV	0.5 kV

Final

Performance of the EUT complied to performance criterion 1 while subjected to Electrically Fast Transient Burst signals generated at Severity Level 2, on both the A.C. power line and the I/O data and control lines.

9.4 EN55022 EMI Radiated and Conducted Emissions

1.0 Introduction

Radio-Noise Emissions tests were performed according to the CISPR Pub. 22 1993, titled **"Measurement of Radio Interference Characteristics of Information Technology Equipment"**. The measuring equipment conforms to CISPR Pub. 16, Section 1, Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

1.1 Summary

The **Gator Transmitter** complies with the limits for a Class B ITE device.

2.0 EMI Countermeasures

No modifications were made to the EUT, by the project engineer to assure compliance to Class B specifications:

3.0 Test Program

The EUT was set to full power and tuned to a specific channel during testing.

4.0 Test Configuration

The EUT and support equipment were setup on the test table in a manner which follows the general guidelines of CISPR 22 Section 8.1. The support equipment consisted of a Host computer, 50 ohm whip antenna, and RS-232 cable as prescribed in Section 8.1. The EUT was centered on the table with it's rear flush with the rear of the table.

The Host notebook PC was connected to the EUT via RS-232 cable, and placed on the test table with the EUT. The 50 ohm whip antenna was placed in various locations on the table..

I/O cables were placed on top of the table and moved in position to maximize emission levels. Cables were more than 40 cm from the ground plane during radiated and conducted tests.

5.0 Conducted Emissions Scheme

The EUT is placed on an 80 cm high 1 X 1.5 m non-conductive table. Power to the CPU is provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 2.2 X 2 meter horizontal ground plane, and a 2.2 X 2 meter vertical ground plane. The LISN has its AC input supplied from a filtered AC power source. A separate LISN provides AC power to the peripheral equipment. I/O cables are moved about to obtain maximum emissions.

The 50 Ω output of the LISN is connected to the input of the spectrum analyzer and emissions in the frequency range of 150 kHz to 30 MHz are searched. The detector function is set to quasi- peak and the resolution bandwidth is set at 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for final measurements. All emissions within 20 dB of the limit are recorded in the data tables.

6.0 Radiated Emissions Scheme

The EUT was initially scanned in the frequency range 0.3 to 10 GHz indoors, at a distance of 1 meter to determine its emissions profile. The EUT was then placed on an 80 cm high 1 X 1.5 meter non-conductive motorized turntable for radiated testing on the 10-meter open area test site. The emissions from the EUT are measured continuously at every azimuth by rotating the turntable. Dipole and log periodic broadband antennas are mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna is varied between 1 and 4 meters. Cables are varied in position to produce maximum emissions. Both the horizontal and vertical field components are measured.

The output from the antenna is connected to the input of the spectrum analyzer. The detector function is set to quasi-peak. The resolution bandwidth of the spectrum analyzer system is set at 120 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. All emissions within 20 dB of the limit are recorded in the data tables.

To convert the spectrum analyzer reading into a quantified E-field level to allow comparison with the CISPR limits, it is necessary to account for various calibration factors. These factors include cable loss (CL) and antenna factors (AF). The AF/CL in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbμV to obtain the Radiated Electric Field in dBμV/m. This level is then compared with the CISPR limit.

Example:

Spectrum Analyzer Volt: VdBuV

Composite Factor: AF/CLdB/m

Electric Field: EdBμV/m = VdBμV + AF/CLdB/m

Linear Conversion: BuV/m = Antilog (EdBμV/m/20)

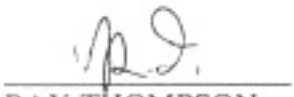
CISPR 22 CLASS B RADIATED DATA

CLIENT: Berkeley Varitronics
EUT: Gator
CPU:

10-METER TEST

FREQ MHz	POL H/V	SPEC A dBuV	AF/CL dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MRGN dB
78.39	V	19.0	8.0	27.0	22.4	32.0	-3.1
84.19	H	20.0	9.0	29.0	28.2	32.0	-1.1
150.00	H	12.0	15.0	27.0	22.4	32.0	-3.1
165.42	H	12.0	16.0	28.0	25.1	32.0	-2.1
250.00	H	13.0	20.0	33.0	44.7	70.0	-3.9
278.76	H	10.0	21.0	31.0	35.5	70.0	-5.9
366.78	V	11.0	14.0	25.0	17.8	70.0	-11.9
500.10	V	15.0	18.0	33.0	44.7	70.0	-3.9
750.00	H	12.0	22.0	34.0	50.1	70.0	-2.9
876.84	V	12.0	23.0	35.0	56.2	70.0	-1.9
945.56	V	8.0	24.0	32.0	39.8	70.0	-4.9
1149.23	H	5.0	25.0	30.0	31.6	70.0	-6.9

TEST ENGINEER



RAY THOMPSON

CISPR 22 CLASS B CONDUCTED DATA

CLIENT: Berkeley Varitronics
EUT: Gator
CPU:

LINE 1 - NEUTRAL

FREQ MHz	QUASI PEAK dBuV	AVERAGE dBuV	QP LIMIT dBuV	AVG LIMIT dBuV
0.204	55.2	52.3	64	54
0.293	54.8	50.4	62	52
0.408	49.6	44.5	59	49
0.782	42.2	39.7	56	46
0.916	42.6	37.6	56	46

LINE 2 - PHASE

FREQ MHz	QUASI PEAK dBuV	AVERAGE dBuV	QP LIMIT dBuV	AVG LIMIT dBuV
0.204	45.8	41.8	64	54
0.289	52.6	49.3	62	52
0.397	49.2	45.4	59	49
0.779	42.1	37.5	56	46
0.911	43.2	40.1	56	46

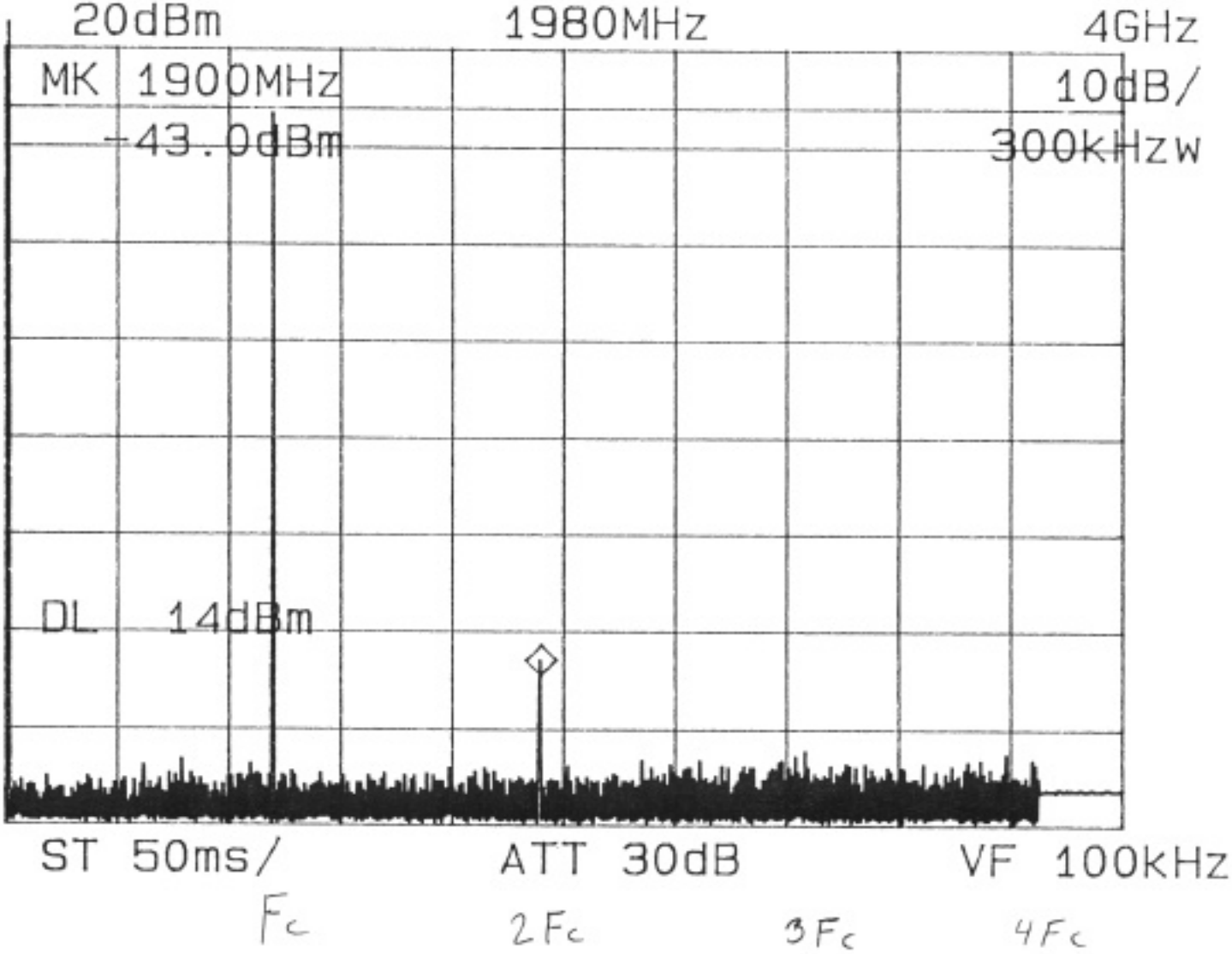
CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 944.50 MHz

TEST RESULTS

COMPONENT	FREQUENCY (MHZ)	RESULT (dBc)
HARMONIC	1889.00	- 57
HARMONIC	2833.50	- 67
HARMONIC	3778.00	- 70
HARMONIC	4722.00	- 72
HARMONIC	5667.00	- 74
HARMONIC	6611.50	- 73
HARMONIC	7556.00	- 75
HARMONIC	8500.50	- 77
HARMONIC	9445.00	- 77

Spurious Output



Peak RF Power - 30 dB Attn.

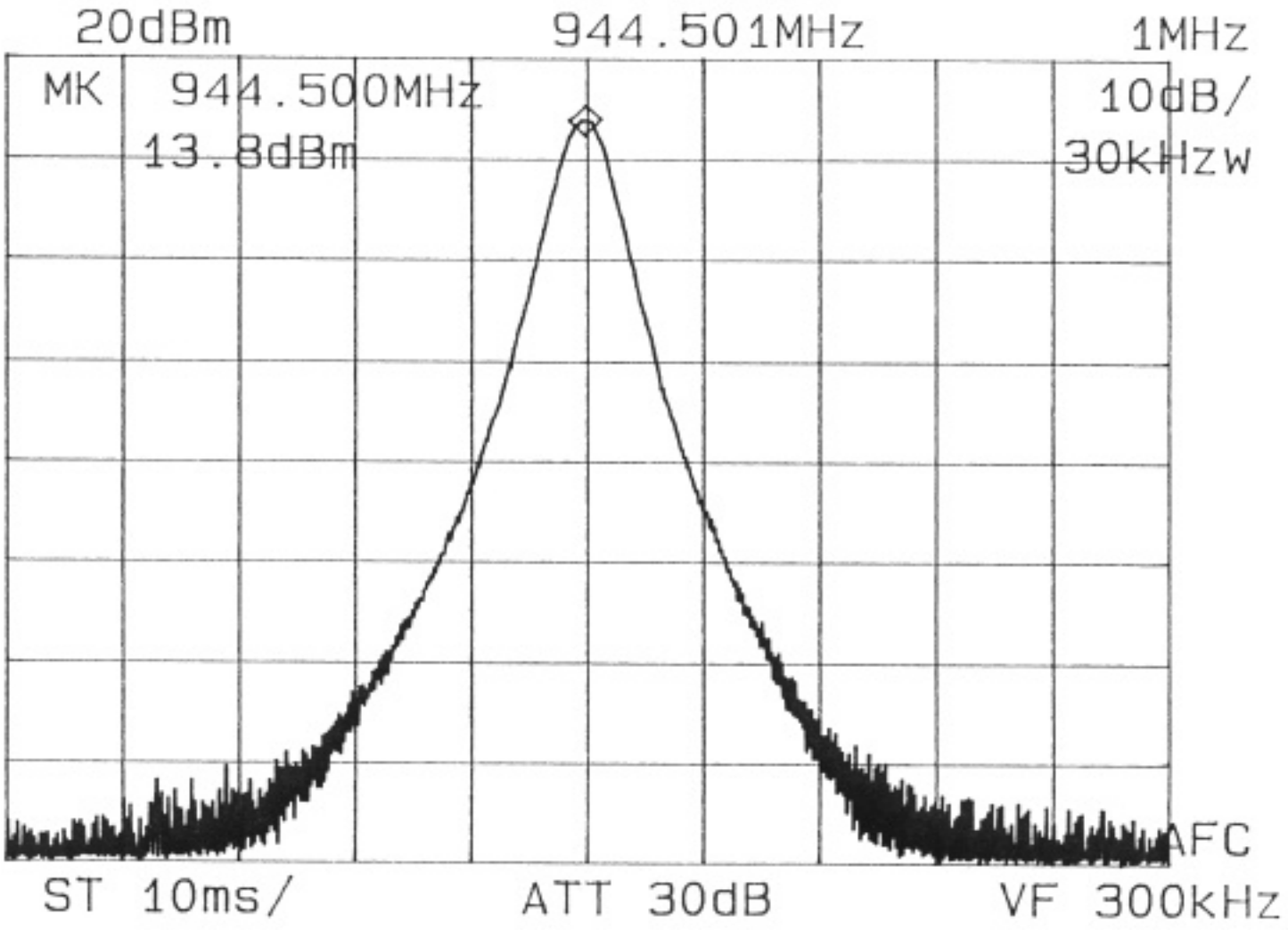


Table 1

Interface Cables Used

EUT to Notebook PC	1.8 meter bundled to 1 meter in length - unshielded
HOST Power	Shielded 120 VAC power cord
All other I/O cables such as monitor, keyboard, mouse are permanently attached to the peripherals - presume shielded.	
Note: There are no ferrite beads attached to any I/O cables for this test.	

Table 2

Measurement Equipment Used

The following equipment is used to perform measurements:

EQUIPMENT	SERIAL NUMBER
Wavetek 2410A 1100 MHz Signal Generator	1362016
EMCO Model 3110 Biconical Antenna	1619
EMCO Model 3146 Log Periodic Antenna	1222
Solar 8012-50-R-24-BNC LISN	924867
Advantest Model R4131D Spectrum Analyzer	54378A
Solar 8012-50-R-24-BNC LISN	927230
4 Meter Antenna Mast	None
Motorized Turntable	None
RG-233U 50 ohm coax Cable	None