EMC TEST REPORT
FOR THE
KENYON LABORATORIES LLC
KS SERIES
GYROSCOPE KITS

Prepared for:

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Submitted by:

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Accredited
Cert 898.01 Test Laboratory

Kenyon Laboratories LLC
CE EMC Testing
At
Green Mountain Electromagnetics, Inc.

Unit: KS-8 Gyroscope Kit
Received: 2/28/11
Tested: February 28 to March 9, 2011

I. Applicable Standards:

The unit described in this report was measured for compliance with European Standard EN 61326-1, "Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements: Part 1 – General Requirements (2006)."

Emission measurement equipment and procedures were in accordance with EN 55011, "Industrial, Scientific and Medical Radio Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement (2007)."

Immunity measurement equipment and procedures were in accordance with:
EN 61000-4-2, "Electromagnetic Compatibility (EMC) Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test (2009),"
EN 61000-4-3, "EMC Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test (2002),"
EN 61000-4-4, "EMC Part 4-4: Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test (2004),"
EN 61000-4-6, "EMC Part 4-6: Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields (2007),"
EN 61000-4-8, "EMC Part 4-8: Testing and Measurement Techniques – Power Frequency Magnetic Field Immunity Test (2001)."

GME, Inc. • 219 Blake Roy Road • Middlebury, VT 05753 • Tel: 802-388-3390 • gmelectro.com

II. Unit Tested:

The Kenyon Laboratories LLC, KS-Series Gyroscope Kits provide mechanical stability control for video cameras and other non-residential devices. The KS-Series is intended for use by qualified personnel in commercial environments. The gyro requires AC power from an inverter. The inverter requires a battery and the kit includes a battery charger. The KS-Series consists of the gyro in a metal enclosure, the inverter electronics in a plastic enclosure, the battery in a case, and cables for power, charging and inverter output. The system was fully connected and operational. The KS-series compliance was based on type-tests of a single model (KS-8: largest size and current rating) representing all features of the product line.

Per the EMC test plan: For emissions, the KS-Series is battery-powered, Class A equipment and EN 61000-3-2/3 do not apply. Immunity levels and performance criteria are from EN 61326-1, Table 2, "Immunity Test Requirements for Equipment Intended for use in Industrial Locations." The unit has signal lines >3m. It does not have long distance lines. The unit is not powered by a DC network and there are not any signal lines connected to AC power. EN 61000-4-8 tests are performed at 50 and 60 Hz. The table below describes the system that was subjected to measurements determining compliance with applicable EMC standards:

Model	Manufacturer	Serial Number
KS-8 Gyroscope	Kenyon Laboratories LLC	1102D43
KP-6 Inverter	Kenyon Laboratories LLC	1102L26

The following table describes the system physical and electrical properties:

Model	Volts	H/W/D in cm
KS-8 Gyroscope	115 VAC, 1 A, 400 Hz	10/8/15
KP-6 Inverter	12 VDC, 3 A	5/11/7

The following table describes the support equipment used during testing:

Product	Manufacturer	Model #	Serial Number
Battery	Power Patrol	SEC1075	n/a
Battery Charger	CELLCON	452240-SB	KL 1102L26

Power cables were used for testing and are supplied by the manufacturer. The following table describes the system cables:

Cable	Description	Agency Rating
Power (AC)	Single Lead, p/o charger	UL
Power (DC Battery)	Belden 8412	n/a
Power (DC Car Charger)	Enercell 270 00J	n/a
Power (DC Wall Adapter)	Single Lead	n/a

III. Summary of Results:

The Kenyon Laboratories LLC, KS-8 Gyroscope Kit is compliant with the EN 61326-1, Class A radiated emissions limits. The unit passes EN 61326-1, Table 2 levels for radiated, conducted, EFT, ESD and magnetic immunity.

Section X compares the unit radiated emissions to the applicable limit from 30 MHz to 1000 MHz in accordance with equations identified in VI and the output identified in measurement procedure VIII-1. Sections XI through XV reference measurement procedures of VIII-2 through -6 in accordance with susceptibility and performance criteria described in Section V for type acceptance and per the manufacturer's test plan.

Testing was performed by Kyle R. Kowalczyk, president, Green Mountain Electromagnetics and requested by:

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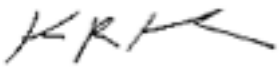


Kyle R. Kowalczyk
4/15/11

IV. Measurement Location:

The GME laboratory and Open Area Test Site (OATS) are located at 219 Blake Roy Road, Middlebury, VT. The OATS is a 10-meter site complete with antenna positioner, ground plane and motorized turntable. The OATS is constructed in accordance with ANSI C63.7-2005 and complies with the requirements for radiated emissions testing in ANSI C63.4-2003 and CISPR standards. The electromagnetic laboratory is constructed in accordance with CE immunity standards and ANSI C63.4-2003.

GME is internationally accredited by the American Association for Laboratory Accreditation (A2LA) and meets the quality requirements in ISO/IEC 17025 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories."

V. Equipment, Software and Cable Configuration:

GME witnessed the unit in satisfactory condition for testing, however the manufacturer is responsible for ensuring that the equipment under test (EUT) represents the product line. The manufacturer is also responsible for the EMC test plan and for assuring that this report is consistent with that plan. The EUT configuration was arranged to produce maximum radiated emissions as shown in the block diagram below. The equipment was subjected to complete emissions and susceptibility tests.

Figure 1 – Block Diagram of EUT on Turntable

The EUT was operating in a continuous mode utilizing and testing its measurement functions. The EUT was also set to self-test upon power up. Susceptibility indications include: gyroscope operation variations, repeatable malfunctions, and erroneous faults.

The performance criteria for the evaluation of the immunity test results are as follows:
Performance Criterion A – during testing, normal performance within the specification limits.
Performance Criterion B – during testing, temporary degradation or loss of function or performance which is self-recovering.
Performance Criterion C – during testing, degradation or loss of function that requires operator intervention or system reset occurs.

VI. Units of Measurement and Uncertainty:

Measurements of radiated electric fields were made in units of dB referenced to 1 microvolt per meter (dBuV/m). Limits appearing on the spectrum analyzer data were corrected for the appropriate antenna factor, cable loss, amplifier gain (when used) and measurement distances X_{std} and X_{site} in meters.

The following equation was employed:
Corrected Limit (dBuV) = Limit (dBuV/m) + 20 log(X_{std}/X_{site}) + Amplifier Gain (dB) – Antenna Factor (dB/m) – Cable Loss (dB).

Sample calculation at 30 MHz (Vertical Polarization):
42 dBuV corrected limit = 40.0 dBuV/m limit + 20 log(10/10) dB distance + 20 dB amp gain – 17 dB/m AF – 1 dB cable loss.

Uncertainty
The uncertainty budgets in GME EMC measurements are identified as follows:

1. Field strength between 30 MHz and 1 GHz on a ten-meter OATS using broadband antennas:

Contribution	Probability Distribution	Uncertainty (dB)
antenna factor calibration	normal k=2	0.5
cable loss calibration	normal k=2	0.5
analyzer specification	rectangular	1.5
distance variation	rectangular	0.6
height variation	rectangular	0.5
site imperfection	rectangular	2.0
mismatch	u-shaped	1.5

repeatability	standard deviation	0.5
combined uncertainty u(y)	normal	1.946
expanded uncertainty U	normal k=2	3.892

$$u(y) = \sqrt{(\frac{0.5}{2})^2 + (\frac{0.5}{2})^2 + \frac{1.5^2 + 0.6^2 + .5^2 + 2.0^2}{3} + \frac{1.5^2}{2} + 0.5^2}$$

U = k u(y)

(Note: "U" represents an expanded uncertainty expressed at an approximately 95% confidence level using a coverage factor of k=2.)

VII. Measuring Equipment:

The table below describes the instrumentation used by Green Mountain Electromagnetics to perform this testing:

Unit	Manufacturer	Model	Serial #	Last Cal.	Next Cal.
Spectrum Analyzer	Hewlett-Packard	8592 L	3624A00631	10/26/10	10/26/11
Pre-Amplifier	MiniCircuits	ZFL-2500VHB+	424400919	1/3/11	1/3/12
Power Amplifier	MiniCircuits	ZVE-8G	n/a	1/20/11	1/20/12
Power Amplifier	MiniCircuits	ZHL-32A	D032498-30	1/20/11	1/20/12
Power Amplifier	Empower RF Systems	1043-BBM 2CTAAJ	1191	1/20/11	1/20/12
Signal Generator	Hewlett-Packard	E4421B	US38220195	3/3/11	3/3/12
Broadband E-field Antenna	Antenna Research Associates	LPB-2513/A	1210	10/25/10	10/25/11
Parallel-Plate Antenna	GME	GP1-T	01	8/26/10	8/26/11
Helmholtz Coil	GME	HH 1m	n/a	1/20/11	1/20/12
ESD Generator	Schaffner	NSG 435	2394	5/13/10	5/13/11

EFT Generator	Haefely-Trench	PEFT 4010	081603-10	10/25/10	10/25/11
Injection Probe	EMCO	95236-1	9803-50213	6/3/10	6/3/11
Current Probe	Stoddart	91550	n/a	6/3/10	6/3/11
Weather Station	Davis Instruments	Perception II	PC30923A07	1/12/11	1/12/12
Plotter	HP	7550A	2444A05912	n/a	n/a

VIII. Measurement Procedures:

1. Radiated Emissions in accordance with EN 55011, Group 1, Class A.

Frequency range: 30 MHz to 230 MHz
Limit: 40 dBuV @ 10 meters
Frequency range: 230 MHz to 1 GHz
Limit: 47 dBuV @ 10 meters

a. Set up instrumentation at open area test site.
   i. Mount EUT on ground plane and broadband antenna on antenna positioner.
   ii. Observe temperature, humidity and atmospheric pressure.
   iii. Measurement distance is 3 meters and antenna scan height is 1 to 4 meters.
b. Verify spectrum analyzer and antenna operation.
   i. Spectrum analyzer is connected to antenna.
   ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit.
c. Set up, power and operate EUT as described in Section V.
d. Perform preliminary evaluation of equipment in the near field.
   i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
   ii. Repeat step d.i. while evaluating electromagnetic radiation in the 30-MHz to 1-GHz spectrum.
e. Determine frequencies and equipment orientations that produce maximum radiation.
   i. Identify processor, clock and beat frequencies, and harmonics.
f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
   i. Ensure the EUT is producing the maximum radiation found in step e.
   ii. Collect data over the entire frequency range.

2. Electrostatic Discharge Immunity in accordance with EN 61000-4-2 Level 3.

Test Voltage: 4-kV contact /8-kV air

a. Set up instrumentation in laboratory.

i. Observe temperature, humidity and atmospheric pressure.

b. Verify ESD generator operation.
   i. Perform self-test.
   ii. Connect 2-meter ground cable.

c. Set up, power and operate EUT as described in Section V.
   i. Position EUT over coupling plane.

d. Singly discharge contact voltages into unit under test with ESD generator.
   i. Place tip in various operator-accessible positions and vary polarity.
   ii. Slowly increase voltage from minimum to maximum test levels.

e. Singly discharge contact voltages into vertical and horizontal coupling planes with ESD generator.
   i. Position vertical plane .1 m from EUT.
   ii. Illuminate all four sides of the EUT.

f. Perform final evaluation of unit by noting EUT indicators.

3. Radiated Susceptibility in accordance with EN 61000-4-3 Level 3 Annex D.

Frequency range: 80 MHz to 1 GHz
Field Strength: 10 V/m
Frequency range: 1.4 MHz to 2 GHz
Field Strength: 3 V/m
Frequency range: 2 GHz to 2.7 GHz
Field Strength: 1 V/m

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.

b. Verify spectrum analyzer, signal generator, and power amplifier operation.
   i. Spectrum analyzer is connected to isotropic probe for calibration of radiating antenna and verification of uniform field.
   ii. Signal generator is connected to power amplifier and set for 80% amplitude modulation with a 1-kHz sine wave.
   iii. Power amplifier is connected to broadband antenna.

c. Set up, power and operate EUT as described in Section V.

d. Calibrate broadband antenna for uniform field necessary to enclose EUT.
   A uniform field is defined as 0 to 6 dB above applicable limit over 75% of EUT surface.
   i. Configure broadband antenna to enclose EUT. Use isotropic probe to determine field strength at 4 to 16 positions.
   ii. At the start frequency, apply forward power necessary to achieve 0 to 6 dB above applicable limit at a minimum of 4 positions on the grid.
   iii. Increase frequency by 10% and repeat steps d.i. and d.ii.

e. Illuminate unit under test with antenna at calibrated distance.

i. Place isotropic probe near EUT to verify proper antenna operation.

f. Sweep frequencies from 80 to 2700 MHz and rotate EUT to ensure units receive maximum radiation.
   i. Frequency step sizes are 1% of previous frequency (i.e. 5 MHz at 500 MHz).
   ii. Dwell time at each frequency is the time necessary for the EUT to respond (i.e. 1s).
   iii. Processor frequencies are analyzed separately.

g. Perform final evaluation of unit by noting EUT indicators.

4. Electrical Fast Transient Immunity in accordance with EN 61000-4-4 Level 2/3.

Voltage Peak: 1-kV signal

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.

b. Verify electrical fast transient generator operation.
   i. Perform model self-test.

c. Set up, power and operate EUT as described in Section V.
   i. Place EUT signal cables in capacitive coupling clamp and connect clamp to EFT generator.
   ii. Verify EFT ground bond.

d. Illuminate unit under test with electrical fast transient/burst.
   i. Duration of at least 1 minute at each level and each polarity.
   ii. Perform power on self-test before, during, and after application of test voltages.

e. Perform final evaluation of unit by noting EUT indicators.

5. Conducted Susceptibility in accordance with EN 61000-4-6 Level 2.

Frequency range: 150 kHz to 80 MHz

Voltage: 3-V signal

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
   ii. Place EUT over ground plane.

b. Verify spectrum analyzer, signal generator, and power amplifier operation.
   i. Spectrum analyzer is connected to 150-Ω adapter for calibration of CDN/current injection probe and verification of applied voltage.
   ii. Signal generator is connected to power amplifier and set for 80% amplitude modulation with a 1-kHz sine wave. Ensure signal is 0 to +2 dB.
   iii. Power amplifier is connected to CDN/probe.

c. Verify applied voltage at probe with spectrum analyzer.

d. Operate EUT as described in Section V.

e. Illuminate unit under test.

f. Sweep frequencies from 150 kHz to 80 MHz.

i. Frequency step sizes are 1% of previous frequency (i.e. 5 kHz at 500 kHz).
ii. Dwell time at each frequency is the time necessary for the EUT to respond (i.e. 1s).
iii. Processor frequencies are analyzed separately.

g. Perform final evaluation of unit by noting EUT indicators.

6. Magnetic-Field Immunity in accordance with EN 61000-4-8 Level 4.

Frequencies: 50 & 60 Hz
Field Strength: 30 A/m

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
b. Verify Helmholtz coil operation; connect coil to 50/60 Hz source.
   i. Place H-field loop between coils and connect to signal analyzer to verify field.
   ii. Use current probe to verify current in coil.
c. Set up, power and operate EUT as described in Section V.
d. Apply field to EUT and repeat for each axis and EUT component.
e. Perform final evaluation of unit by noting EUT indicators.

IX. Photographs of Measurement Setup:

The following pages are photographs of the equipment as it was tested.

Photograph 1 – Radiated Emissions

Photograph 2 – ESD Immunity

Photograph 3 – Radiated Immunity

Photograph 4 – EFT Immunity

Photograph 5 – Conducted Immunity

Photograph 6 – Magnetic Immunity

X. Radiated Emissions Data:

Vertical Polarization

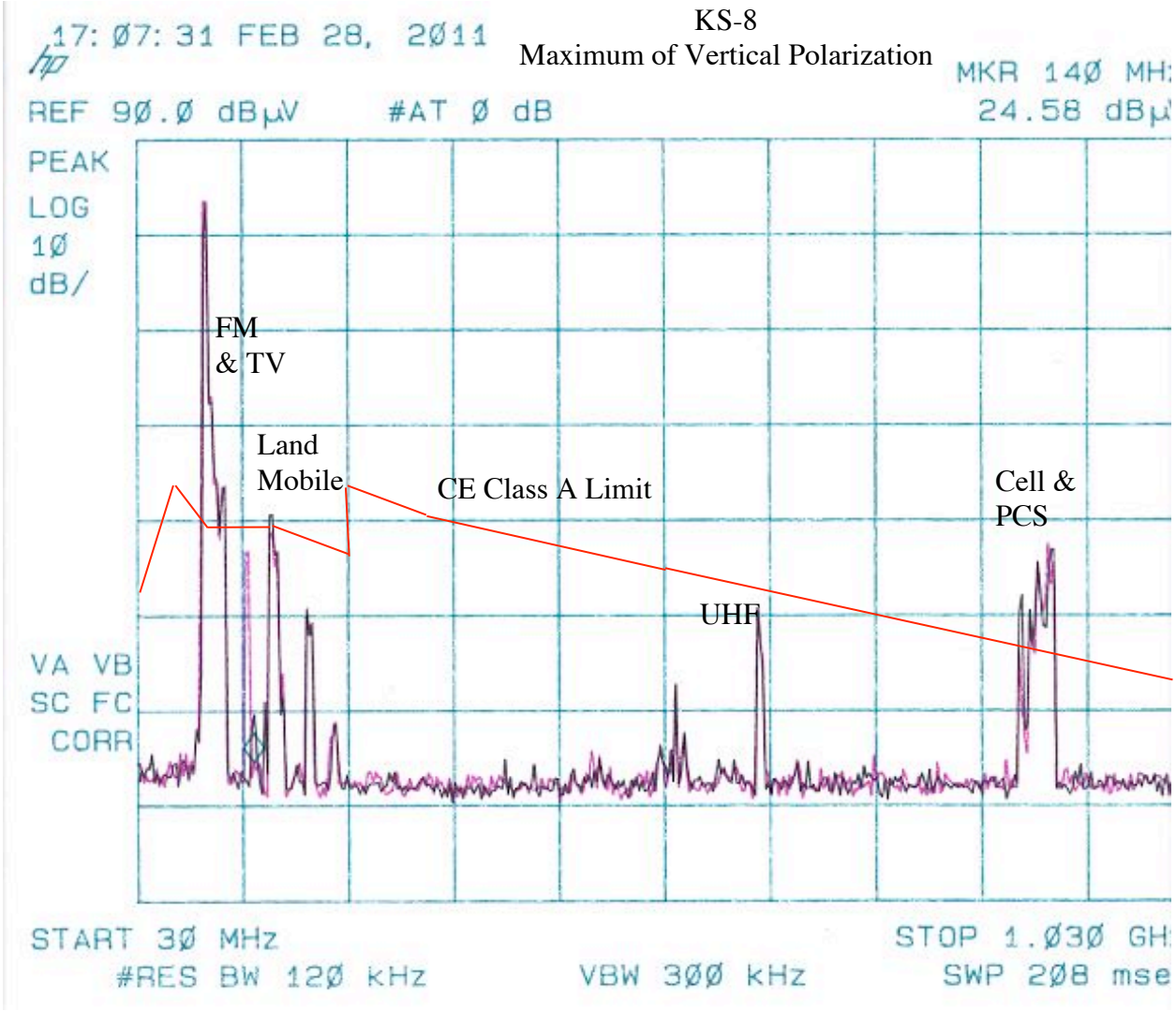
The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following page contains the spectrum analyzer output with the corrected specification limits superimposed. The black pen is the ambient condition, and the other color identifies EUT emissions. Maximum amplitudes of vertical polarization are shown in the results below.

Frequency MHz	Class A limit @ 10m dBuV	Amp Gain dB	Antenna Factor dB	Cable Loss dB	Corrected Limit dBuV
30	40	20	17.0	1	42.0
50	40	20	13.6	1	45.4
75	40	20	6.5	1	52.5
100	40	20	10.1	2	47.9
125	40	20	9.4	2	48.6
150	40	20	8.5	3	48.5
230	40	20	11.3	3	45.7
231	47	20	11.3	3	52.7
300	47	20	13.5	4	49.5
500	47	20	17.8	6	43.2
1000	47	20	23.8	10	33.2

Table 1 – Corrected CE Limit - Vertical Polarization

X. Radiated Emissions Data Cont'd:

KS-8
Maximum of Vertical Polarization



X. Radiated Emissions Data Cont'd:

Horizontal Polarization

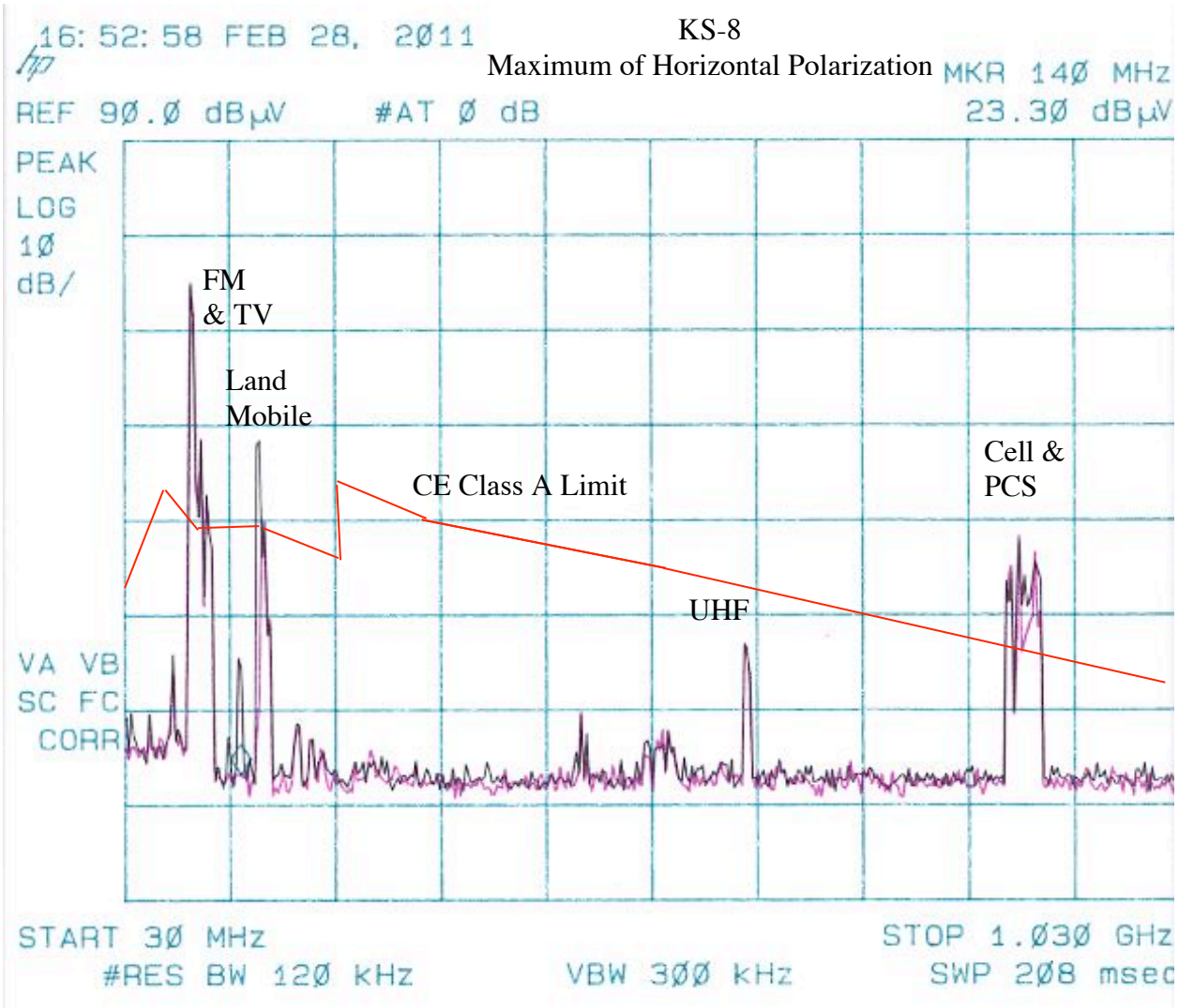
The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following page contains the spectrum analyzer output with the corrected specification limits superimposed. The black pen is the ambient condition, and the other color identifies EUT emissions. Maximum amplitudes of horizontal polarization are shown in the results below.

Frequency MHz	Class A limit @ 10m dBuV	Amp Gain dB	Antenna Factor dB	Cable Loss dB	Corrected Limit dBuV
30	40	20	17.5	1	41.5
50	40	20	14.5	1	44.5
75	40	20	6.6	1	52.4
100	40	20	9.4	2	48.6
125	40	20	10.7	2	47.3
150	40	20	8.2	3	48.8
230	40	20	11.8	3	45.2
231	47	20	11.8	3	52.2
300	47	20	13.0	4	50.0
500	47	20	16.7	6	44.3
1000	47	20	23.2	10	33.8

Table 2 – Corrected CE Limit - Horizontal Polarization

X. Radiated Emissions Data Cont'd:

KS-8
Maximum of Horizontal Polarization



XI. ESD Data:

The system does not exhibit susceptibility to 4-kV contact/8-kV air discharges, applied singly or repetitively, and directly or indirectly. The relative humidity during unit testing was measured to be between 30% and 60%. "A" result = No effect on EUT.

Level	Voltage	Application Point	Contact/Air	Spec.	Result
1	2	Connector	Contact	B	A
2	4	Connector	Contact	B	A
1	2	Enclosure	Air	B	A
2	4	Enclosure	Air	B	A
3	8	Enclosure	Air	B	A
1	2	Coupling Plane	Contact	B	A
2	4	Coupling Plane	Contact	B	A
1	2	Connector	Air	B	A
2	4	Connector	Air	B	A
3	8	Connector	Air	B	A
1	2	Coupling Plane	Air	B	A
2	4	Coupling Plane	Air	B	A
3	8	Coupling Plane	Air	B	A

Table 3 – ESD Results

XII. Radiated Susceptibility Data:

The system does not exhibit susceptibility to 1- 3- & 10-V/m radiated electric fields, amplitude modulated at 1000 Hz, 80%, from 80 MHz to 2.7 GHz. Frequencies listed are samples; sweep rate is <1.5 decade/s. "A" result = No effect on EUT.

Frequency (MHz)	Voltage	Evaluation	Criteria	Spec.	Result
80	10	Gyro Output	Normal Operation	A	A
100	10	Gyro Output	Normal Operation	A	A
120	10	Gyro Output	Normal Operation	A	A
140	10	Gyro Output	Normal Operation	A	A
160	10	Gyro Output	Normal Operation	A	A
180	10	Gyro Output	Normal Operation	A	A
200	10	Gyro Output	Normal Operation	A	A
250	10	Gyro Output	Normal Operation	A	A
300	10	Gyro Output	Normal Operation	A	A
350	10	Gyro Output	Normal Operation	A	A
400	10	Gyro Output	Normal Operation	A	A
450	10	Gyro Output	Normal Operation	A	A
500	10	Gyro Output	Normal Operation	A	A
550	10	Gyro Output	Normal Operation	A	A
600	10	Gyro Output	Normal Operation	A	A
700	10	Gyro Output	Normal Operation	A	A
800	10	Gyro Output	Normal Operation	A	A
900	10	Gyro Output	Normal Operation	A	A
950	10	Gyro Output	Normal Operation	A	A
1000	10	Gyro Output	Normal Operation	A	A
1400	3	Gyro Output	Normal Operation	A	A
2000	3	Gyro Output	Normal Operation	A	A
2200	1	Gyro Output	Normal Operation	A	A
2400	1	Gyro Output	Normal Operation	A	A
2700	1	Gyro Output	Normal Operation	A	A

Table 4 – Radiated Susceptibility Results

XIII. Electrical Fast Transient Data:

The system does not exhibit susceptibility to 1-kV electrical fast transients, delivered in 5-kHz bursts to DC signal lines. "A" result = No effect on EUT.

Level	Voltage	Application Port	Polarity and Duration	Spec.	Result
1	500	Capacitive Clamp	Plus/1 Minute	B	A
2	1000	Capacitive Clamp	Plus /1 Minute	B	A
1	500	Capacitive Clamp	Minus/1 Minute	B	A
2	1000	Capacitive Clamp	Minus/1 Minute	B	A

Table 5 – EFT Results - Signal Ports

XIV. Conducted Immunity Data Cont'd:

The system does not exhibit susceptibility to 3-V conducted signals applied, using the injection probe, to the DC/signal lines from 150 kHz to 80 MHz. Frequencies listed are samples; dwell > EUT response time. "A" result = No effect on EUT.

Frequency (MHz)	Voltage	Evaluation	Criteria	Spec.	Result
0.150	3	Gyro Output	Normal Operation	A	A
0.500	3	Gyro Output	Normal Operation	A	A
0.750	3	Gyro Output	Normal Operation	A	A
1	3	Gyro Output	Normal Operation	A	A
2	3	Gyro Output	Normal Operation	A	A
3	3	Gyro Output	Normal Operation	A	A
4	3	Gyro Output	Normal Operation	A	A
5	3	Gyro Output	Normal Operation	A	A
10	3	Gyro Output	Normal Operation	A	A
15	3	Gyro Output	Normal Operation	A	A
20	3	Gyro Output	Normal Operation	A	A
25	3	Gyro Output	Normal Operation	A	A
30	3	Gyro Output	Normal Operation	A	A
35	3	Gyro Output	Normal Operation	A	A
40	3	Gyro Output	Normal Operation	A	A
45	3	Gyro Output	Normal Operation	A	A
50	3	Gyro Output	Normal Operation	A	A
55	3	Gyro Output	Normal Operation	A	A
60	3	Gyro Output	Normal Operation	A	A
65	3	Gyro Output	Normal Operation	A	A
70	3	Gyro Output	Normal Operation	A	A
75	3	Gyro Output	Normal Operation	A	A
80	3	Gyro Output	Normal Operation	A	A

Table 6 – Conducted Immunity Results - Signal Lines

XV. Magnetic-Field Immunity Data:

The system does not exhibit susceptibility to 30 A/m fields at 50 or 60 Hz. "A" result = No effect on EUT.

Frequency (Hz)	Field (A/m)	Application Port	Axis	Spec.	Result
50	30	Enclosure	X	A	A
50	30	Enclosure	Y	A	A
50	30	Enclosure	Z	A	A

Frequency (Hz)	Field (A/m)	Application Port	Axis	Spec.	Result
60	30	Enclosure	X	A	A
60	30	Enclosure	Y	A	A
60	30	Enclosure	Z	A	A

Tables 7 & 8 – Magnetic Immunity Results