Measurement of RF Interference from an Light Control Module (LCM), Model No. XS0246, Rev. 3 Transceiver

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P.O. No.	:	131
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Date Tested	:	May 7, 2007 through May 9, 2007
Test Personnel	:	Mark E. Longinotti
Specification	:	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B and Subpart C, Section 15.247 for Digital Transmission Systems Operating within The band 2400-2483.5MHz
		Industry Canada RSS-210
:		Industry Canada RSS-GEN

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REVISION HISTORY

Revision	Date	Description
—	May 16, 2007	Initial release

Measurement of RF Emissions from a Light Control Module (LCM), Model No. XS0246, Rev. 3 Transceiver

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Light Control Module (LCM), Model No.XS0246, Rev. 3 transceiver (hereinafter referred to as the test item). Serial No. 128880 was used for all tests except for Duty Cycle correction factor measurements. Serial No. 128888 was used for Duty Cycle correction factor measurements. The test item was designed to transmit and receive in the 2405MHz to 2475MHz band using an internal, non-detachable antenna. The test item transmitted using digital transmission system techniques. The test item was manufactured and submitted for testing by Twisthink, LLC located in Holland, MI.

1.2 Purpose

The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, and Subpart C, Sections15.207 and 15.247 for Intentional Radiators operating within the 2400-2483.5MHz band. Testing was performed in accordance with ANSI C63.4-2003.

1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.5 Laboratory Conditions

The temperature at the time of the test was 23C and the relative humidity was 35%.

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2006
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
- Industry Canada RSS-210, Issue 6, September 2005, “Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment”
- Industry Canada RSS-GEN, Issue 1, September 2005, “Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment”
- Public Notice 558074, “New Guidance on Measurements for Digital Transmission Systems in 15.247”
- Public Notice DA 00-705, “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum

Systems”

3 TEST ITEM SET-UP AND OPERATION

3.1 General Description

The test item is a Light Control Module (LCM), Model No. XS0246, Rev. 3 transceiver. A block diagram of the test item set-up is shown as Figure 1. A photograph of the test item is shown as Figure 2.

The test item is connected to a Model No. 6939.000.000 light fixture. A light occupancy sensor, Part No. HB350DR was also connected to the light fixture.

3.1.1 Power Input

The test item, light fixture, and light occupancy sensor were powered with either 115V, 60Hz or 277V, 60Hz power through a 2.6 meter long, 3 wire unshielded power cord. The power supply used by the test item converted either 115V, 60Hz or 277V, 60Hz input power to 3.3VDC.The high and low leads of the input power were connected through a line impedance stabilization network (LISN) which was located on the ground plane. The network complies with the requirements of Paragraph 4.1.2 of ANSI C63.4-2001.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the test item:

Item	Description
Light Fixture	Model No. 6939.000.000
Light Occupancy Sensor	Part No. HB350DR

3.1.3 Interconnect Cables

The test item was submitted for testing with no interconnect cables.

3.1.4 Grounding

The light fixture, light fixture housing, and test item hosing were grounded only through the third wire of its input power cord. The test item circuit board was ungrounded.

3.2 Operational Mode

For all tests, the test item and all peripheral equipment were placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized.

For radiated emissions tests, the test item was programmed to operate in one of the following modes:

- transmit @ 2405MHz
- transmit @ 2445MHz
- transmit @ 2475MHz

For conducted emissions tests, the test item was programmed to operate in one of the following modes:

- transmit @ 2445MHz, with modulation, 115V, 60Hz input power
- transmit @ 2445MHz, with modulation, 277V, 60Hz input power

3.3 Test Item Modifications

No modifications were required for compliance to the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, and Subpart C, Sections 15.207 and 15.249 requirements.

4 TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1 Equipment List. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Conducted emission tests were performed with a spectrum analyzer in conjunction with a quasi-peak adapter. Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths detector functions specified by the FCC.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

5 TEST PROCEDURES

5.1 Powerline Conducted Emissions

5.1.1 Receiver

5.1.1.1 Requirements

Per 15.101(b), receivers operating above 960MHz are exempt from complying with the conducted emissions requirements of 15.107. Therefore, no conducted emissions tests were performed with the test item operating in the receive mode.

5.1.2 Transmitter

5.1.2.1 Requirements

All radio frequency voltages on the power lines of an intentional radiator shall be below the values shown below when using a quasi-peak or average detector:

CONDUCTED LIMITS FOR AN INTENTIONAL RADIATOR

Frequency MHz	RFI Voltage dBuV(QP)	RFI Voltage dBuV(Average)
0.15-0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

Note 1: The lower limit shall apply at the transition frequencies.
Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the test item is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.1.2.2 Procedures

The interference on each power lead was measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. The meter terminal of the LISN not under test was terminated with 50 ohms. Measurements were first made over the entire frequency range from 150kHz through 30MHz with a peak detector and the results were automatically plotted. The data thus obtained was then searched by the computer for the highest levels. Quasi-peak measurements were automatically performed at the frequencies selected from the highest peak measurements, and the results printed.

5.1.2.3 Results

The plots of the peak preliminary conducted voltage levels on each power line, with the test item transmitting at 2445MHz, modulation on, 115V, 60Hz input power, are presented on pages 21 and 22. The conducted emissions limits for intentional radiators are shown as a reference. The final quasi-peak and average results are presented on pages 23 and 24. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closest to the limit (worst case) occurred at 1.298MHz. The emissions level at this frequency was 3.9dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 3.

The plots of the peak preliminary conducted voltage levels on each power line, with the test item transmitting at 2445MHz, modulation on, 277V, 60Hz input power, are presented on pages 25 and 26. The conducted emissions limits for intentional radiators are shown as a reference. The final quasi-peak and average results are presented on pages 27 and 28. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closest to the limit (worst case) occurred at 734kHz. The emissions level at this frequency was 3.4dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 3.

5.2 Duty Cycle Factor Measurements

5.2.1 Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning the center frequency to the transmitter frequency and then setting a zero span width with 10msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of a word period. If the word period exceeds 100 msec the word period is set to 100 msec. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.2.2 Results

The plot of the duty cycle is shown on data page 29. The duty cycle correction factor was calculated to be -16.48dB (-16.48dB = 20*log(15msec/100msec).

5.3 Radiated Measurements

5.3.1 Receiver

5.3.1.1 Requirements

Per 15.101(b), receivers operating above 960MHz are exempt from complying with the radiated emissions requirements of 15.109. Therefore, no radiated emissions tests were performed with the test item operating in the receive mode.

5.3.2 Transmitter

5.3.2.1 Requirements

Per section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.3.2.2 Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the test item.

For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 25GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 25GHz.

1) For all harmonics not in the restricted bands, the following procedure was used:

   a) The field strength of the fundamental was measured using a double-ridged waveguide antenna. The double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.

   b) The field strength of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.

   c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:

      i) The test item was rotated so that all of its sides were exposed to the receiving antenna.

      ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

      iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

   d) All harmonics not in the restricted bands must be at least 20dB below level measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:

   a) The field strength of all emissions below 1GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.

   b) The field strength of all emissions above 1GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 1MHz was used on the spectrum analyzer.

   c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:

      i) The test item was rotated so that all of its sides were exposed to the receiving antenna.

      ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

      iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

   d) For all radiated emissions measurements below 1GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

   e) For all radiated emissions measurements above 1GHz, measurements were taken using a 1MHz resolution bandwidth and a 10Hz video bandwidth. For pulsed emissions, these readings were corrected to average levels using a duty cycle factor which was computed from the pulse train. All average levels must comply with the limits specified in 15.209(a).

5.3.2.3 Results

Preliminary radiated emissions plots with the test item transmitting at 2405MHz are shown on pages 30 through

33. Final radiated emissions data are presented on data page 34. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 4810MHz. The emissions level at this frequency was 22.5dB within the limit. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 4.

Preliminary radiated emissions plots with the test item transmitting at 2445MHz are shown on pages 35 through38. Final radiated emissions data are presented on data page 39. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 4890MHz. The emissions level at this frequency was 18.2dB within the limit. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 4.

Preliminary radiated emissions plots with the test item transmitting at 2475MHz are shown on pages 40 through 43. Final radiated emissions data are presented on data page 44. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 4950MHz. The emissions level at this frequency was 16.2dB within the limit. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 4.

5.4 6dB Bandwidth and 99% Bandwidth

5.4.1 Requirements

Per 15.247(a) (2), for systems using digital modulation in the 2400-2483.5MHz band, the minimum 6dB bandwidth shall be al least 500kHz.

5.4.2 Procedures

The test item was set up inside the test chamber.

a) With the modulation enabled, the test item was allowed to transmit continuously at 2405MHz.

b) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.

c) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 100kHz.

d) The 'Max-Hold' function of the spectrum analyzer was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.

e) The marker-to-peak function of the analyzer was used to set the marker to the peak of the emission. The marker-delta function was used to measure 6dB down point from the peak of the emission. The marker-delta function was reset and the marker was moved to the other side of the emission until it is even with the reference marker level. The marker-delta reading at this point is the 6dB bandwidth.

f) The analyzer's display was plotted using a 'screen dump' utility.

g) The resolution bandwidth was then reduced to 30kHz.

h) The 'Max-Hold' function of the spectrum analyzer was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The 99% bandwidth function of the spectrum analyzer was then used to measure the 99% bandwidth. The measurement was recorded.

i) Steps (a) through (h) were repeated with the test item transmitting at 2445MHz.

j) Steps (a) through (h) were repeated with the test item transmitting at 2475MHz.

5.4.3 Results

The plot on the 6dB bandwidth, with the test item transmitting at 2405MHz, is shown on page 45. As can be seen from the plot, the 6dB bandwidth is 1.61MHz which is greater than the minimum required 6dB bandwidth of 500kHz. The 99% bandwidth was measured to be 2.38MHz.

The plot on the 6dB bandwidth, with the test item transmitting at 2445MHz, is shown on page 46. As can be seen from the plot, the 6dB bandwidth is 1.62MHz which is greater than the minimum required 6dB bandwidth of 500kHz. The 99% bandwidth was measured to be 2.36MHz.

The plot on the 6dB bandwidth, with the test item transmitting at 2475MHz, is shown on page 47. As can be seen from the plot, the 6dB bandwidth is 1.59MHz which is greater than the minimum required 6dB bandwidth of 500kHz. The 99% bandwidth was measured to be 2.33MHz.

5.5 Peak Output Power

5.5.1 Requirements

Per section 15.247(b)(3), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per section 15.247(b) (4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).

5.5.2 Procedures

The test item was set up inside the test chamber.

a) With the modulation enabled, the test item was allowed to transmit continuously at 2405MHz.

b) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.

c) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 3MHz (greater than the 6dB bandwidth of the test item).

d) The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded.

e) The equivalent isotropic power was determined from the field intensity levels measured at 3 meters using substitution method. To determine the emission power, a second double ridged waveguide antenna was then set in place of the test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss and antenna gain, as required.

f) Steps (a) through (e) were repeated with the test item transmitting at 2445MHz.

g) Steps (a) through (e) were repeated with the test item transmitting at 2475MHz.

5.5.3 Results

The results are presented on page 48. The maximum EIRP measured from the transmitter was 7.1dBm or 0.005W which is below the 4 Watt or 36 dBm defacto limit.

5.6 Power Spectral Density

5.6.1 Requirements

Per section 15.247(d), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

5.6.2 Procedures

The Power Spectral Density Measurement Option 1 of Public Notice 558074, New Guidance for Digital Transmission Systems in 15.247, was used to measure power spectral density.

The test item was set up inside the test chamber.

a) With the modulation enabled, the test item was allowed to transmit continuously at 2475MHz.

b) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.

c) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 3MHz (greater than the 6dB bandwidth of the test item).

d) The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded.

e) The equivalent isotropic power was determined from the field intensity levels measured at 3 meters using substitution method. To determine the emission power, a second double ridged waveguide antenna was then set in place of the test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss and antenna gain, as required.

f) The test item was placed back in the test chamber.

g) Steps (a) through (d) were repeated to maximize the worst case emissions from the test item.

h) Using the substitution data taken during the peak output power measurements, it is known that a reading of 69.7dBuV on the spectrum analyzer is equivalent to a power reading of 6.3dBm. Therefore a spectrum analyzer reading of 71.4dBuV (71.4dBuV = 69.7dB + (8dB – 6.3dB)) is equivalent to a power reading of 8.0dBm.

i) The display line on the spectrum analyzer was set to 71.4dBuV. (This level represents the 8.0dBm power spectral density level.) The resolution bandwidth (RBW) was set to 3kHz, the sweep time was set to a time equal to or greater than the span divided by 3kHz (2 MHz/3kHz = 666 seconds). The peak detector and 'Max-Hold' function was engaged.

j) The analyzer's display was plotted using a 'screen dump' utility.

5.6.3 Results

Data page 49 shows the power spectral density results. As can be seen from this plot, the power spectral density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

5.7 Band-edge Compliance

5.7.1 Requirements

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required. In addition, the radiated emissions which fall in the restricted band beginning at 2483.5 MHz must meet the general limits of 15.209(a).

5.7.2 Procedures

a) The test item was set up inside the test chamber on a non-conductive stand.

b) A broadband measuring antenna was placed at a test distance of 3 meters from the test item.

c) The test item was set to transmit continuously at the channel closest to the low band-edge.

d) The test item was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.

e) To determine the band-edge compliance, the following spectrum analyzer settings were used:

   i. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.

ii. Resolution bandwidth (RBW) = 100kHz.

iii. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.

iv. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)

v. The analyzer's display was plotted using a 'screen dump' utility.

f) The test item was set to transmit continuously at the channel closest to the high band-edge.

g) Per Public Notice DA00-705, the Marker-Delta method of measuring band edge compliance can only be used for measuring emissions that are up to two “standard” bandwidths away form the band-edge. (Since C63.4 specifies a 1MHz resolution bandwidth for measurements above 1GHz, two “standard” bandwidths away from the band-edge would be 2MHz away from the band-edge.) Radiated emissions that are removed by more than two “standard” bandwidths must be measured in the conventional manner.

h) The highest transmit frequency used by the test item is 2475MHz. Since this is more than two “standard” bandwidths away from the band-edge, conventional radiated emissions measurements were taken at the band-edge.

i) The test item was set up in the test chamber. With the modulation enabled, the test item was allowed to transmit continuously at 2475MHz.

j) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.

k) The center frequency of the spectrum analyzer was set to the band-edge (2483.5MHz). The resolution bandwidth on the analyzer was set to 1MHz.

l) The test item was maximized for worst case emissions at the measuring antenna. The video bandwidth was reduced to 10Hz and an average reading was taken.

5.7.3 Results

Page 50 shows the radiated band-edge compliance results at 2400MHz. As can be seen from the plot, the emissions at the band-edge are within the 20 dB down limits.

Page 51 shows the radiated band-edge compliance results at 2483.5MHz. As can be seen from the data, the emissions at the band-edge are within the general limits.

6 CONCLUSIONS

It was determined that the Twisthink, LLC Light Control Module (LCM), Model No. XS0246, Rev. 3 transceiver, (Serial No. 128880 was used for all tests but Duty Cycle correction factor test and Serial No. 128888 was used for the Duty Cycle correction factor test), did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109 for receivers and Subpart C Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400MHz to 2483.5MHz band, when tested per ANSI C63.4-2003.

7 CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

8 ENDORSEMENT DISCLAIMER

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

9 EQUIPMENT LIST

Table 9-1 Equipment List

ELITE ELECTRONIC ENG. INC. Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/	001	4.8-20GHZ	07/27/06	12	07/27/07
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---		N/A	
Equipment Type: AMPLIFIERS								
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	03/16/07	12	03/16/08
APW0	PREAMPLIFIER	PLANAR ELECTRON	PE2-30-20G20	PL2926/0646	20GHZ-26.5GHZ	11/27/06	12	11/27/07
APW3	PREAMPLIFIER	PLANAR ELECTRON	PE2-35-120-5	PL2924	1GHZ-20GHZ	11/27/06	12	11/27/07
Equipment Type: ANTENNAS								
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ		NOTE 1	
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	08/21/06	12	08/21/07
NWI0	RIDGED WAVE GUIDE	AEL	H1498	153	2-18GHZ	10/09/06	12	10/09/07
NWI1	RIDGED WAVE GUIDE	AEL	H1498	154	2-18GHZ	10/09/06	12	10/09/07
Equipment Type: ATTENUATORS								
T1EA	10DB, 25W ATTENUATOR	WEINSCHEL	46-10-34	BN2316	DC-18GHZ	03/22/07	12	03/22/08
Equipment Type: CONTROLLERS								
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ	0028483108	1.8GHZ		N/A	
Equipment Type: PROBES; CLAMP-ON & LISNS								
PLL9	50UH LISN 462D	ELITE	462D/70A	010	0.01-400MHZ	03/08/07	12	03/08/08
PLLA	50UH LISN 462D	ELITE	462D/70A	011	0.01-400MHZ	03/08/07	12	03/08/08
Equipment Type: POWER SUPPLIES								
SRA7	DC POWER SUPPLY	TEKPOWER	HY3005D	0023471			NOTE 1	
Equipment Type: PRINTERS AND PLOTTERS								
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	02/21/07	12	02/21/08
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	02/21/07	12	02/21/08
RAF3	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	02/21/07	12	02/21/08
RBA1	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100146	20HZ-26.5GHZ	08/14/06	12	08/14/07
Equipment Type: SIGNAL GENERATORS								
GBR7	SIGNAL GENERATOR	HEWLETT PACKARD	8648D	3847M00602	9KHZ-4000MHZ	02/20/07	12	02/20/08

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

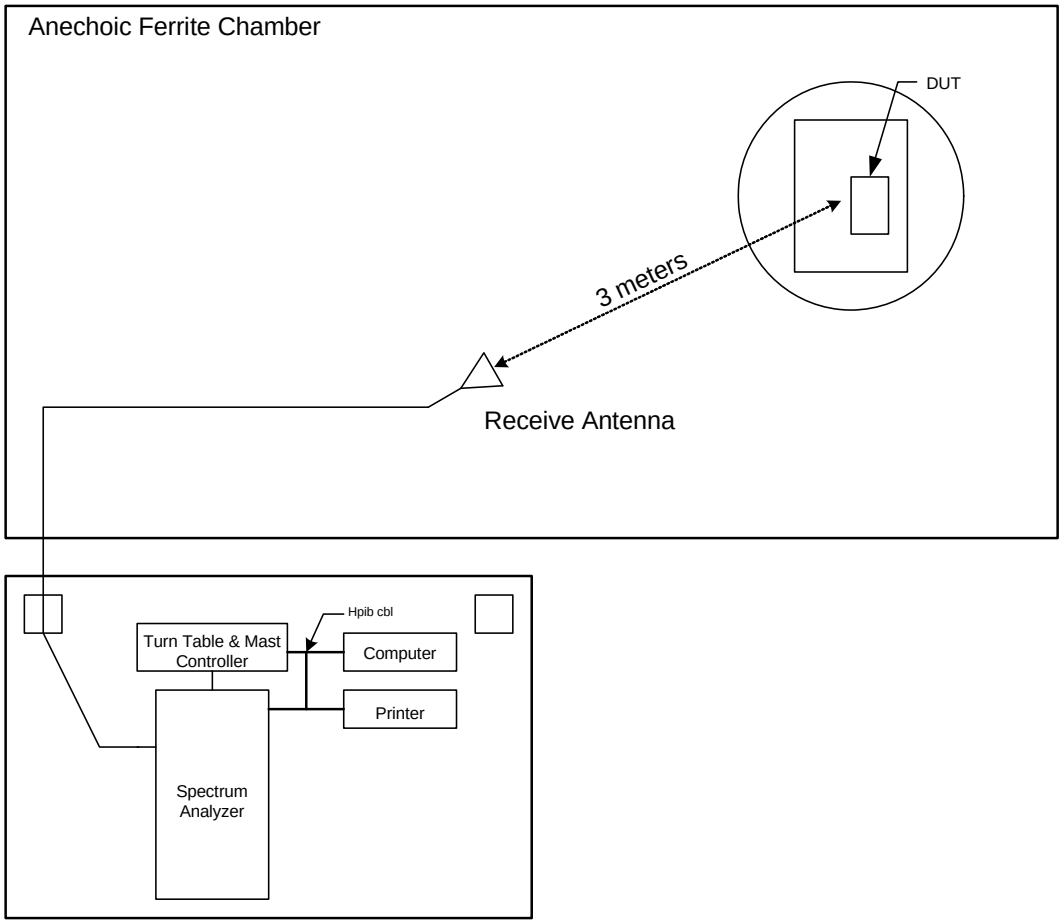
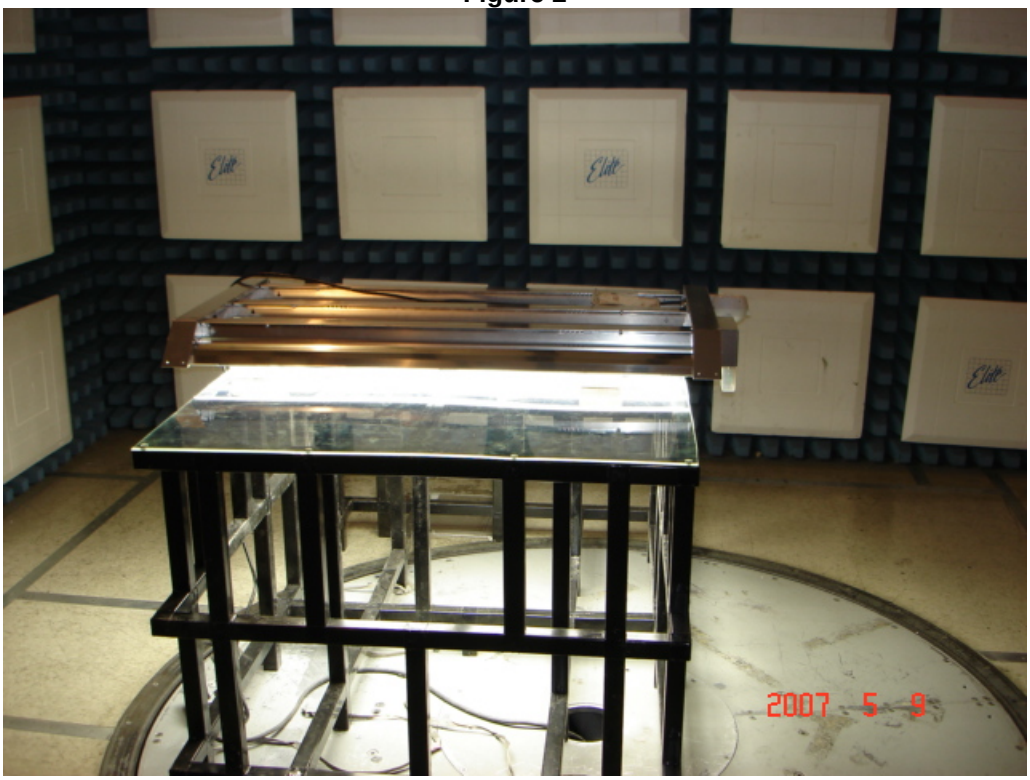


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2

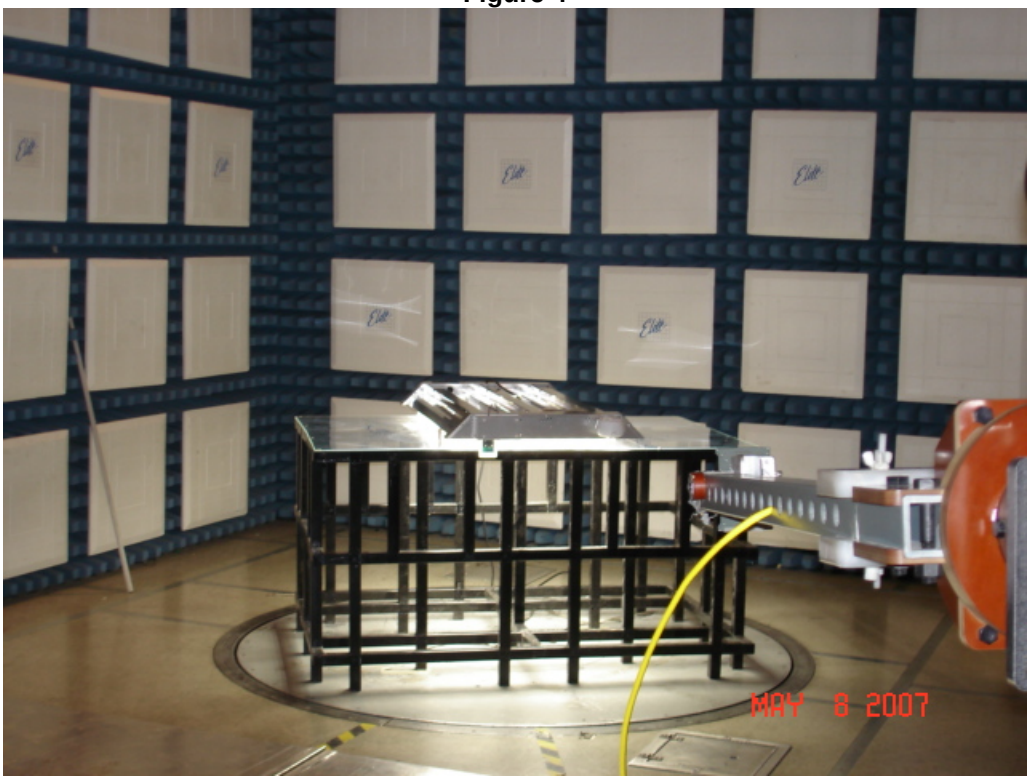


Test Item Set-up

Figure 3

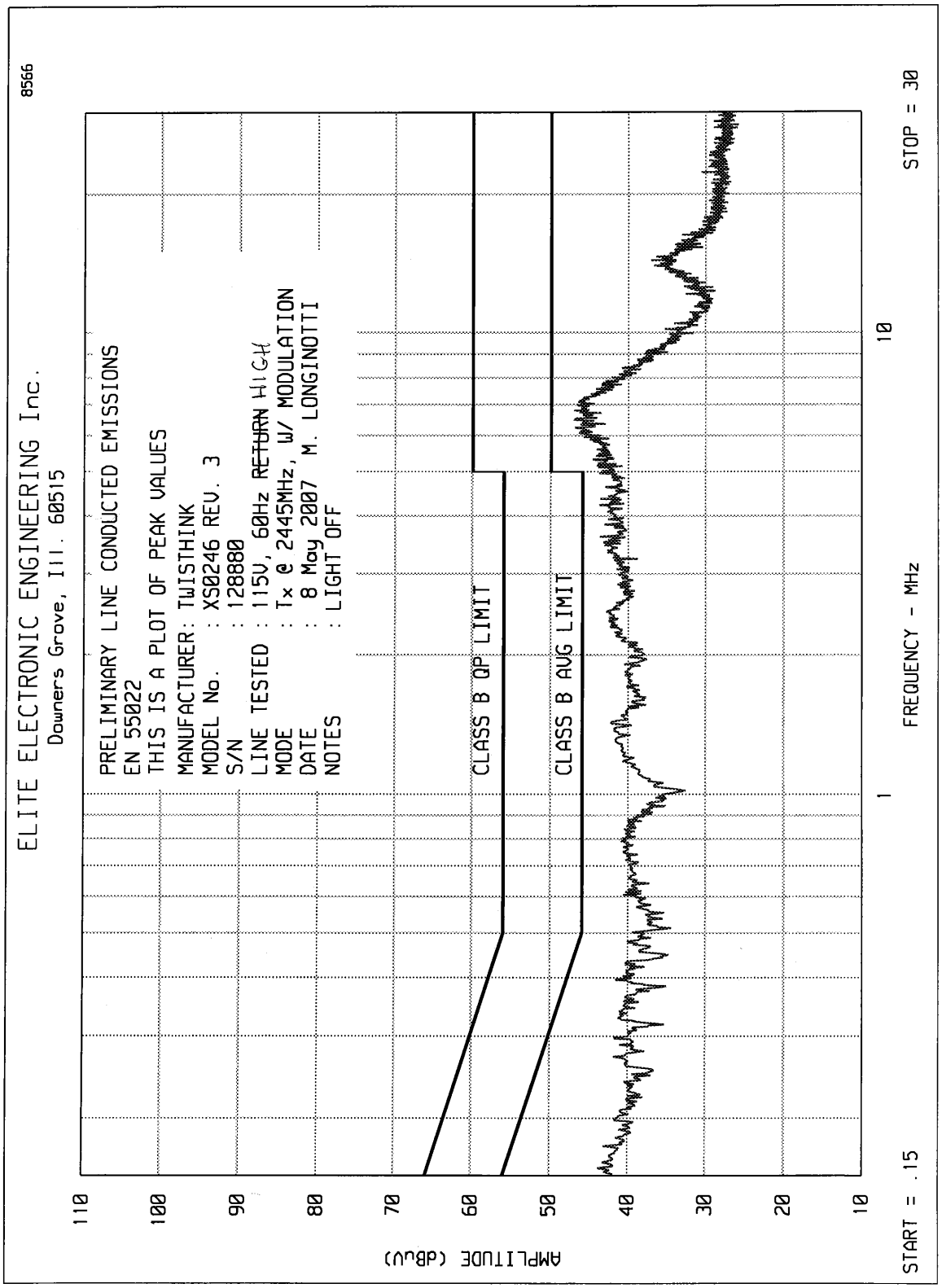
Test Set-up for Conducted Emissions

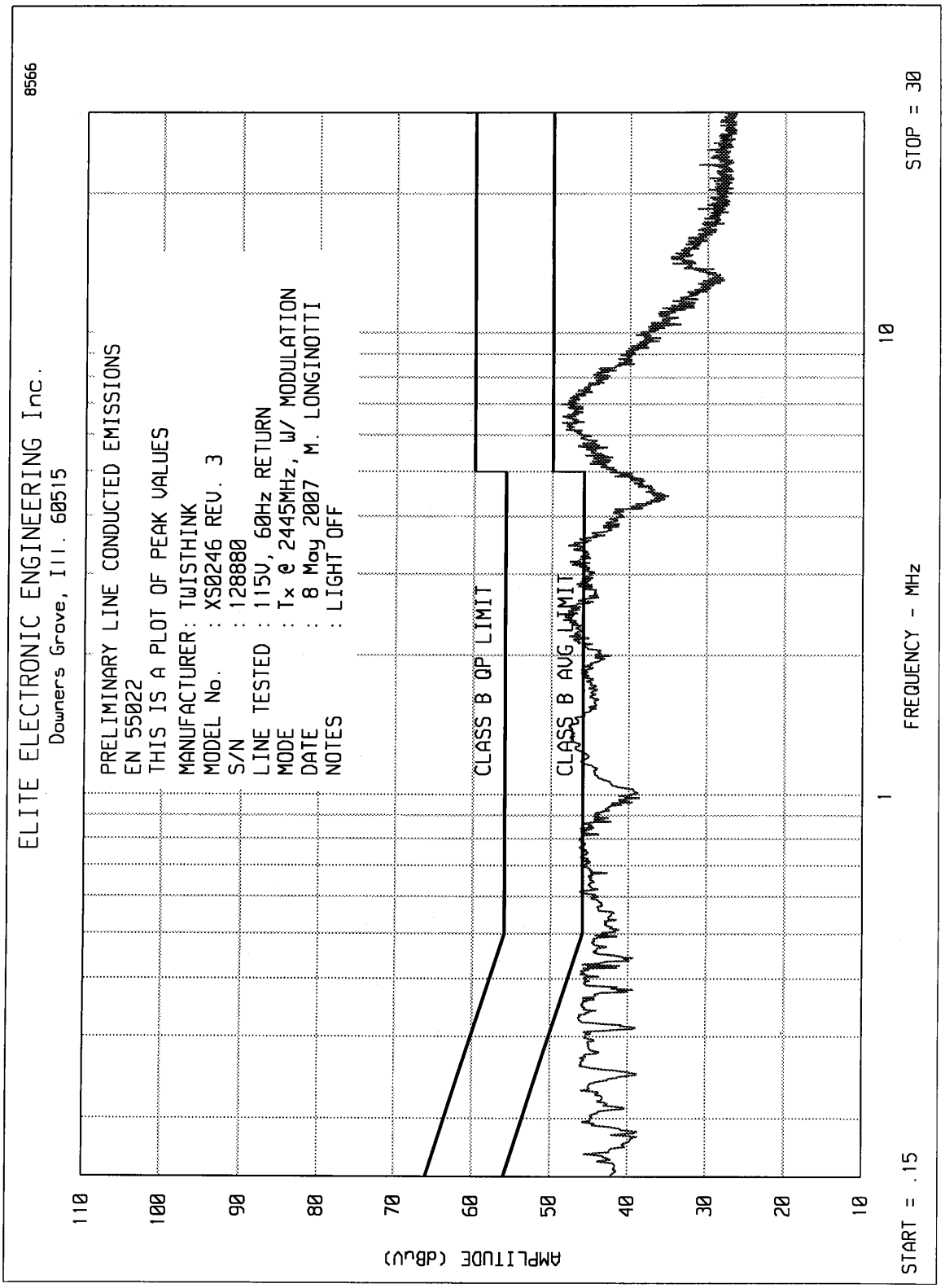
Figure 4



Test Set-up for Radiated Emissions, 2GHz to 18GHz – Horizontal Polarization

Test Set-up for Radiated Emissions, 2GHz to 18GHz – Vertical Polarization


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8566
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: TWISTHINK
MODEL No. : XS0246 REV. 3
S/N : 128880
LINE TESTED : 115V, 60Hz RETURN High
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 8 May 2007 M. LONGINOTTI
NOTES : LIGHT OFF
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: TWISTHINK
MODEL No. : XS0246 REV. 3
S/N : 128880
LINE TESTED : 115V, 60Hz RETURN
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 8 May 2007 M. LONGINOTTI
NOTES : LIGHT OFF
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz

ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : TWISTHINK
MODEL : XS0246 REV. 3
S/N : 128880
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 115V, 60Hz ~~RETURN~~ HIGH
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 8 May 2007
NOTES : LIGHT OFF
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.166	33.0	65.2		55.2	
.260	36.5	61.4		51.4	
.394	34.5	58.0		48.0	
.615	33.9	56.0		46.0	
.659	34.5	56.0		46.0	
.786	35.5	56.0		46.0	
.849	34.1	56.0		46.0	
1.301	36.2	56.0		46.0	
1.428	34.3	56.0		46.0	
2.302	35.8	56.0		46.0	
2.368	35.9	56.0		46.0	
2.478	34.2	56.0		46.0	
3.568	35.9	56.0		46.0	
4.205	36.0	56.0		46.0	
5.976	38.5	60.0		50.0	
6.012	38.8	60.0		50.0	
6.474	39.7	60.0		50.0	
7.255	39.0	60.0		50.0	
7.352	38.5	60.0		50.0	
8.712	32.0	60.0		50.0	
13.233	27.9	60.0		50.0	
14.356	29.6	60.0		50.0	
15.020	28.3	60.0		50.0	
17.618	26.0	60.0		50.0	
22.228	25.7	60.0		50.0	
23.548	25.7	60.0		50.0	
27.739	25.7	60.0		50.0	

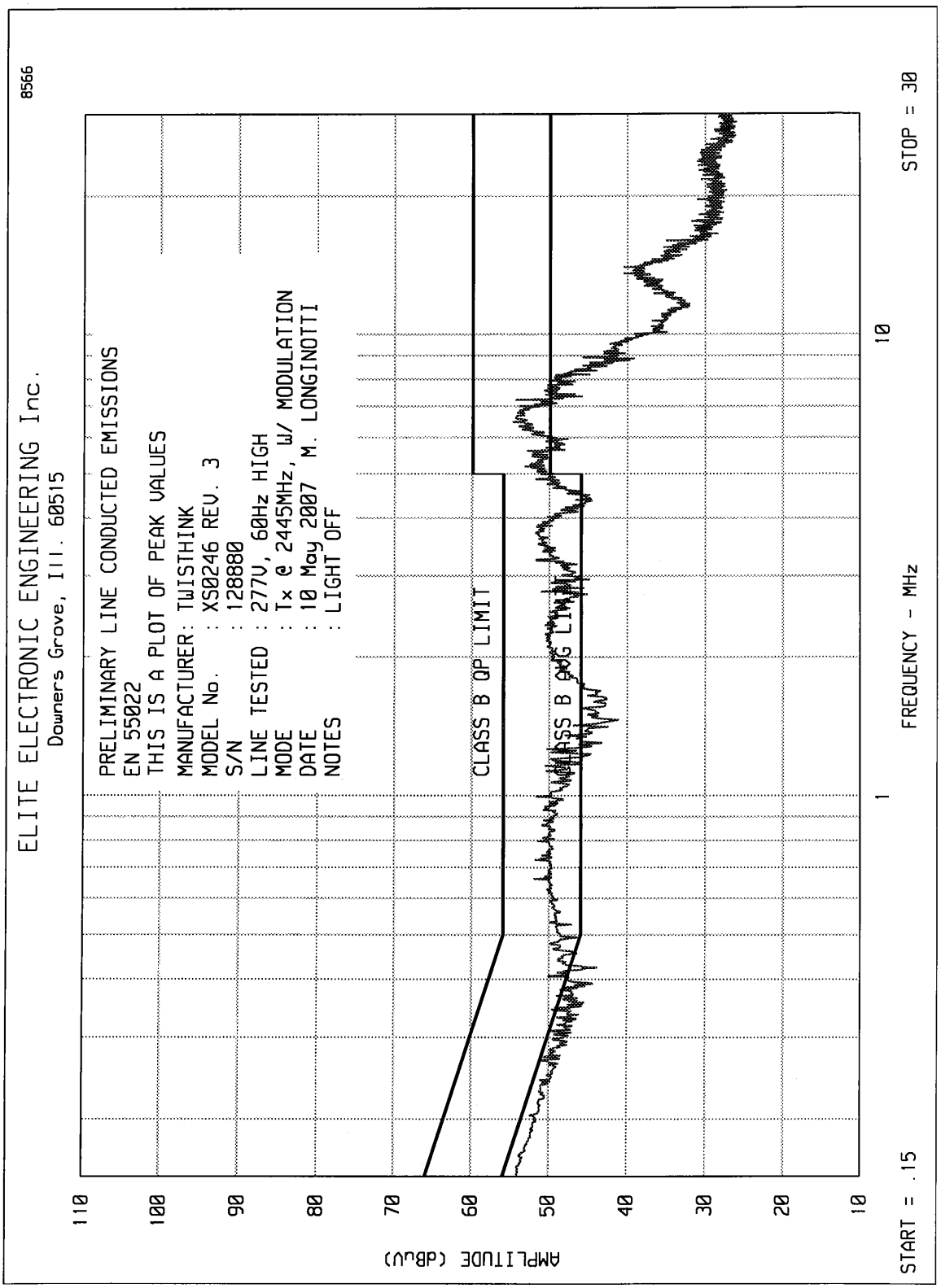
CHECKED BY: Mark E Longinotti
M. LONGINOTTI

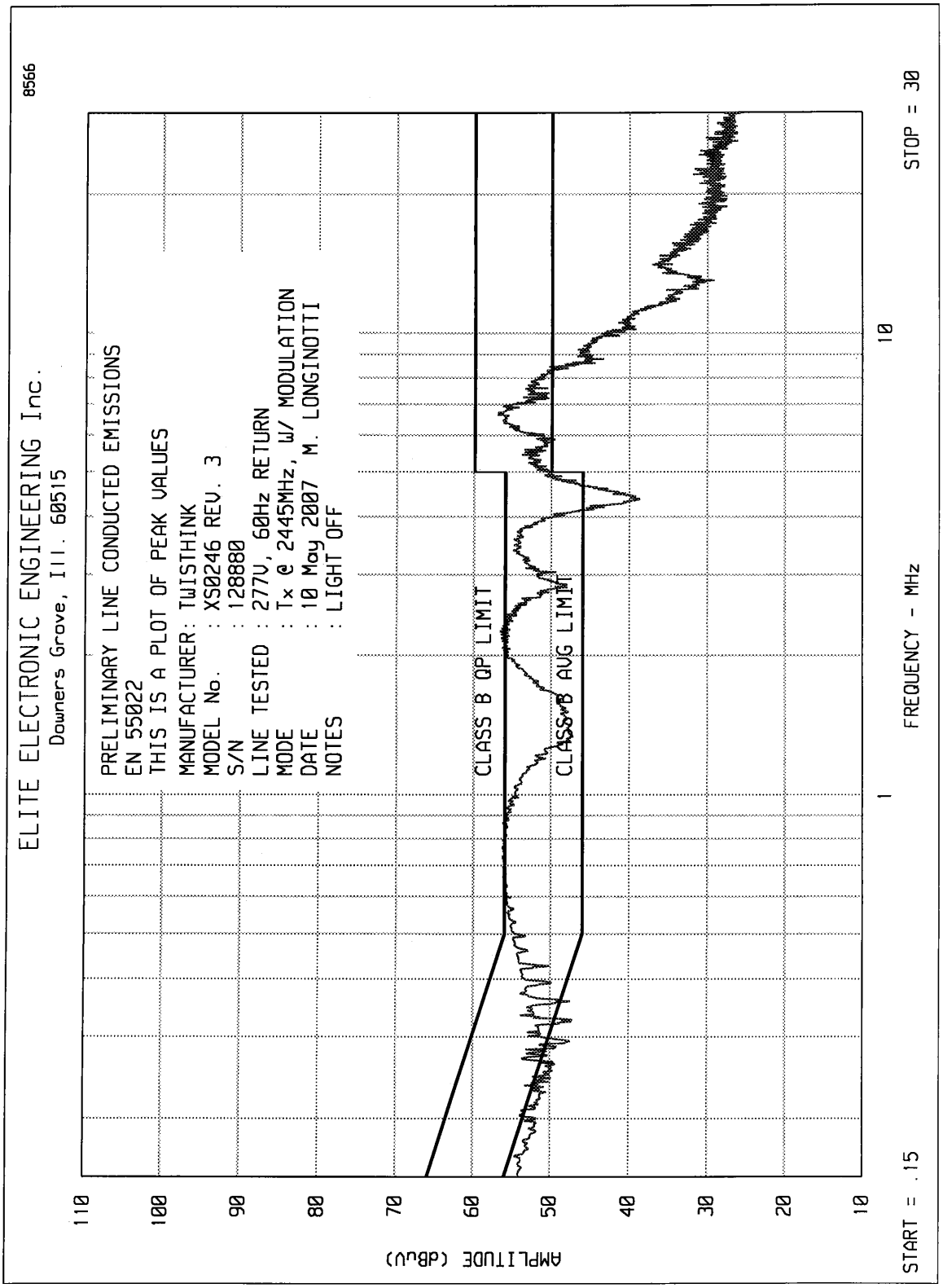
ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : TWISTHINK
MODEL : XS0246 REV. 3
S/N : 128880
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 115V, 60Hz RETURN
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 8 May 2007
NOTES : LIGHT OFF
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.234	40.6	62.3		52.3	
.264	42.5	61.3		51.3	
.330	42.4	59.5		49.5	
.413	40.7	57.6		47.6	
.478	39.3	56.4		46.4	
.613	39.8	56.0		46.0	
.801	41.3	56.0		46.0	
.833	40.0	56.0		46.0	
1.298	42.1	56.0		46.0	
1.401	41.1	56.0		46.0	
2.199	40.2	56.0		46.0	
2.398	41.9	56.0		46.0	
2.428	41.3	56.0		46.0	
3.397	40.3	56.0		46.0	
3.463	40.3	56.0		46.0	
4.962	36.4	56.0		46.0	
5.664	38.7	60.0		50.0	
5.995	40.6	60.0		50.0	
6.196	41.2	60.0		50.0	
6.961	41.9	60.0		50.0	
7.339	40.9	60.0		50.0	
8.128	38.0	60.0		50.0	
8.733	34.9	60.0		50.0	
9.987	31.0	60.0		50.0	
11.698	26.3	60.0		50.0	
15.051	26.3	60.0		50.0	
17.553	25.6	60.0		50.0	
21.698	25.4	60.0		50.0	
24.788	25.7	60.0		50.0	
26.763	25.6	60.0		50.0	

CHECKED BY: Mark E Longinotti
M. LONGINOTTI


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: TWISTHINK
MODEL No. : XS0246 REV. 3
S/N : 128880
LINE TESTED : 277V, 60Hz HIGH
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 10 May 2007 M. LONGINOTTI
NOTES : LIGHT OFF
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8566
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: TWISTHINK
MODEL No. : XS0246 REV. 3
S/N : 128880
LINE TESTED : 277V, 60Hz RETURN
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 10 May 2007 M. LONGINOTTI
NOTES : LIGHT OFF
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz

ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : TWISTHINK
MODEL : XS0246 REV. 3
S/N : 128880
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 277V, 60Hz HIGH
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 10 May 2007
NOTES : LIGHT OFF
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.150	43.8	66.0		56.0	
.271	41.2	61.1		51.1	
.415	43.4	57.5		47.5	
.622	44.7	56.0		46.0	
.662	44.8	56.0		46.0	
.697	44.8	56.0		46.0	
.767	45.2	56.0		46.0	
1.002	43.1	56.0		46.0	
1.144	40.5	56.0		46.0	
1.913	42.3	56.0		46.0	
2.214	44.4	56.0		46.0	
2.246	44.5	56.0		46.0	
2.764	36.9	56.0		46.0	
3.640	45.1	56.0		46.0	
3.744	45.4	56.0		46.0	
4.869	44.9	56.0		46.0	
5.175	45.6	60.0		50.0	
5.215	45.4	60.0		50.0	
6.474	48.0	60.0		50.0	
6.723	47.7	60.0		50.0	
7.564	43.6	60.0		50.0	
8.092	42.6	60.0		50.0	
8.924	35.6	60.0		50.0	
9.984	31.9	60.0		50.0	
13.171	30.7	60.0		50.0	
13.561	32.8	60.0		50.0	
15.062	28.9	60.0		50.0	
17.833	26.0	60.0		50.0	
21.346	27.4	60.0		50.0	
23.828	25.7	60.0		50.0	
27.673	25.7	60.0		50.0	

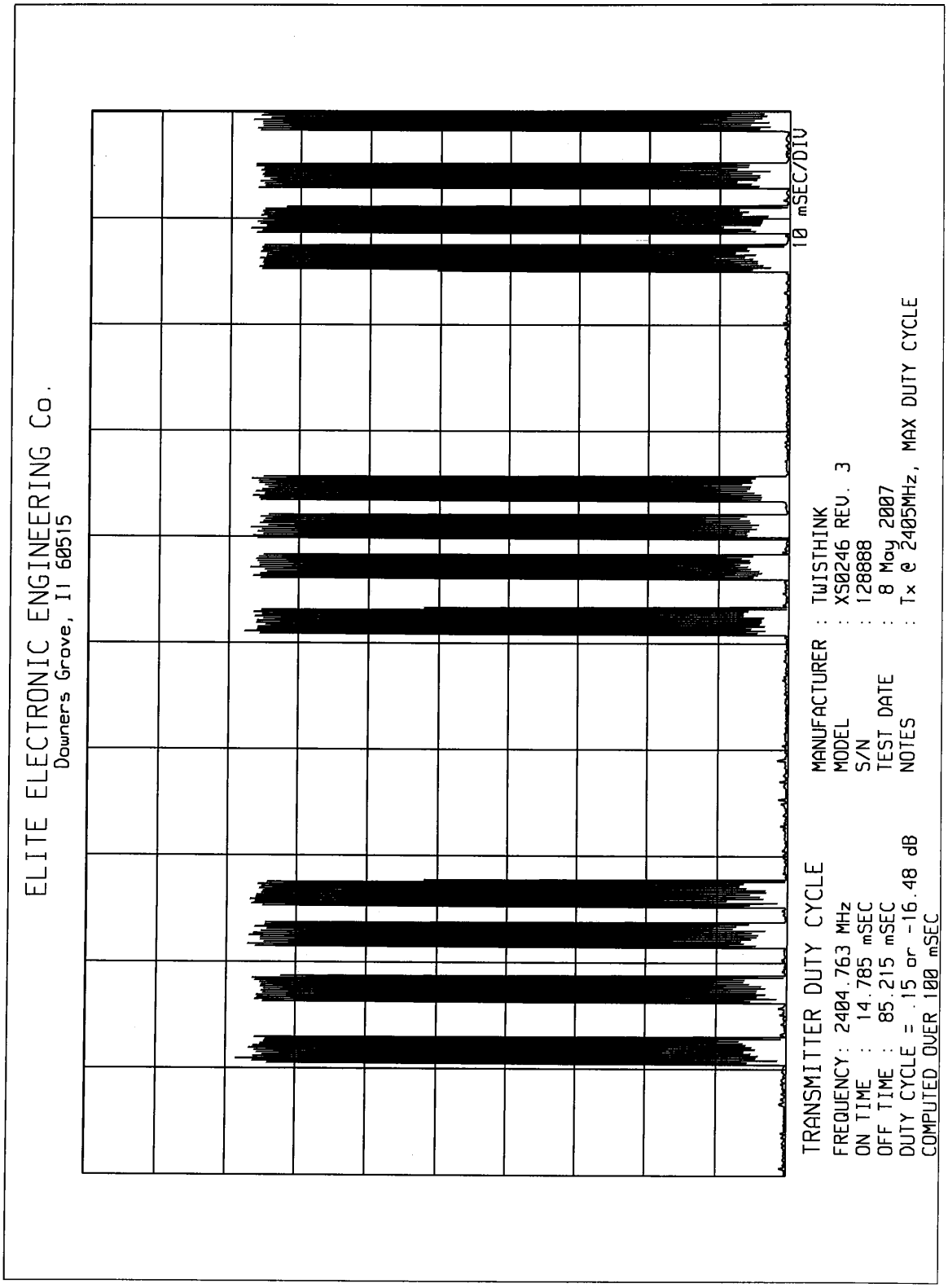
CHECKED BY: Mark E. Longinotti
M. LONGINOTTI

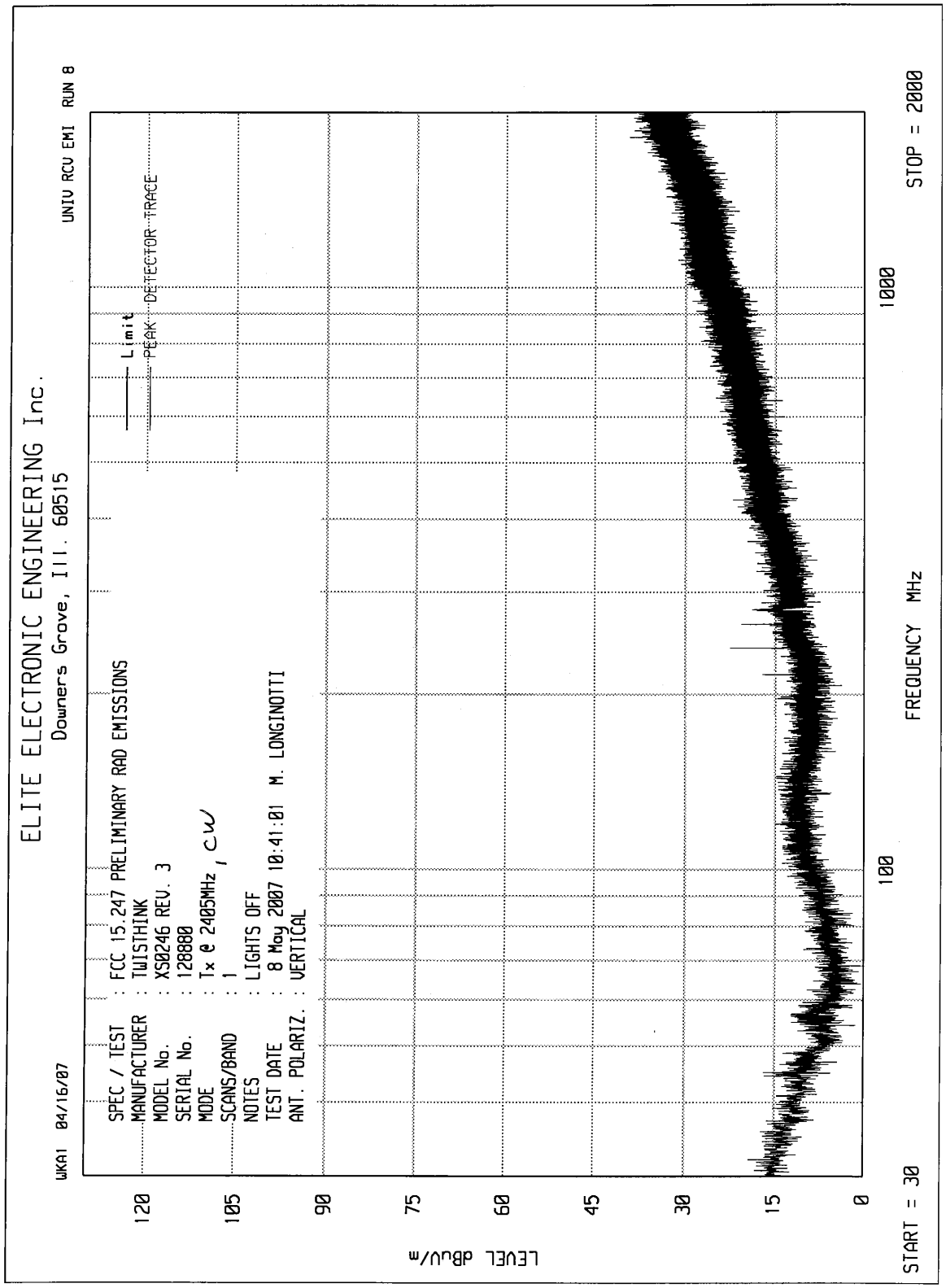
ETR No.
ELITE ELECTRONIC ENGINEERING CO.

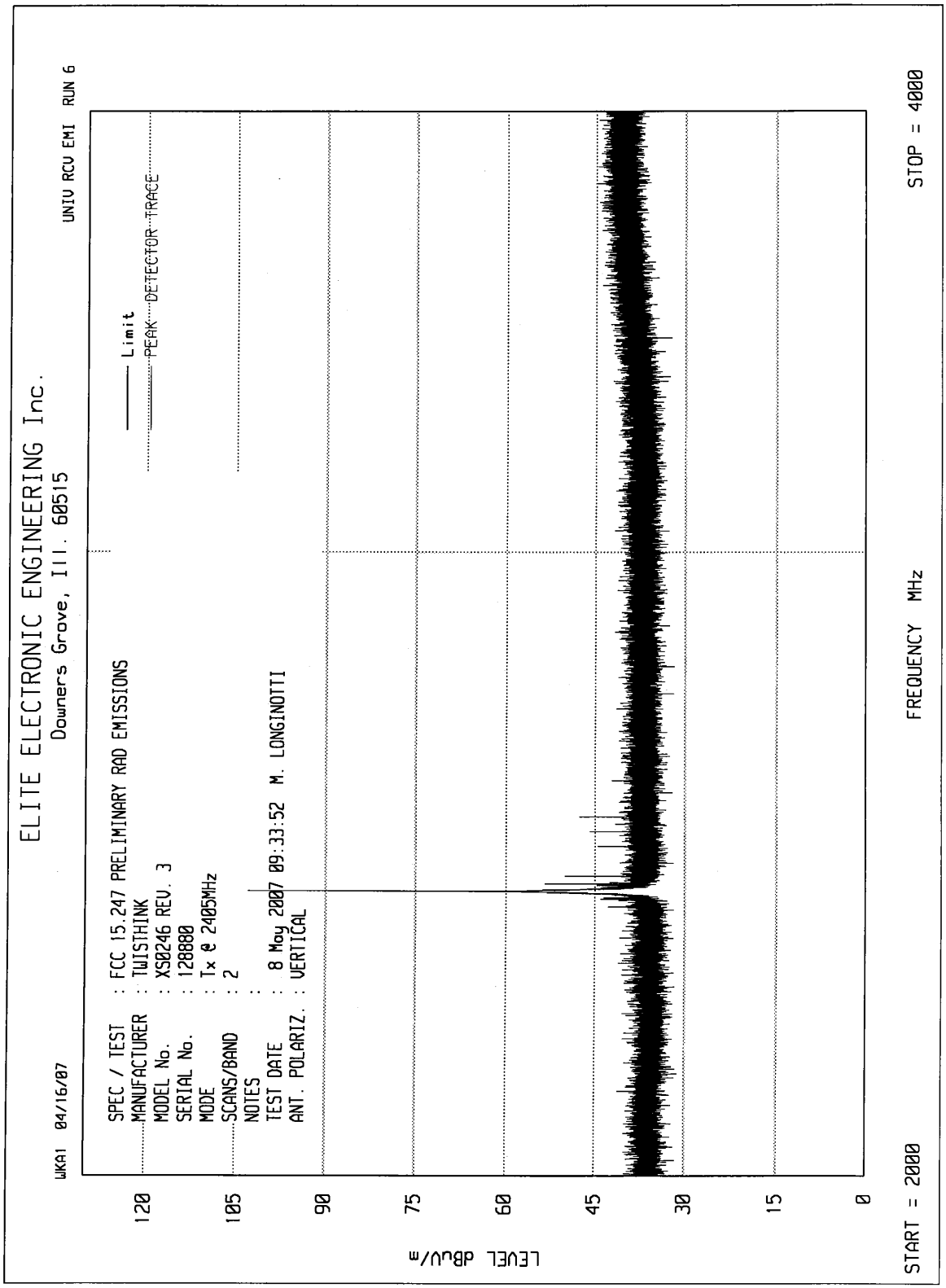
MANUFACTURER : TWISTHINK
MODEL : XS0246 REV. 3
S/N : 128880
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 277V, 60Hz RETURN
MODE : Tx @ 2445MHz, W/ MODULATION
DATE : 10 May 2007
NOTES : LIGHT OFF
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

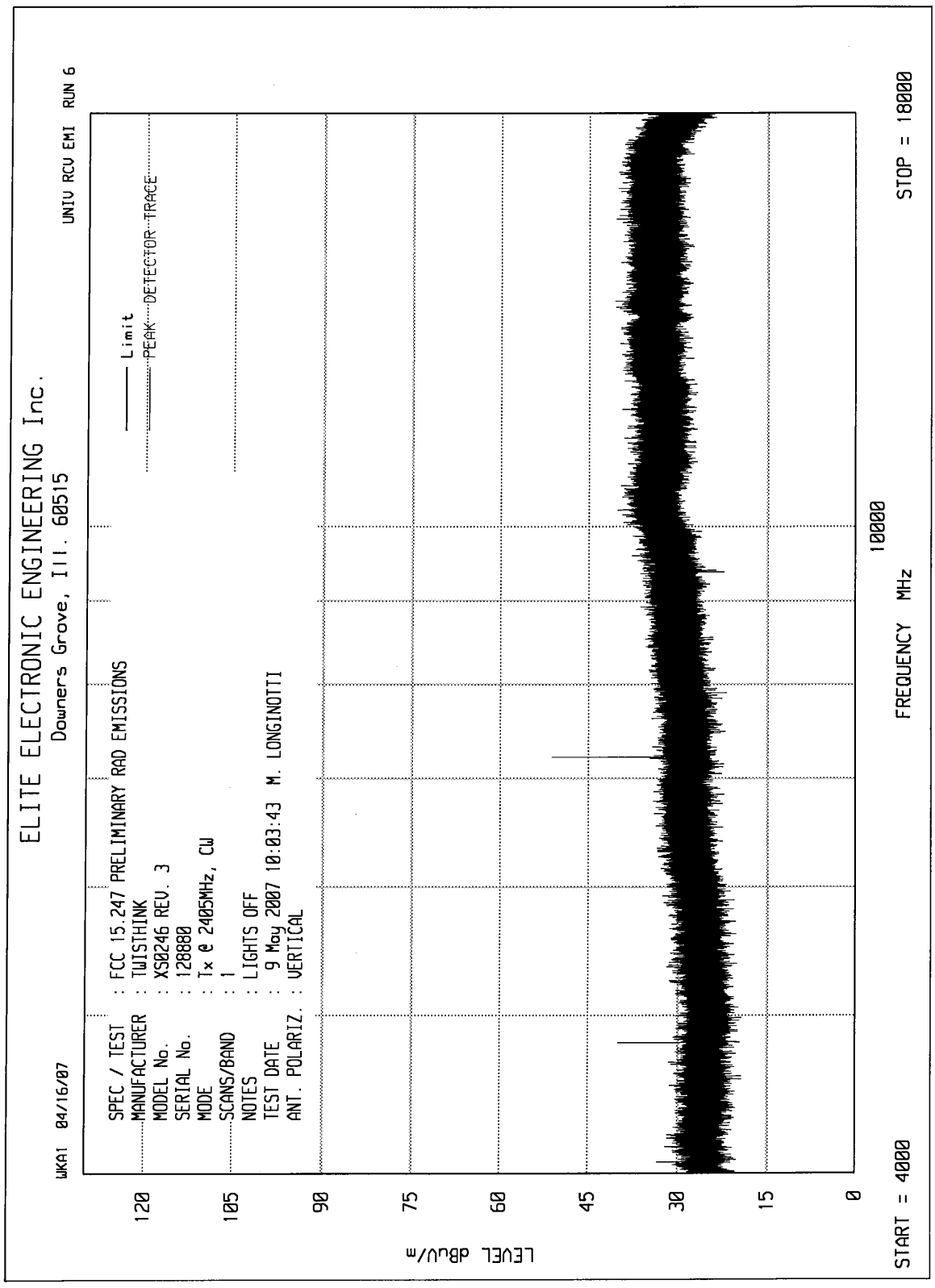
FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.171	43.4	64.9		54.9	
.241	46.2	62.1		52.1	
.340	49.0	59.2		49.2	
.417	50.6	57.5	25.6	47.5	*
.452	51.0	56.8	25.6	46.8	*
.624	52.3	56.0	26.3	46.0	*
.700	52.5	56.0	26.4	46.0	*
.734	52.6	56.0	26.6	46.0	*
.872	52.2	56.0	26.9	46.0	*
1.012	50.4	56.0	25.4	46.0	*
1.041	49.9	56.0	25.0	46.0	*
2.118	51.5	56.0	28.2	46.0	*
2.254	51.7	56.0	28.7	46.0	*
2.357	51.3	56.0	28.6	46.0	*
3.366	49.0	56.0	30.4	46.0	*
3.400	49.1	56.0	30.6	46.0	*
4.950	46.3	56.0	22.1	46.0	*
5.401	47.1	60.0		50.0	
5.469	46.7	60.0		50.0	
6.635	51.0	60.0	33.3	50.0	*
6.683	50.9	60.0	33.2	50.0	*
7.546	47.5	60.0		50.0	
8.074	46.8	60.0		50.0	
8.913	39.5	60.0		50.0	
10.000	35.7	60.0		50.0	
11.648	29.8	60.0		50.0	
14.078	30.7	60.0		50.0	
15.618	28.2	60.0		50.0	
18.253	25.9	60.0		50.0	
21.993	25.9	60.0		50.0	
24.273	26.0	60.0		50.0	
26.903	25.6	60.0		50.0	

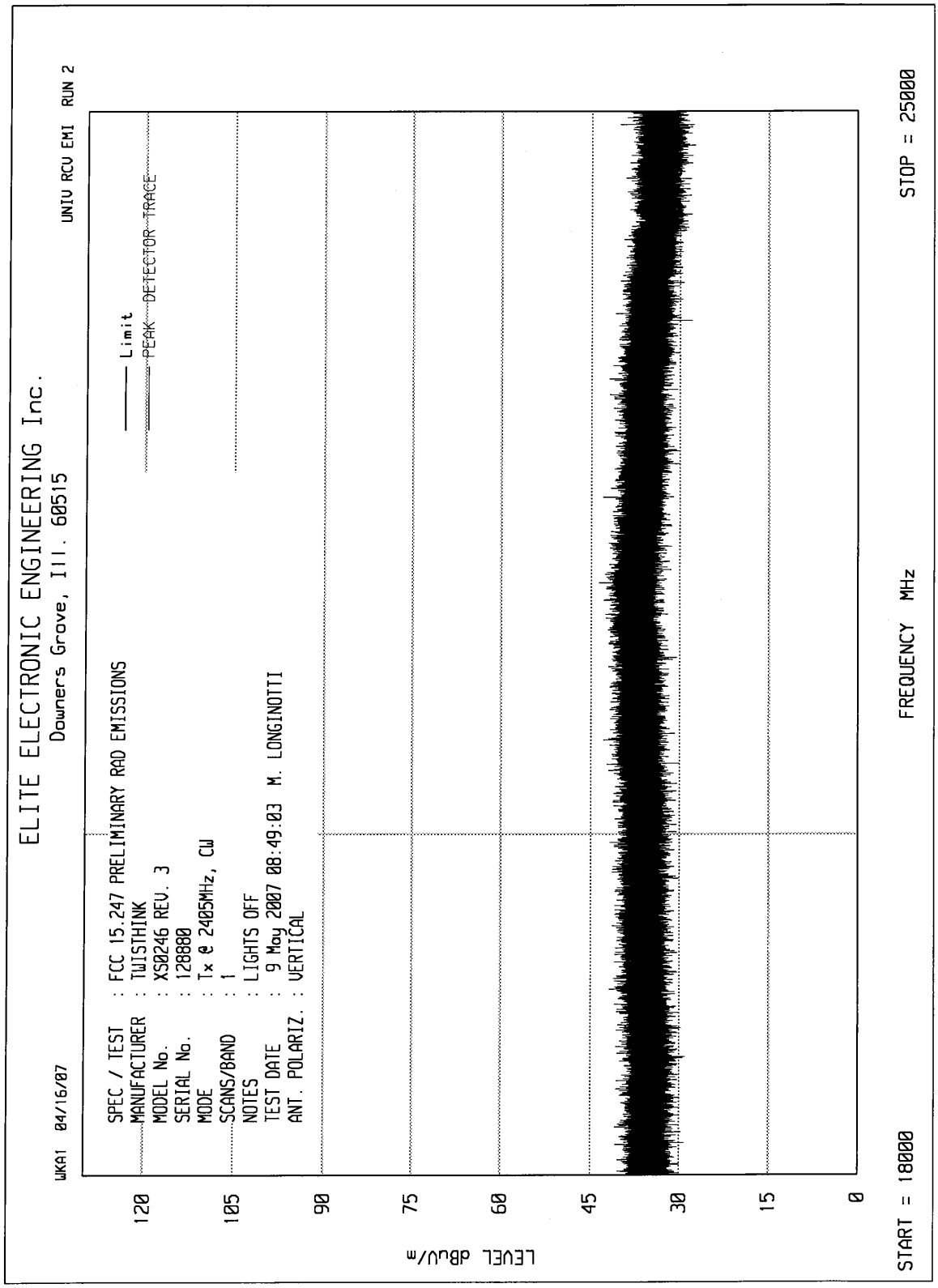
* QP EXCEEDS AVG LIMIT, SEE DATA CHECKED BY: Mark E Longinotti
M. LONGINOTTI


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 2404.763 MHz
ON TIME : 14.785 mSEC
OFF TIME : 85.215 mSEC
DUTY CYCLE = .15 or -16.48 dB
COMPUTED OVER 100 mSEC
MANUFACTURER : TWISTHINK
MODEL : XS0246 REV. 3
S/N : 128888
TEST DATE : 8 May 2007
NOTES : Tx @ 2405MHz, MAX DUTY CYCLE


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 128880
MODE : Tx @ 2405MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 8 May 2007 10:41:01 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
1000
STOP = 2000
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. J
SERIAL No. : 128888
MODE : Tx @ 2405MHz
SCANS/BAND : 2
NOTES :
TEST DATE : 8 May 2007 09:33:52 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 2000
FREQUENCY MHz
STOP = 4000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 128880
MODE : 1x @ 2405MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 10:03:43 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 4000
10000
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 120880
MODE : Tx @ 2405MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 08:49:03 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Twisthink
Test Item : Light Control Module (LCM)
Model No. : XS0246, Rev. 3
Serial No. : 128880
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : May 7, 2007 through May 9, 2007
Mode : Transmit @ 2405MHz
Test Distance : 3 meters
Notes : -3dBm power setting

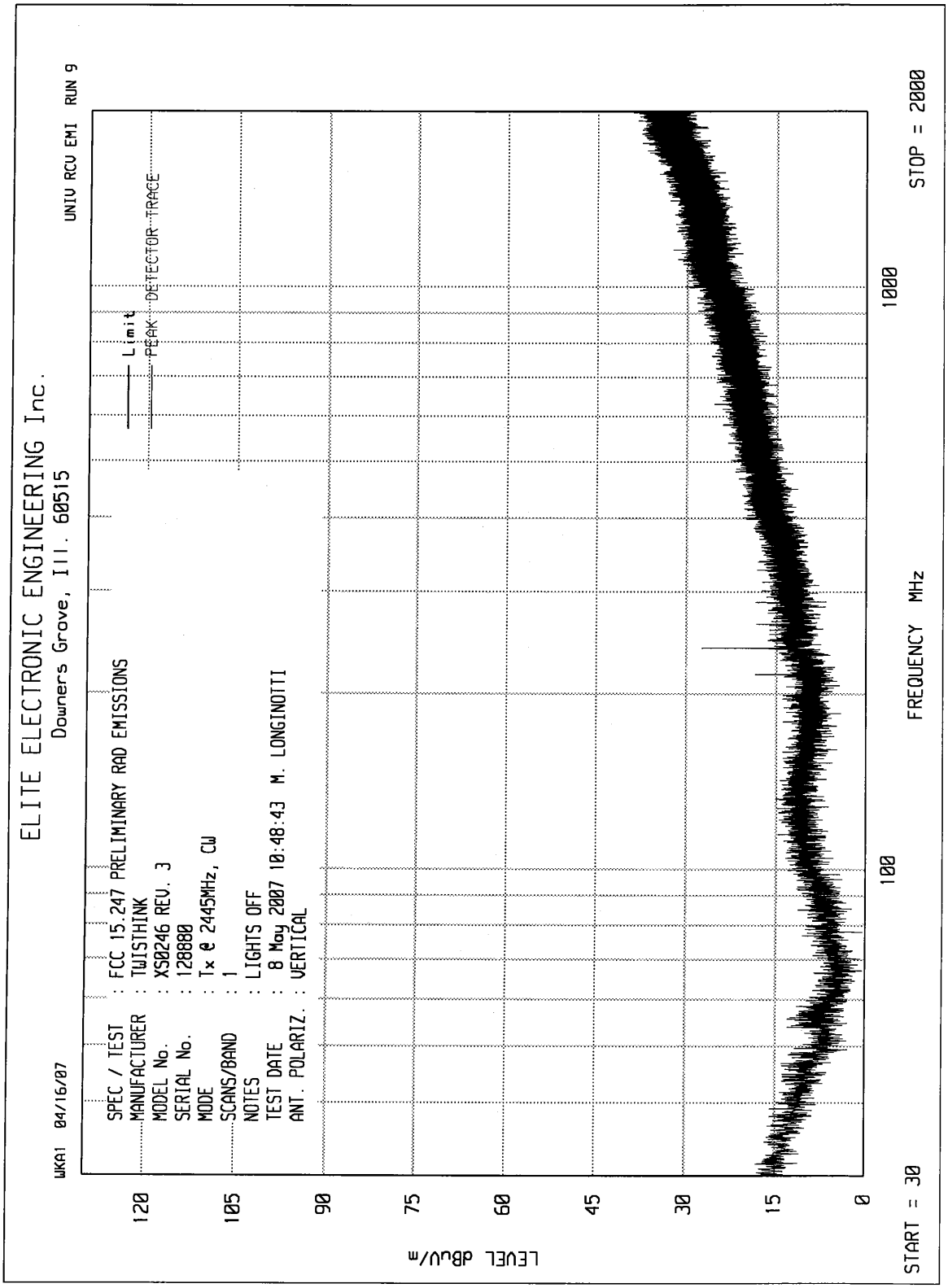
Gray rows indicate restricted bands which must meet the general limits

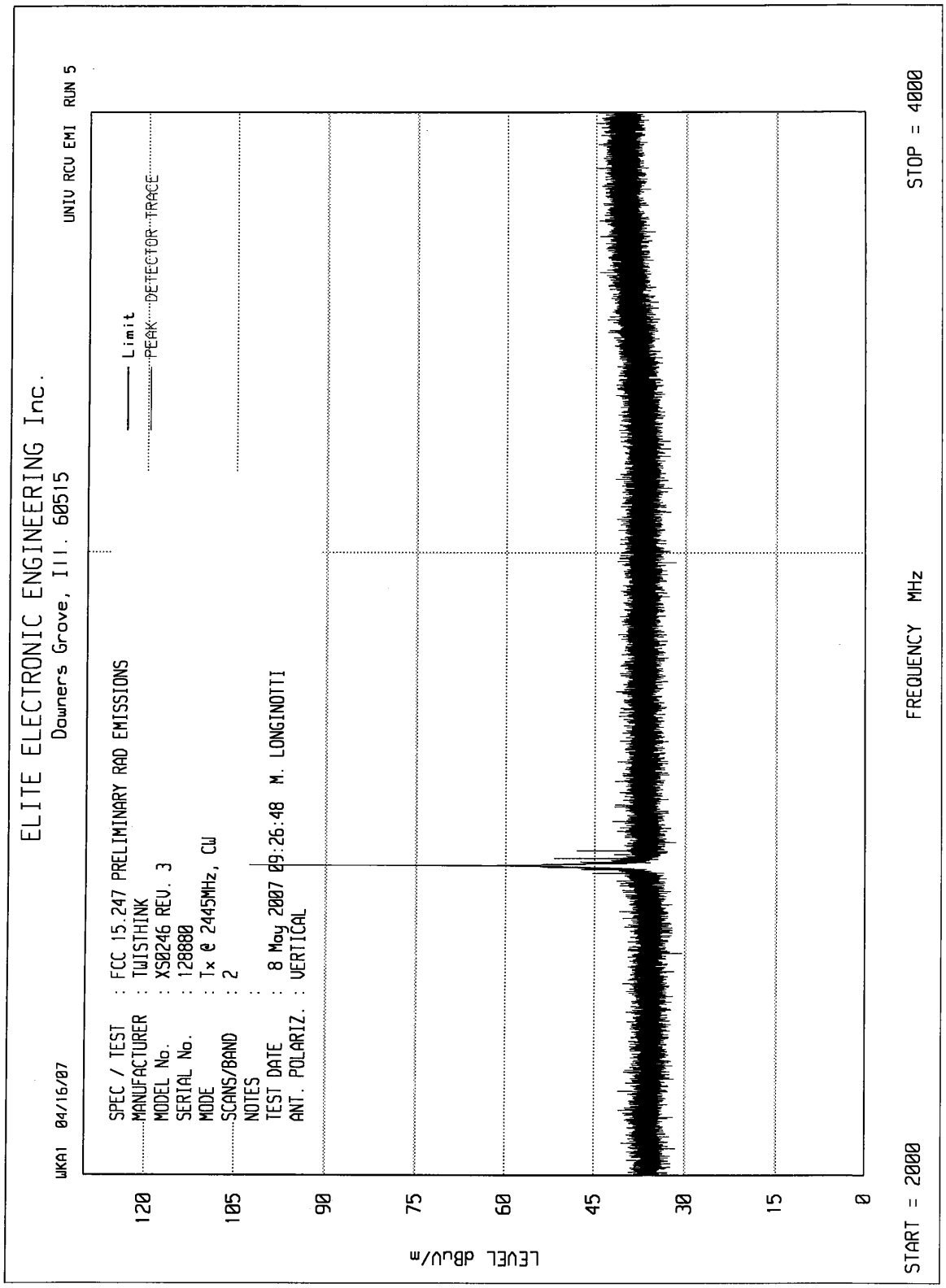
Frequency MHz	Antenna Polarity	Meter Reading dBuV	Amb	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Duty Cycle Factor dB	Total dBuV/m	Total uV/m	Limit uV/m
2405.0	H	71.1		3.5	31.4	0.0	0.0	105.9	197452.8	
2405.0	V	70.6		3.5	31.4	0.0	0.0	105.4	186407.4	
4810.0	H	47.4		4.9	34.5	-40.1	-16.5	30.3	32.6	500.0
4810.0	V	48.6		4.9	34.5	-40.1	-16.5	31.5	37.4	500.0
7215.0	H	46.3		6.6	38.0	-39.8	0.0	51.2	361.6	19745.3
7215.0	V	48.3		6.6	38.0	-39.8	0.0	53.2	455.2	19745.3
9620.0	H	36.0	Amb	7.5	39.8	-38.8	0.0	44.5	167.5	19745.3
9620.0	V	37.5	Amb	7.5	39.8	-38.8	0.0	46.0	199.0	19745.3
12025.0	H	35.5	Amb	8.5	41.4	-39.6	-16.5	29.3	29.1	500.0
12025.0	V	35.3	Amb	8.5	41.4	-39.6	-16.5	29.1	28.5	500.0
14430.0	H	38.4	Amb	9.7	43.7	-39.9	0.0	51.9	395.3	19745.3
14430.0	V	37.5	Amb	9.7	43.7	-39.9	0.0	51.0	356.4	19745.3
16835.0	H	36.9	Amb	10.4	44.6	-38.7	0.0	53.2	457.2	19745.3
16835.0	V	37.4	Amb	10.4	44.6	-38.7	0.0	53.7	484.3	19745.3
19240.0	H	24.1	Amb	2.2	40.4	-27.5	-16.5	22.8	13.8	500.0
19240.0	V	24.1	Amb	2.2	40.4	-27.5	-16.5	22.8	13.8	500.0
21645.0	H	28.1	Amb	2.2	40.6	-26.2	0.0	44.7	172.2	19745.3
21645.0	V	28.1	Amb	2.2	40.6	-26.2	0.0	44.7	172.2	19745.3
24050.0	H	25.2	Amb	2.2	40.6	-27.4	0.0	40.6	107.5	19745.3
24050.0	V	25.7	Amb	2.2	40.6	-27.4	0.0	41.1	113.9	19745.3

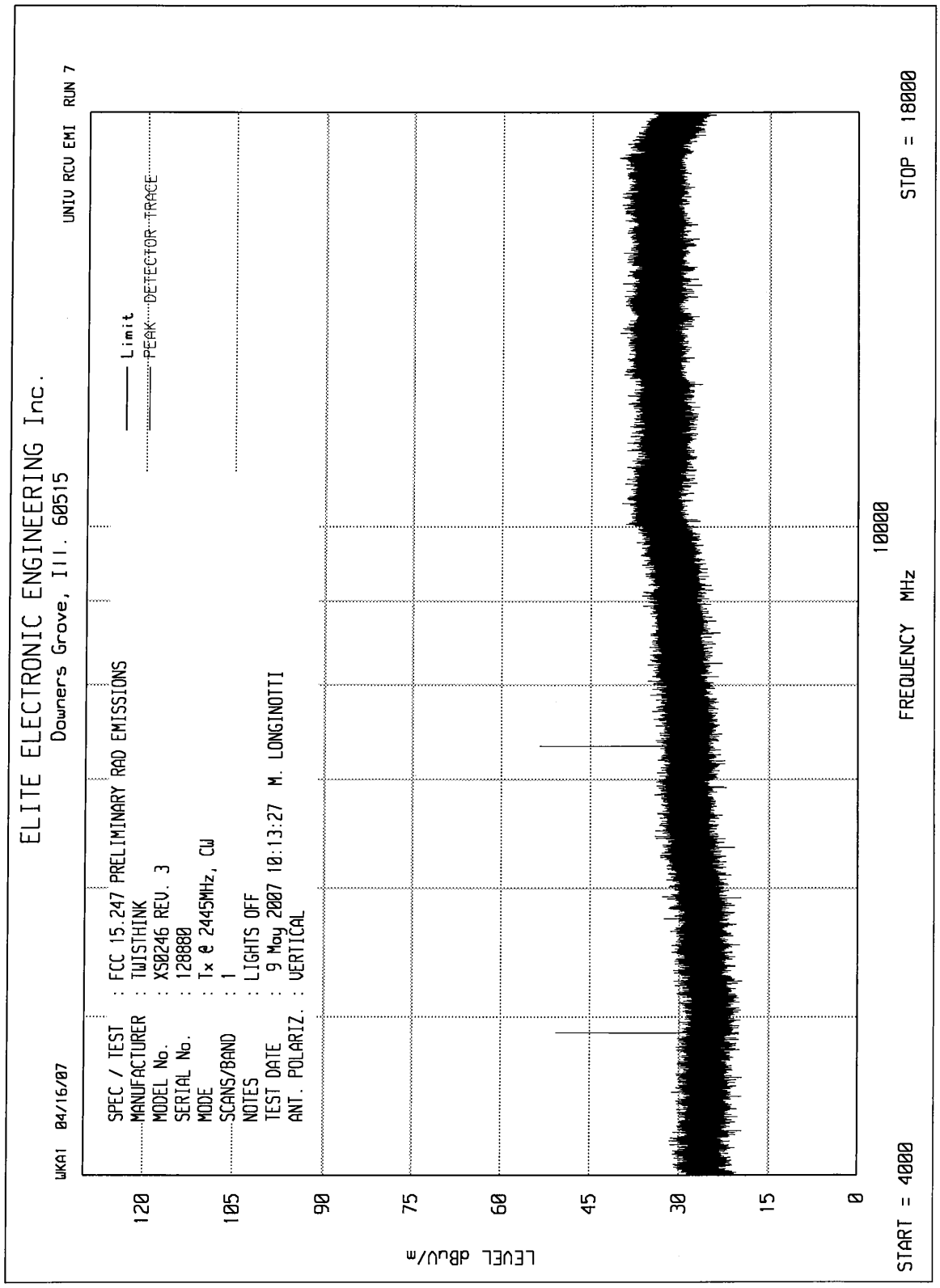
Amb = Ambient

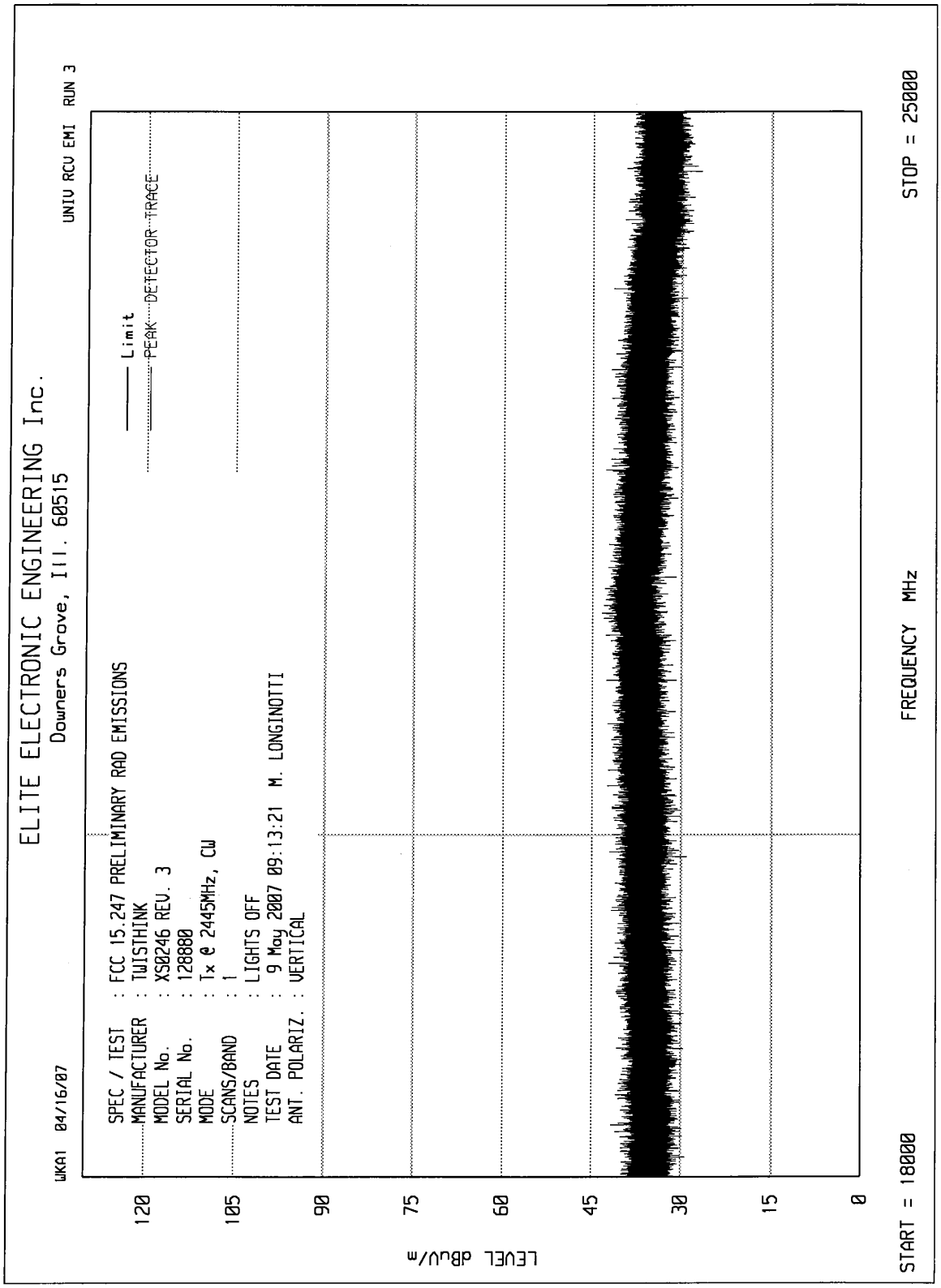
Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Checked By: MARK E. LONGINOTTI


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. J
SERIAL No. : 128880
MODE : Tx @ 2445MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 8 May 2007 10:48:43 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
1000
STOP = 2000
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 128888
MODE : Tx @ 2445MHz, CW
SCANS/BAND : 2
NOTES :
TEST DATE : 8 May 2007 09:26:48 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 2000
FREQUENCY MHz
STOP = 4000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 128880
MODE : Tx @ 2445MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 10:13:27 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 4000
10000
STOP = 18000
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 04/16/07
UNIV RCV EMI RUN 3
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 120880
MODE : Tx @ 2445MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 09:13:21 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Twisthink
Test Item : Light Control Module (LCM)
Model No. : XS0246, Rev. 3
Serial No. : 128880
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : May 7, 2007 through May 9, 2007
Mode : Transmit @ 2445MHz
Test Distance : 3 meters
Notes : -3dBm power setting

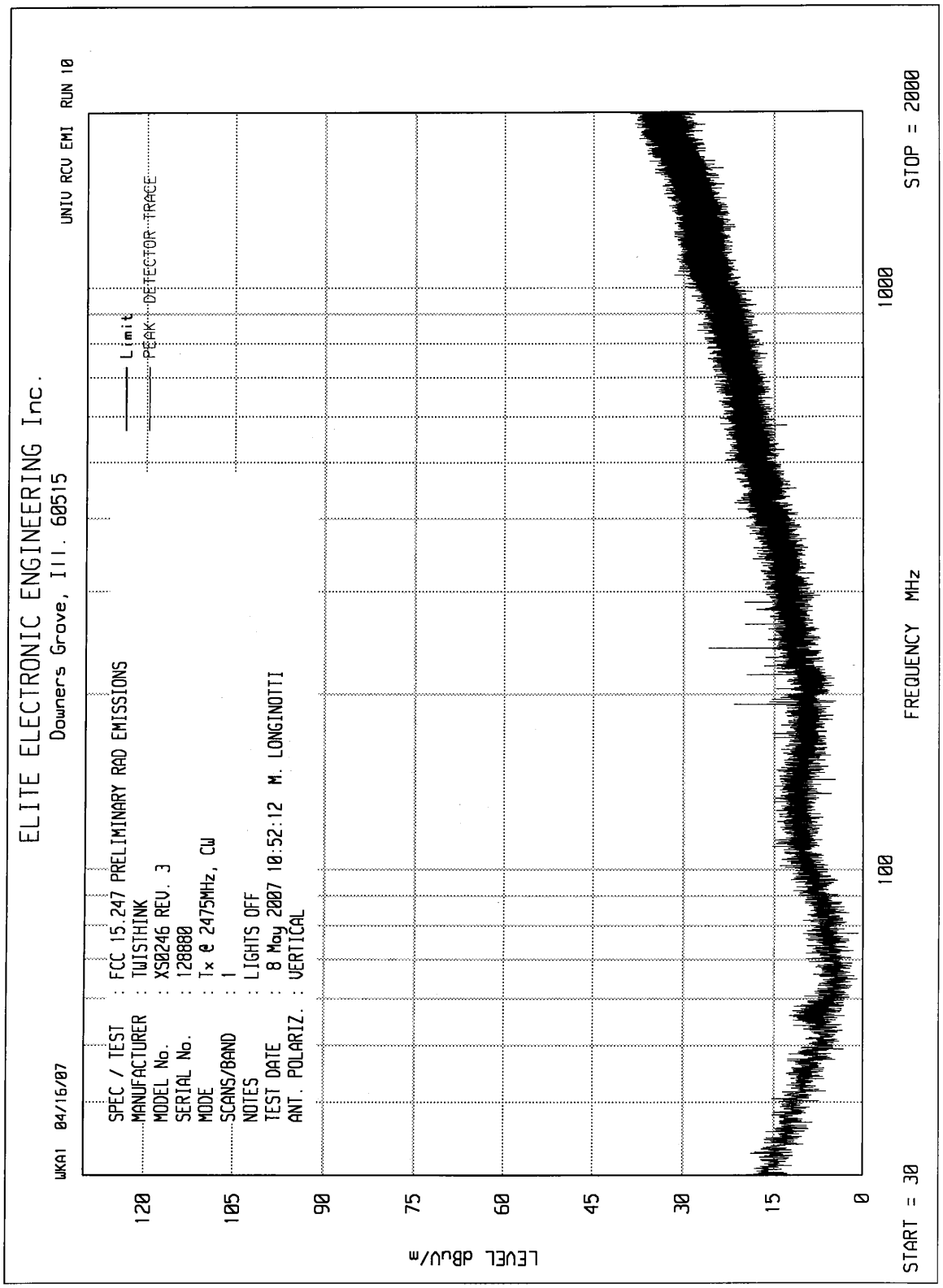
Gray rows indicate restricted bands which must meet the general limits

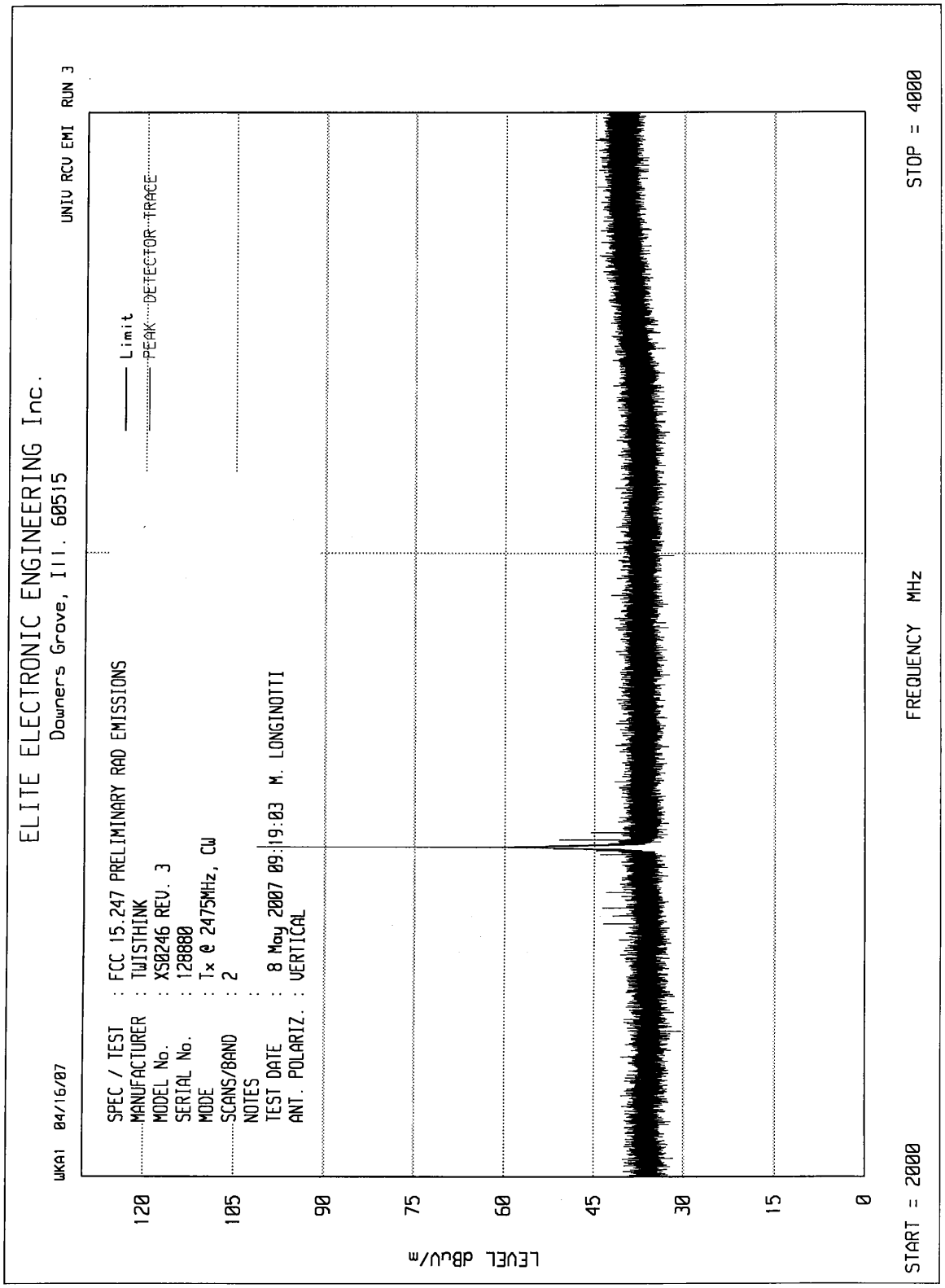
Frequency MHz	Antenna Polarity	Meter Reading dBuV	Amb	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Duty Cycle Factor dB	Total dBuV/m	Total uV/m	Limit uV/m
2445.0	H	68.0		3.5	31.4	0.0	0.0	102.9	139190.6	
2445.0	V	63.0		3.5	31.4	0.0	0.0	97.9	78272.6	
4890.0	H	50.4		5.0	34.5	-40.1	-16.5	33.3	46.0	500.0
4890.0	V	52.9		5.0	34.5	-40.1	-16.5	35.8	61.4	500.0
7335.0	H	44.9		6.7	38.1	-39.7	-16.5	33.4	46.8	500.0
7335.0	V	47.3		6.7	38.1	-39.7	-16.5	35.8	61.7	500.0
9780.0	H	36.4	Amb	7.5	39.9	-38.7	0.0	45.1	180.1	13919.1
9780.0	V	35.8	Amb	7.5	39.9	-38.7	0.0	44.5	168.1	13919.1
12225.0	H	34.9	Amb	8.7	41.4	-39.4	-16.5	29.1	28.5	500.0
12225.0	V	34.4	Amb	8.7	41.4	-39.4	-16.5	28.6	26.9	500.0
14670.0	H	37.3	Amb	9.8	44.1	-40.1	0.0	51.2	362.5	13919.1
14670.0	V	37.5	Amb	9.8	44.1	-40.1	0.0	51.4	370.9	13919.1
17115.0	H	36.6	Amb	10.6	44.5	-38.7	0.0	52.9	441.3	13919.1
17115.0	V	36.4	Amb	10.6	44.5	-38.7	0.0	52.7	431.2	13919.1
19560.0	H	23.8	Amb	2.2	40.4	-27.1	-16.5	22.8	13.8	500.0
19560.0	V	24.0	Amb	2.2	40.0	-27.1	-16.5	22.6	13.5	500.0
22005.0	H	28.3	Amb	2.2	40.6	-27.0	0.0	44.1	160.3	13919.1
22005.0	V	28.3	Amb	2.2	40.6	-27.0	0.0	44.1	160.3	13919.1
24450.0	H	24.4	Amb	2.2	40.6	-27.5	0.0	39.7	97.0	13919.1
24450.0	V	34.2	Amb	2.2	40.6	-27.5	0.0	49.5	299.6	13919.1

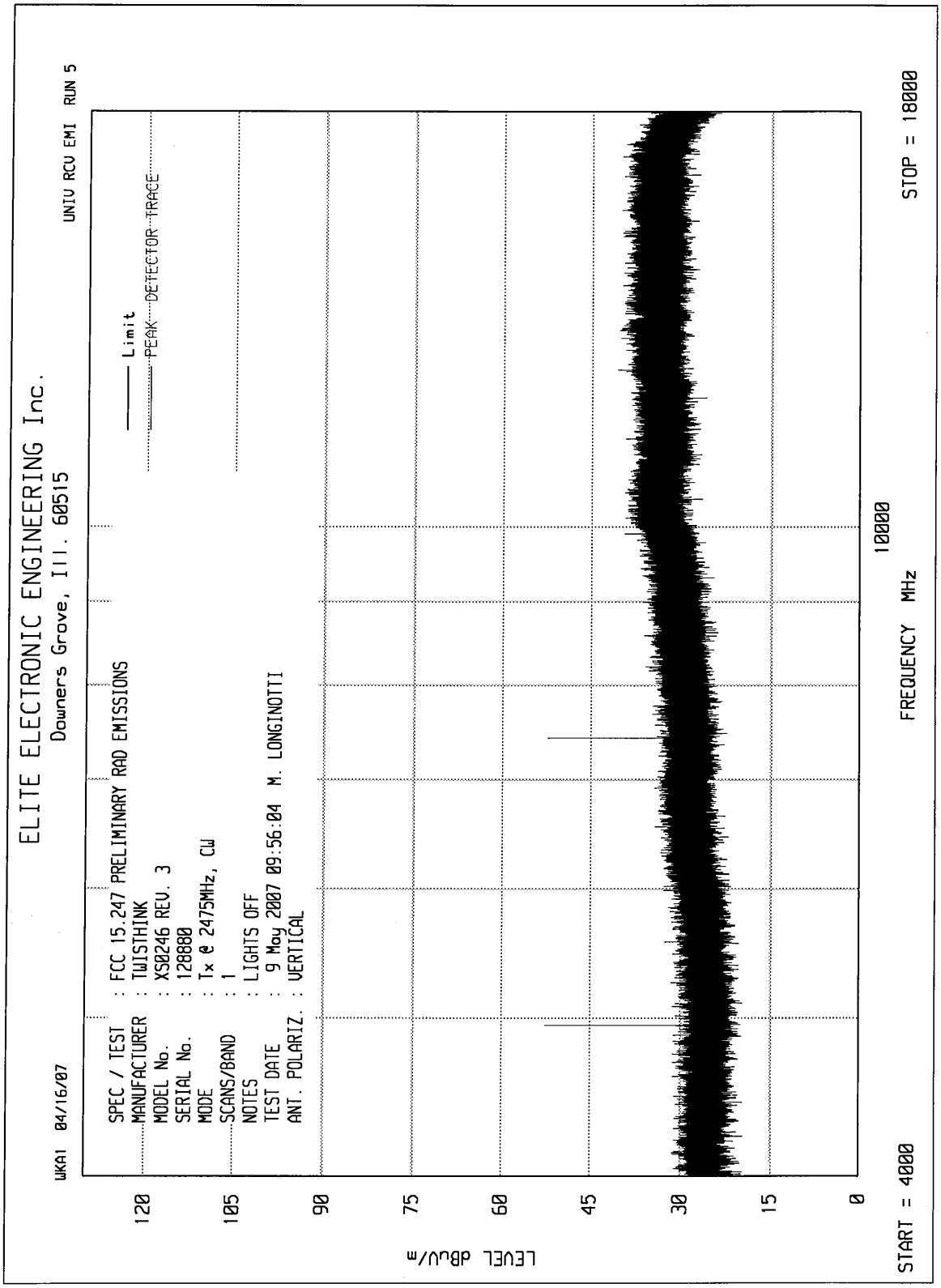
Amb = Ambient

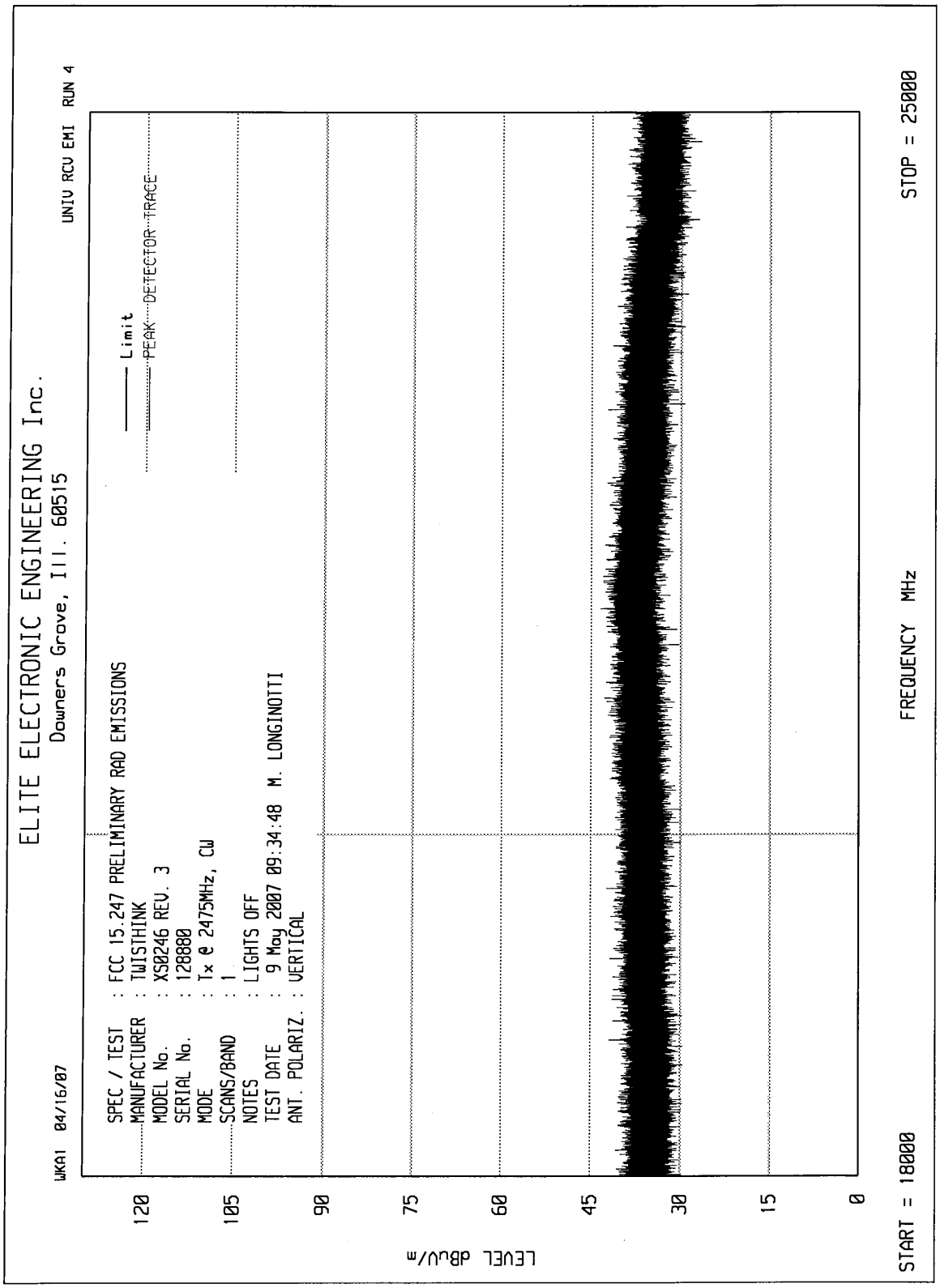
Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Checked By: MARK E. LONGINOTTI


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
WKAI 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 120880
MODE : Tx @ 2475MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 8 May 2007 10:52:12 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
1000
STOP = 2000
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 128880
MODE : Tx @ 2475MHz, CW
SCANS/BAND : 2
NOTES :
TEST DATE : 8 May 2007 09:19:03 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 2000
FREQUENCY MHz
STOP = 4000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 04/16/07
UNIV RCV EMI RUN 5
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 120880
MODE : Tx @ 2475MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 09:56:04 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 4000
10000
STOP = 18000
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 04/16/07
SPEC / TEST : FCC 15.247 PRELIMINARY RAD EMISSIONS
MANUFACTURER : TWISTHINK
MODEL No. : XS0246 REV. 3
SERIAL No. : 120880
MODE : 1x @ 2475MHz, CW
SCANS/BAND : 1
NOTES : LIGHTS OFF
TEST DATE : 9 May 2007 09:34:48 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Twisthink
Test Item : Light Control Module (LCM)
Model No. : XS0246, Rev. 3
Serial No. : 128880
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : May 7, 2007 through May 9, 2007
Mode : Transmit @ 2475MHz
Test Distance : 3 meters
Notes : -3dBm power setting

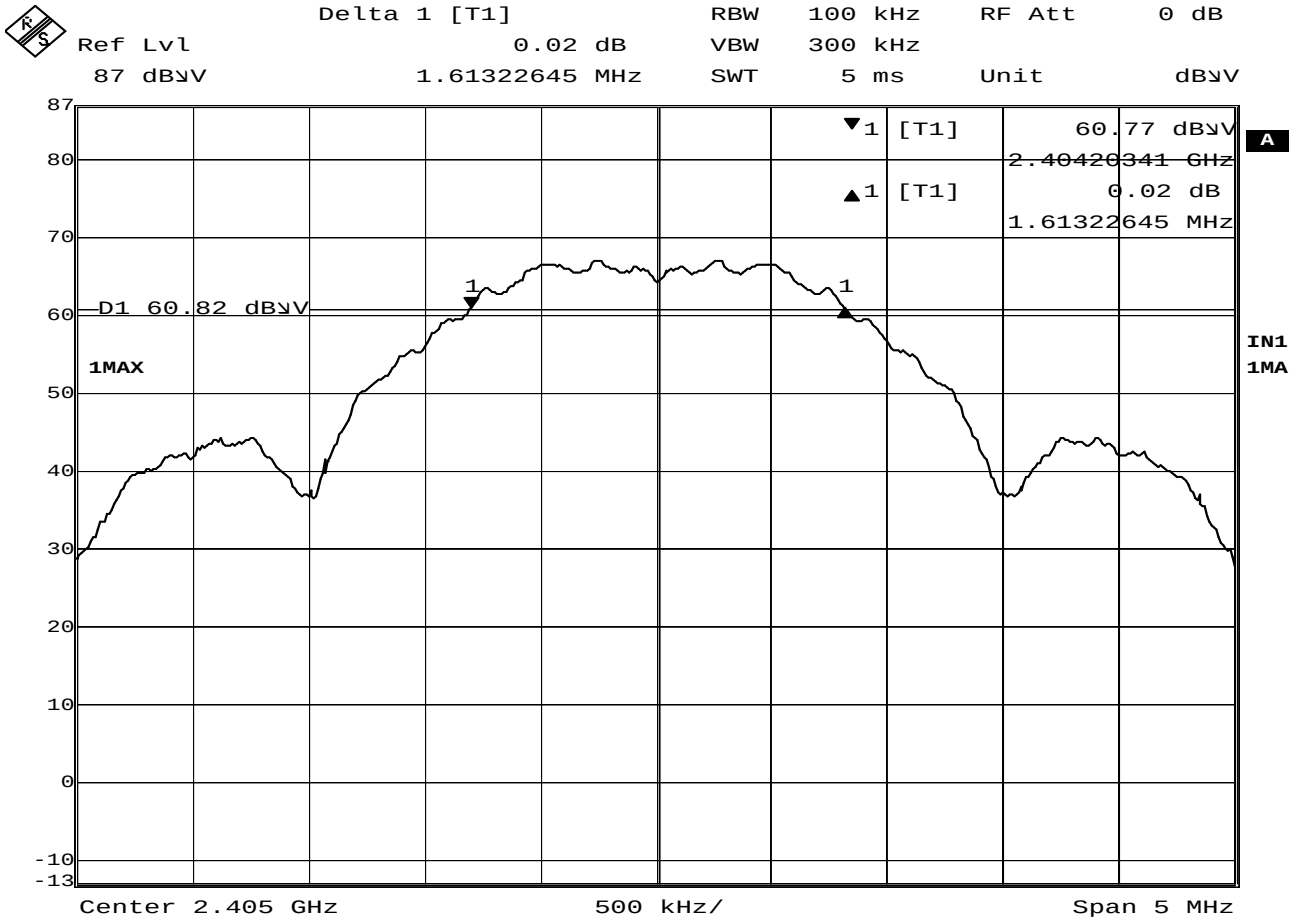
Gray rows indicate restricted bands which must meet the general limits

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Amb	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Duty Cycle Factor dB	Total dBuV/m	Total uV/m	Limit uV/m
2475.0	H	60.1		3.5	31.4	0.0	0.0	95.0	56355.5	
2475.0	V	66.2		3.5	31.4	0.0	0.0	101.1	113746.0	
4950.0	H	51.6		5.0	34.5	-40.2	-16.5	34.5	52.8	500.0
4950.0	V	54.9		5.0	34.5	-40.2	-16.5	37.8	77.3	500.0
7425.0	H	44.0		6.7	38.1	-39.7	-16.5	32.6	42.7	500.0
7425.0	V	45.7		6.7	38.1	-39.7	-16.5	34.3	51.9	500.0
9900.0	H	35.6	Amb	7.5	40.0	-38.6	0.0	44.5	167.6	11374.6
9900.0	V	35.6	Amb	7.5	40.0	-38.6	0.0	44.5	167.6	11374.6
12375.0	H	34.7	Amb	8.9	41.3	-39.3	-16.5	29.2	28.8	500.0
12375.0	V	34.7	Amb	8.9	41.3	-39.3	-16.5	29.2	28.8	500.0
14850.0	H	36.3	Amb	9.9	44.5	-40.2	0.0	50.4	332.7	11374.6
14850.0	V	35.8	Amb	9.9	44.5	-40.2	0.0	49.9	314.1	11374.6
17325.0	H	36.5	Amb	10.7	44.4	-39.0	0.0	52.6	425.7	11374.6
17325.0	V	36.1	Amb	10.7	44.4	-39.0	0.0	52.2	406.5	11374.6
19800.0	H	23.4	Amb	2.2	40.4	-26.9	-16.5	22.7	13.6	500.0
19800.0	V	23.5	Amb	2.2	40.4	-26.9	-16.5	22.8	13.7	500.0
22275.0	H	23.8	Amb	2.2	40.6	-27.1	-16.5	23.1	14.3	500.0
22275.0	V	23.8	Amb	2.2	40.6	-27.1	-16.5	23.1	14.3	500.0
24750.0	H	23.5	Amb	2.2	40.6	-27.2	0.0	39.1	89.8	11374.6
24750.0	V	23.0	Amb	2.2	40.6	-27.2	0.0	38.6	84.7	11374.6

Amb = Ambient

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

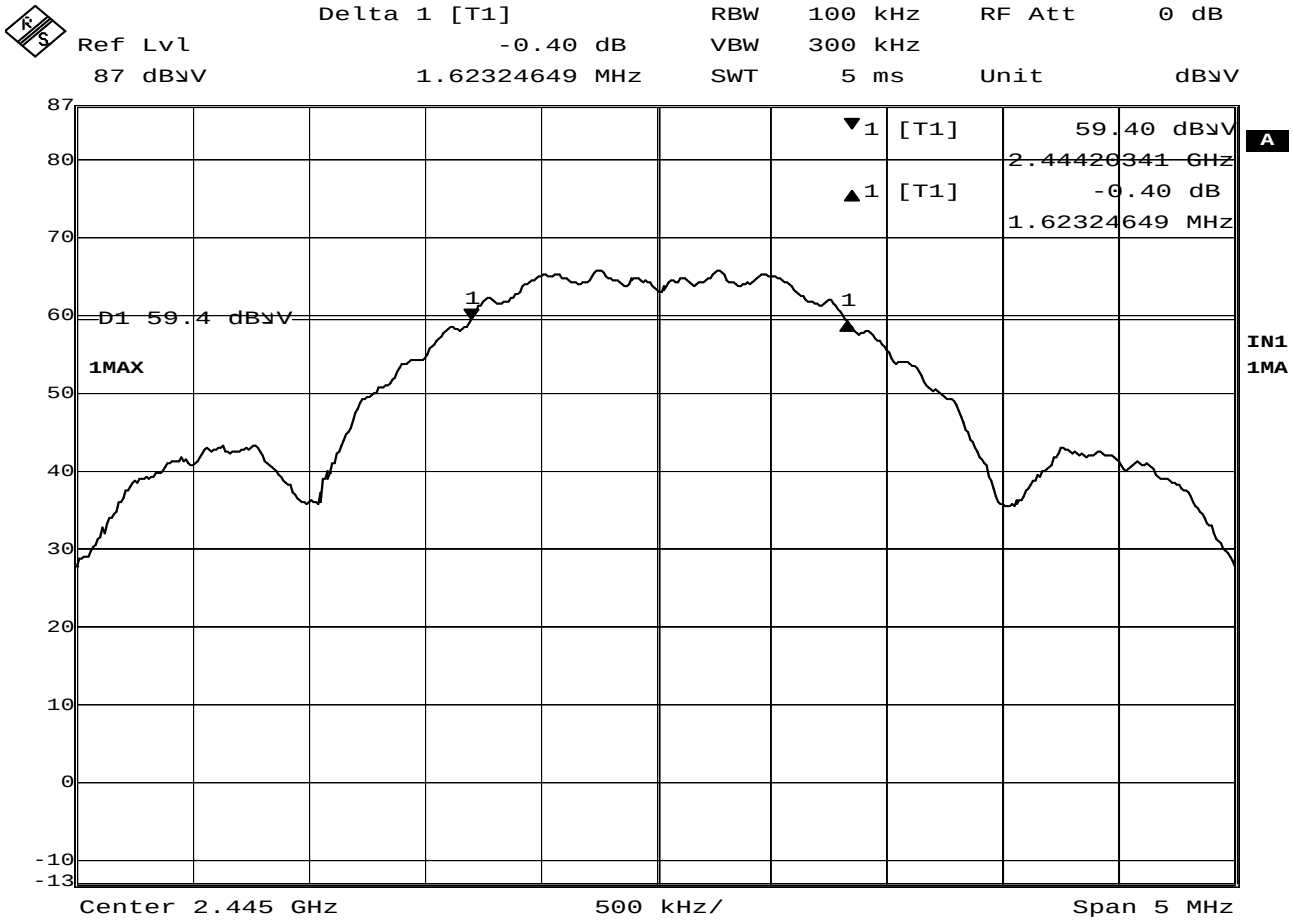
Checked By: MARK E. LONGINOTTI



FCC 15.247 6dB Bandwidth

MANUFACTURER	: Twisthink
PRODUCT NAME	: Light Control Module (LCM)
MODEL NUMBER	: XS0246 Rev. 3
SERIAL NUMBER	: 128880
TEST MODE	: Transmit @ 2405MHz
TEST PARAMETERS	: 6dB bandwidth at 2405MHz
NOTES	: -3dBm Power Setting, Light Off
EQUIPMENT USED	: RBA1, NWI1

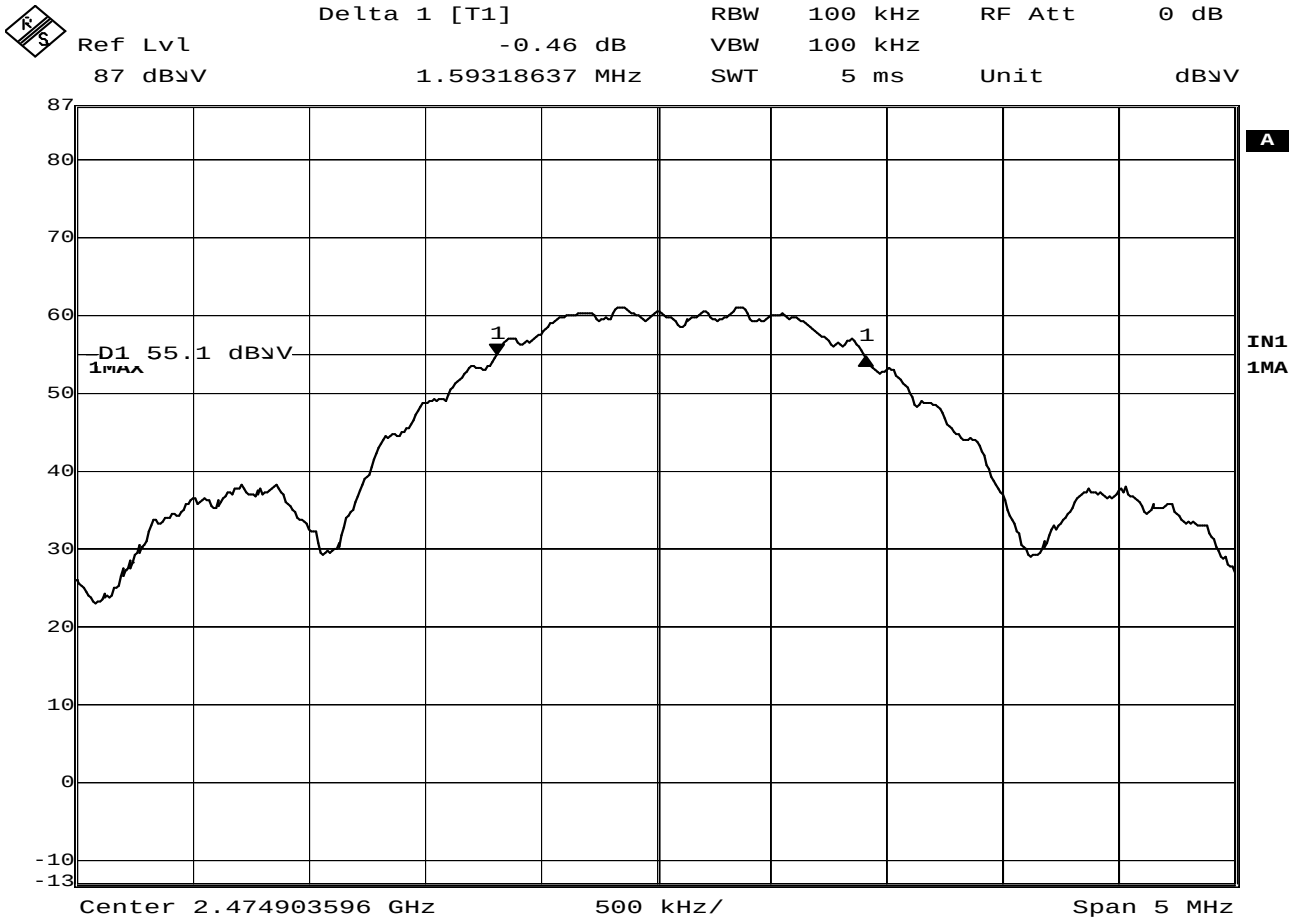
NOTES



FCC 15.247 6dB Bandwidth

MANUFACTURER	: Twisthink
PRODUCT NAME	: Light Control Module (LCM)
MODEL NUMBER	: XS0246 Rev. 3
SERIAL NUMBER	: 128880
TEST MODE	: Transmit @ 2445MHz
TEST PARAMETERS	: 6dB bandwidth at 2445MHz
NOTES	: -3dBm Power Setting, Light Off
EQUIPMENT USED	: RBA1, NWI1

NOTES



FCC 15.247 6dB Bandwidth

MANUFACTURER	: Twisthink
PRODUCT NAME	: Light Control Module (LCM)
MODEL NUMBER	: XS0246 Rev. 3
SERIAL NUMBER	: 128880
TEST MODE	: Transmit @ 2475MHz
TEST PARAMETERS	: 6dB bandwidth at 2475MHz
NOTES	: -3dBm Power Setting, Light Off
EQUIPMENT USED	: RBA1, NWI1

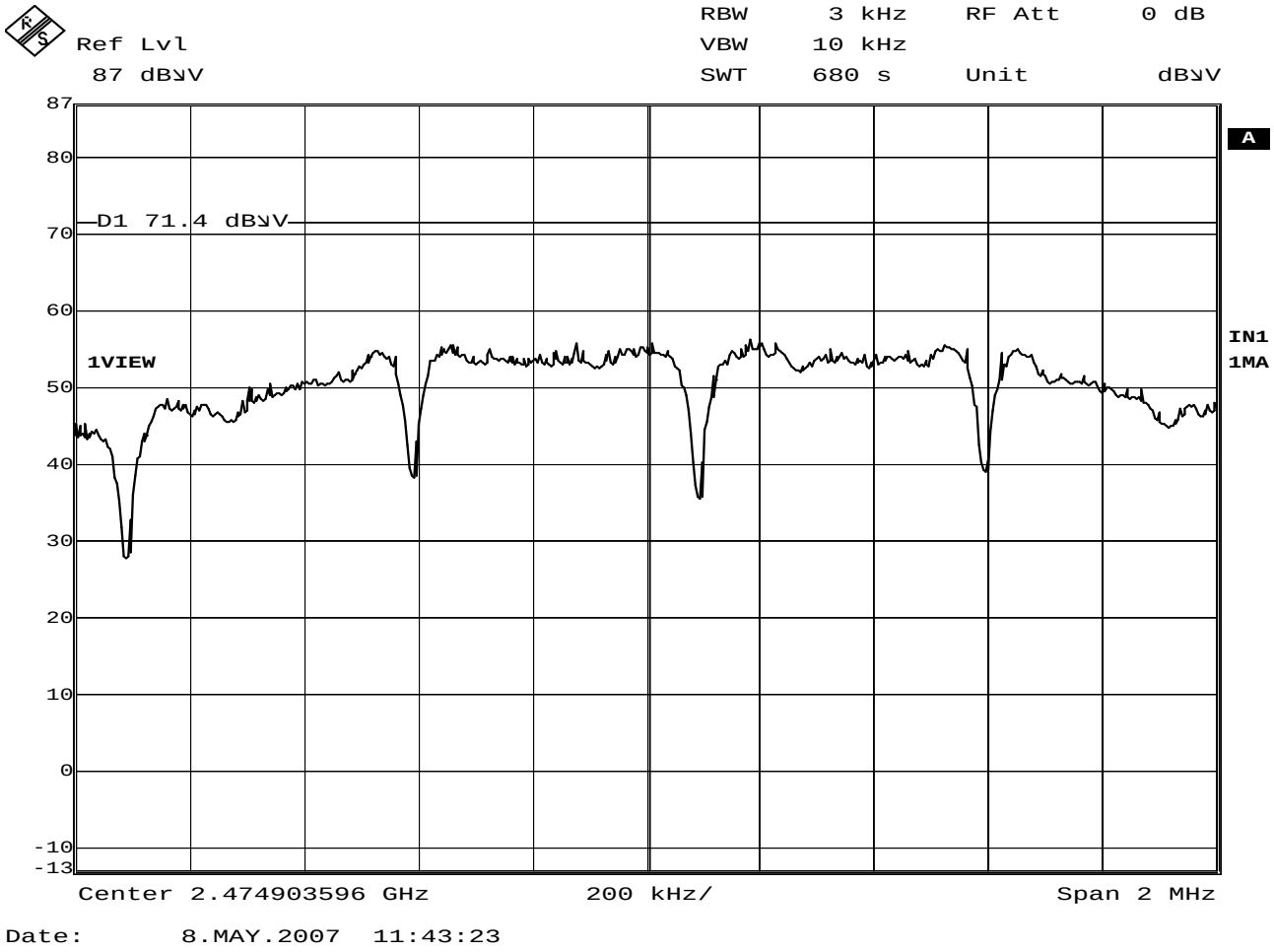
NOTES

Manufacturer : Twisthink
Test Item : Light Control Module (LCM)
Model No. : XS0246, Rev. 3
Serial No. : 128880
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : May 7, 2007 through May 9, 2007
Mode : See Below
Notes : -3dBm power setting

Frequency MHz	Antenna Polarity	Meter Reading dBuV		Matched Signal dBm	Cable Loss dBm	Antenna Gain dB	EIRP Total dBm	EIRP Limit dBm
Transmit @ 2405MHz, Modulation On								
2405	V	70.6		3.4	2.8	6.5	7.1	36
2405	H	71.1		2.6	2.8	6.5	6.3	36
Transmit @ 2405MHz, Modulation On								
2445	V	68.0		1.2	2.8	6.7	5.1	36
2445	H	63.0		-4.4	2.8	6.7	-0.5	36
Transmit @ 2405MHz, Modulation On								
2475	V	69.7		2.5	2.9	6.7	6.3	36
2475	H	64.3		-3.1	2.9	6.7	0.7	36

EIRP = Matched Signal - Cable Loss + Antenna Gain

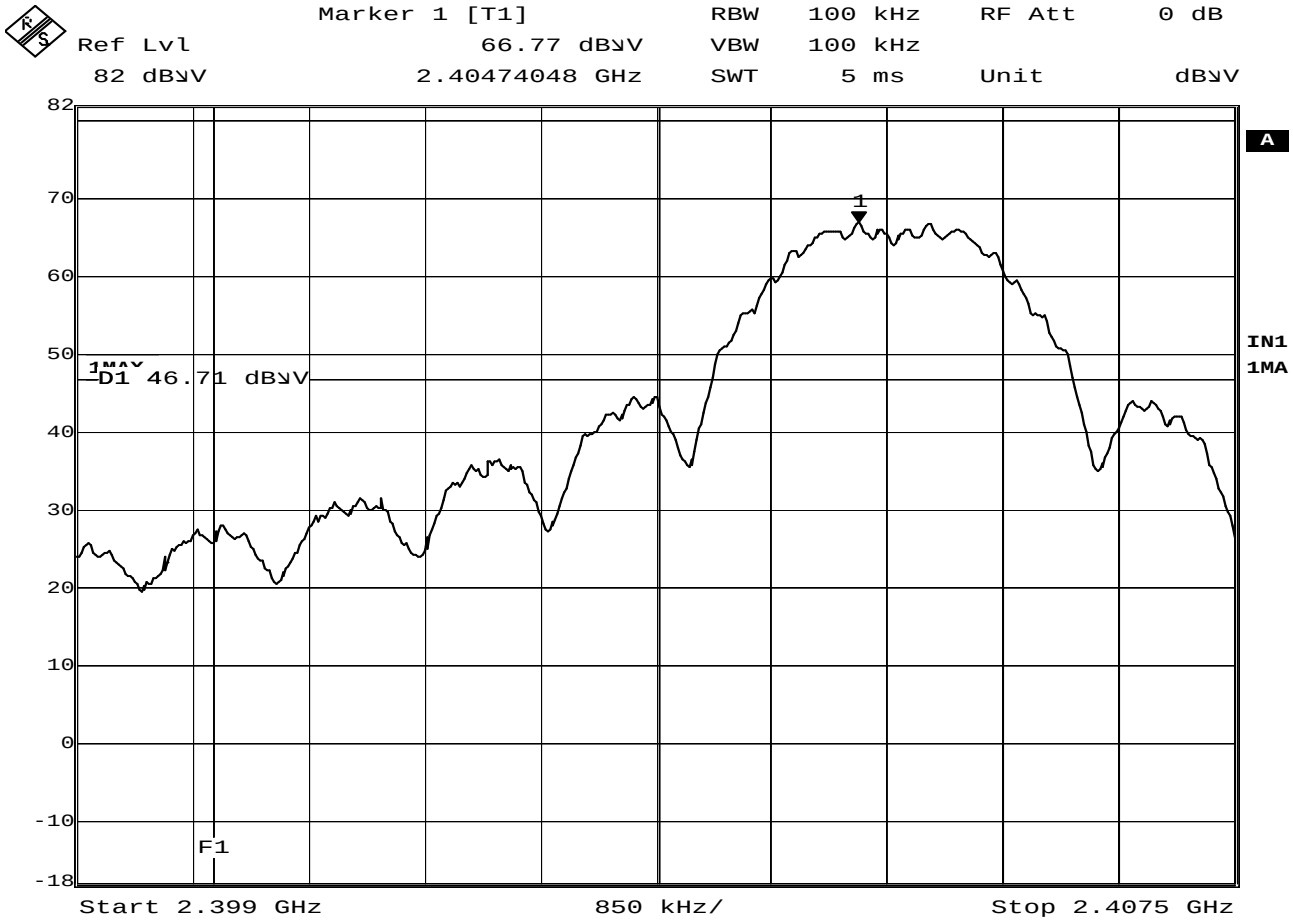
Checked By: MARK E. LONGINOTTI



FCC 15.247 Power Spectral Density

MANUFACTURER	: Twisthink
PRODUCT NAME	: Light Control Module (LCM)
MODEL NUMBER	: XS0246 Rev. 3
SERIAL NUMBER	: 128880
TEST MODE	: Transmit @ 2475MHz
TEST PARAMETERS	: Power Spectral Density at 2475MHz
NOTES	: -3dBm Power Setting, Lights Off
NOTES	: 71.4dBuV display line represents the +8dBm limit.
	: (Based on matching, 69.7dBuV level represents an
	: EIRP reading of 6.3dBm. Therefore a +8dBm level
	: would be represented by a level of 71.4dBuV
	: (69.7dB + (8dB – 6.3dB)).
EQUIPMENT USED	: RBA1, NWI1, CMA0

NOTES



FCC 15.247 Band Edge Compliance

MANUFACTURER	: Twisthink
PRODUCT NAME	: Light Control Module (LCM)
MODEL NUMBER	: XS0246 Rev. 3
SERIAL NUMBER	: 128880
TEST MODE	: Transmit @ 2405MHz
TEST PARAMETERS	: Band Edge Compliance at 2400MHz
NOTES	: -3dBm Power Setting
NOTES	: F1 = 2400MHz
EQUIPMENT USED	: RBA1, NWI1, CMA0

NOTES

Manufacturer : Twisthink
Test Item : Light Control Module (LCM)
Model No. : XS0246, Rev. 3
Serial No. : 128880
Test Specification : FCC Part 15, Subpart C, Section 15.247, Band-edge compliance
Date : May 7, 2007 through May 9, 2007
Mode : Transmit @ 2475MHz
Test Distance : 3 meters
Notes : -3dBm power setting

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Amb	Cable Loss dB	Antenna Factor dB	Total dBuV/m	Total uV/m	Limit uV/m
2483.5	H	14.6		3.5	31.4	49.5	299.6	500.0
2483.5	V	16.5		3.5	31.4	51.4	372.9	500.0

Total = Meter Reading + Cable Loss + Antenna Factor

Checked By: MARK E. LONGINOTTI