Measurement of RF Interference from a Product No. 6440ENT BLE Relay

For	Master Lock Company 6744 Howell Ave Oak Creek, WI 53154
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REVISION HISTORY

Revision	Date	Description
—	02/12/2019	Initial release

Measurement of RF Emissions from a BLE Relay, Product No. 6440ENT

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Master Lock Company BLE Relay, Product No. 6440ENT, transceiver (hereinafter referred to as the EUT). . No serial number was assigned to the EUT. The EUT is a digital modulation transceiver. The transceiver was designed to transmit and receive in the 2400-2483.5 MHz band using an inverted "f" non-removable antenna. The EUT was manufactured and submitted for testing by Master Lock Company located in Oak Creek, WI.

Two samples were submitted for testing. Sample #1 was used for all radiated emissions tests. Sample #2 was modified by placing a coaxial cable on the antenna terminals of the circuit board. Sample #2 was used for all antenna port conducted emissions tests.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted RF emission requirements, radiated RF emissions requirements, and additional provisions 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 15.249 for Intentional Radiators Operating within the 2400-2483.5 MHz band.

The test series was also performed to determine if the EUT meets the conducted RF emission requirements, radiated RF emissions requirements, and additional provisions of the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen Section 8.8 and Section 7.3 for receivers and Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen Section 8.8 and Industry Canada Radio Standards Specification RSS-247 for Transmitters.

Testing was performed in accordance with ANSI C63.10-2013.

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 American Association for Laboratory Accreditation (A2LA), A2LA Lab Code: 1786-01.

1.5 Laboratory Conditions

The temperature at the time of the test was 23 C° and the relative humidity was 17%.

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, Subparts B and C
- ANSI C63.4-2014, "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”
- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”

- Federal Communications Commission Office of Engineering and Technology Laboratory Division, Guidance For Performing Compliance Measurements On Digital Transmissions Systems (DTS) Operating Under §15.247
  February 11, 2019

- Industry Canada RSS-247, Issue 2, February 2017, "Spectrum Management and Telecommunications Radio Standards Specification, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs), and License-Exempt Local Area Network (LE-LAN) Devices"

- Industry Canada RSS-GEN, Issue 5, April 2018, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements for Compliance of Radio Apparatus"

3. EUT SET-UP AND OPERATION

3.1 General Description

The EUT is a BLE Relay, Product No. 6440ENT. A block diagram of the EUT setup is shown as Figure 1 and Figure 2. A photograph of the EUT is shown as Figure 3.

3.1.1 Power Input

The EUT is normally powered by 12VDC from an external power supply. For testing purposes, the EUT obtained 12VDC from a Triad switching mode power supply, Part No. WSU120-1500. The output of the power supply was connected to the EUT via a 1.7 meter long, 2 wire power cable. The power supply was powered with 115V, 60Hz.

3.1.2 Peripheral Equipment

The EUT was submitted for testing with no peripheral equipment.

3.1.3 Interconnect Cables

The EUT was submitted for testing with no interconnect cables.

3.1.4 Grounding

The EUT was not grounded during tests.

3.2 Software

For all tests the EUT had Firmware Version dtm 1.00 loaded onto the device to provide correct load characteristics.

3.3 Operational Mode

The EUT was powered up and checked for proper operation. The EUT was programmed to operate in one of the following modes:

- Transmit at 2402MHz
- Transmit at 2440MHHz
- Transmit at 2480MHHz

3.4 EUT Modifications

No modifications were required for compliance.

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 C63.4-2014 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis with a calibration interval not greater than two years. All calibrations are traceable to the International System Units (SI).

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.

Values of Expanded Measurement Uncertainty (95% Confidence) are presented below:

Measurement Type	Expanded Measurement Uncertainty
Conducted disturbance (mains port) (150 kHz – 30 MHz)	2.7
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2

5. TEST PROCEDURES

5.1 Receiver

5.1.1 Receiver Requirements

Receivers operating above 960MHz are exempt from complying with the technical requirements.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, section 207(a) and ISED RSS-Gen section 8.8, all radio frequency voltages on the power lines of a transmitter shall be below the values shown below when using a quasi-peak or average detector:

Frequency MHz	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 – 0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 - 5	56	46
5 - 30	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 EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.2.1.2 Procedures

The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms.

a) The EUT was operated in the transmit at 2440MHz mode.

b) Measurements were first made on the 115V, 60Hz high line of the Triad switching mode power supply, Part No. WSU120-1500, which provided 12VDC to the EUT.

c) The frequency range from 150 kHz to 30 MHz was broken up into smaller frequency sub-bands.

d) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector.

e) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.)

f) Steps (d) and (e) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits.

g) Steps (c) through (f) were repeated on the 115V, 60Hz return line of the Triad switching mode power supply, Part No. WSU120-1500.

5.2.1.3 Results

The plots of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line with the EUT operated in the transmit at 2440MHz mode are shown on pages 25 and 27. The tabular quasi-peak and average results from each input power line with the EUT operated in the transmit at 2440MHz mode are shown on pages 24 and 26. All power line conducted emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown in Figure 4.

5.2.2 6dB Bandwidth

5.2.2.1 Requirements

Per FCC 15.247(a)(2) and ISED RSS-247 section 5.2.(a), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

5.2.2.2 Procedures

a) The antenna port of the EUT was connected to the DUT 1 port of the Rohde & Schwarz OSP 120/OSP-B157 system via a coaxial cable and RF attenuator.

b) The Rohde & Schwarz OSP 120 RF switches were used to connect the inputs of the DUT ports (DUT 1, DUT 2, etc.) to the inputs of the ESW 44 EMI Test Receiver via a coaxial cable.

c) The EUT was powered up and set to transmit in the first mode listed in section 3.3.

d) The following settings were employed on the EMI Test Receiver:

1. Center Frequency = Transmit Frequency of the DUT
2. Frequency Span = 2 x Occupied Channel Bandwidth
3. RBW = 100kHz
4. VBW = 3 x RBW
5. Detector Mode = Max Peak
6. Trace Mode = Max Hold

e) Allow the trace to stabilize.

f) Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

g) Determine the 6dB down amplitude.

h) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope trace, such that each marker is at or slightly below the 6dB down amplitude determined in step g). If a marker is below this 6dB down amplitude value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers.

i) Steps c) through h) were repeated for each of the modes listed in section 3.3.

5.2.2.3 Results

The plots on pages 28 through 30 show that the minimum 6 dB bandwidth was 554.5kHz which is greater than minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 1.02MHz.

5.2.3 Peak Output Power

5.2.3.1 Requirements

Per FCC 15.247(b)(3) and ISED RSS-247 5.4(d) for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm).

5.2.3.2 Procedures

a) The antenna port of the EUT was connected to the DUT 1 port of the Rohde & Schwarz OSP 120/OSP-B157 system via a coaxial cable and RF attenuator.

b) The Rohde & Schwarz OSP 120 RF switches were used to connect the inputs of the DUT ports (DUT 1, DUT 2, etc.) to the inputs of the ESW 44 EMI Test Receiver via a coaxial cable.

c) The EUT was powered up and set to transmit in the first mode listed in section 3.3.

d) The following settings were employed on the EMI Test Receiver:

1. Center Frequency = Transmit Frequency of the DUT
2. Frequency Span = 0 span
3. RBW = 1MHz
4. VBW = 3MHz
5. Detector Mode = Max Peak
6. Trace Mode = Max Hold
7. Sweep Points = 101

8. Sweep Time = 2 seconds

e) Record the highest value.

f) Steps c) through e) were repeated for each of the modes listed in section 3.3.

5.2.3.3 Results

The results are presented on page 31. The maximum peak conducted output power from the transmitter was 0.98mW (-0.1 dBm) which is below the 1 Watt limit.

5.2.4 EIRP

5.2.4.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, section 15.247(b)(3) and ISED RSS-247 section 5.4(d), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, section 15.247(b)(4) and ISED RSS-247 section 5.4(d), 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).

5.2.4.2 Procedures

The EUT was placed on the non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 6dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high channels.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a double ridged waveguide antenna was then set in place of the EUT 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. The peak EIPR was calculated for low, middle, and high channels.

5.2.4.3 Results

The results are presented on pages 32 through 34. The maximum EIRP measured from the transmitter was 0.9dBm or 1.23mW which is below the 4 Watt limit.

5.2.5 Duty Cycle Factor Measurements

5.2.5.1 Requirements

Per ANSI C63.10 section 11.6, when continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). The duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting.

5.2.5.2 Procedures

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 center frequency to the transmitter frequency and then setting a zero span width with 500usec/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 the “on-time”. The trace is recorded. The ON time of each pulse is measured.

Next the spectrum analyzer center frequency is set to the transmitter frequency with a zero span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less

than 100msec, the display is set to show at least one word. 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).

5.2.5.3 Results

The plots of the duty cycle are shown on data pages 35 through 40. As can be seen from the data, the duty cycle correction factors were calculated for:

Transmit at 2402MHz = 1.22dB
Transmit at 2440MHz = 1.21dB
Transmit at 2480MHz = 1.22dB

5.2.6 Radiated Spurious Emissions Measurements

5.2.6.1 Requirements

Per section 15.247(d) (and RSS-247 section 5.5), 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 a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) (and RSS-Gen Table 5) is not required.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a) (and RSS-Gen, Table 7) must comply with the radiated emission limits specified in §15.209(a) (and RSS-Gen, Table 5).

Paragraph 15.209(a) (and RSS-Gen, Table 5 and Table 6) 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

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

The final 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 waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) The field strengths 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 EUT. The EUT was placed on a 1.5 meter high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

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

i) The EUT 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.

iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.

d) All harmonics not in the restricted bands must be at least 20 dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) (and RSS-Gen, Table 5) is not required.

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

a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand. A peak detector with a resolution bandwidth of 1 MHz 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 EUT 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.

iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.

d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a) (and RSS-Gen, Table 5), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a) (and RSS-Gen, Table 5), then the emissions are remeasured using a quasi-peak detector.

e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken.

g) When continuous transmission cannot be achieved, the duty cycle correction factor is added to the reading to compute the emission level that would have been measured had the test been performed at 100% duty cycle.

5.2.6.3 Results

Preliminary radiated emissions plots and final radiated emissions data are shown on pages 41 through 73. As can be seen from the data, all emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown in Figure 5 through Figure 7.

5.2.7 Band Edge Compliance

5.2.7.1 Requirements

Per FCC 15.247(d) and ISED RSS-247 section 5.5, 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) and RSS-Gen 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) (and RSS-Gen, Table 5).

5.2.7.2 Procedures

5.2.7.2.1 Low Band Edge

a) The antenna port of the EUT was connected to the DUT 1 port of the Rohde & Schwarz OSP 120/OSP-B157 system via a coaxial cable and RF attenuator.

b) The Rohde & Schwarz OSP 120 RF switches were used to connect the inputs of the DUT ports (DUT 1, DUT 2, etc.) to the inputs of the ESW 44 EMI Test Receiver via a coaxial cable.

c) The EUT was powered up and set to transmit in the first mode listed in section 3.3.

d) The following settings were employed on the EMI Test Receiver:

Sweep 1:

1. Start Frequency = 2400MHz
2. Stop Frequency = 2483.5MHz
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector Mode = Max Peak
6. Trace Mode = Max Hold
7. Sweep Points = 1670
8. Sweep Time = 1.67 msec
9. Sweep Count = 100

e) The highest value in Sweep 1 was recorded.

f) The limit line for sweep 2 was set at 20dB down from the highest value recorded in Sweep 1.

Sweep 2:

1. Start Frequency = 2310MHz
2. Stop Frequency = 2400MHz
3. RBW = 100kHz

4. VBW = 300kHz
5. Detector Mode = Max Peak
6. Trace Mode = Max Hold
7. Sweep Points = 1800
8. Sweep Time = 1.8 msec
9. Sweep Count = 100

g) The highest values in Sweep 2 were recorded and compared to the 20dB down limit which was determined from Sweep 1.

h) The two sweeps were combined and plotted.

5.2.7.2.2 High Band Edge

1) The EUT was set to transmit continuously at the channel closest to the high band-edge.
2) A double ridged waveguide was placed 3 meters away from the EUT. The antenna was connected to the input of a spectrum analyzer.
3) The start frequency of the analyzer was set to the high band edge (2483.5MHz). The frequency span was set to 10MHz.
4) The resolution bandwidth was set to 1MHz.
5) To ensure that the maximum or worst case emission level was measured, the following steps were taken:

    a. The EUT was rotated so that all of its sides were exposed to the receiving antenna.
    b. Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
    c. The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

6) The highest measured peak reading was recorded.
7) The highest measured average reading was recorded.

5.2.7.3 Results

Pages 74 through 76 show the band-edge compliance results. As can be seen from these plots, the conducted emissions at the low end band-edge are within the 20 dB down limits. The radiated emissions at the high end band-edge are within the general limits.

5.2.8 Power Spectral Density

5.2.8.1 Requirement

Per FCC 15.247(f) and ISED RSS-247 section 5.2.(b), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.8.2 Procedures

a) The antenna port of the EUT was connected to the DUT 1 port of the Rohde & Schwarz OSP 120/OSP-B157 system via a coaxial cable and RF attenuator.

b) The Rohde & Schwarz OSP 120 RF switches were used to connect the inputs of the DUT ports (DUT 1, DUT 2, etc.) to the inputs of the ESW 44 EMI Test Receiver via a coaxial cable.

c) The EUT was powered up and set to transmit in the first mode listed in section 3.3.

d) The following settings were employed on the EMI Test Receiver:

a. Center frequency = transmit frequency
b. Span = 3MHz
c. Resolution bandwidth (RBW): 3kHz ≤ RBW ≤ 100kHz
d. VBW = 3 x RBW
e. Sweep Points = 600
f. Sweep time = Auto
g. Sweep Count = 100
h. The peak detector and 'Max-Hold' function was engaged.
i. The display line represents the 8 dBm limit

e) If the measured value exceeds the 8dBm limit, the RBW was reduced (no less than 3kHz) and step d) was repeated.

f) Steps d) and e) were repeated for the rest of the modes listed in section 3.3.

5.2.8.3 Results

Pages 77 through 79 show the power spectral density results. As can be seen from the data, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

6. CONCLUSIONS

The Master Lock Company BLE Relay, Product No. 6440ENT digital modulation transceiver 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 2400-2483.5 MHz band, when tested per ANSI C63.10-2013.

The Master Lock Company BLE Relay, Product No. 6440ENT digital modulation transceiver did also fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 8.8 and Section 7.3 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 8.8 and Radio Standards Specification RSS-247 for transmitters, when tested per ANSI C63.10-2013.

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 EUT at the test date. Any electrical or mechanical modification made to the EUT 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 certification, approval, or endorsement by A2LA, NIST or any agency of the Federal Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	4/5/2018	4/5/2019
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	4/5/2018	4/5/2019
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
GBR5	SIGNAL GENERATOR	AGILENT TECHNOLOGIES	8648D	4037U00607	0.009-4000MHZ	2/15/2019	2/15/2020
GSFA	OSP-B157 OSP MODULE	ROHDE & SCHWARZ	OSP-B157	100867		10/23/2018	10/23/2019
GSFB	OSP120 BASE UNIT	ROHDE & SCHWARZ	OSP120	101246	---	10/23/2018	10/23/2019
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	9/5/2018	9/5/2019
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/31/2018	5/31/2020
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/22/2018	3/22/2020
PLF1	CISPR16 50UH LISN	ELITE	CISPR16/70A	001	.15-30MHz	5/7/2018	5/7/2019
PLF3	CISPR16 50UH LISN	ELITE	CISPER16/70A	003	.15-30MHz	5/7/2018	5/7/2019
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	12/5/2018	12/5/2019
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	2/21/2019	2/21/2020
T1D2	10DB 20W ATTENUATOR	NARDA	768-10	---	DC-11GHZ	2/22/2018	2/22/2020
VBR8	CISPR EN FCC CE VOLTAGE.exe					N/A	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XOB2	ADAPTER	HEWLETT PACKARD	K281C,012	09407	18-26.5GHZ	NOTE 1	
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	9/12/2017	9/12/2019

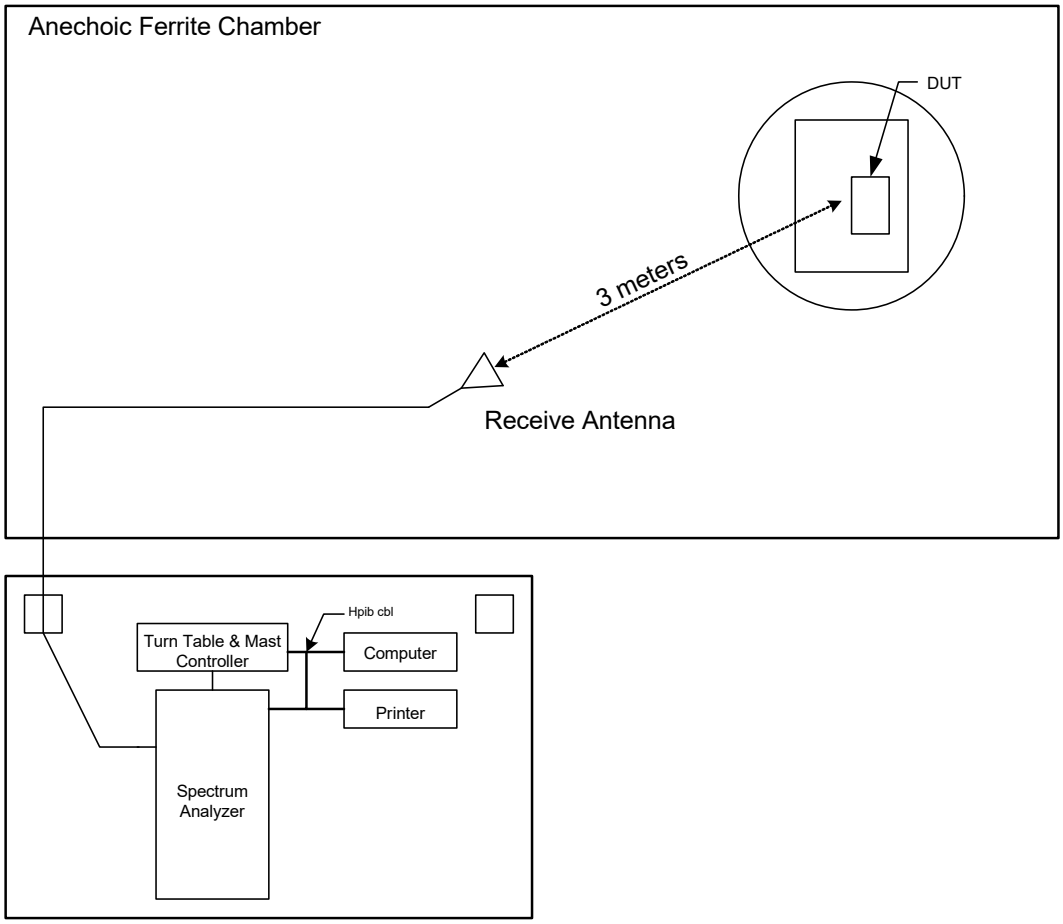


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

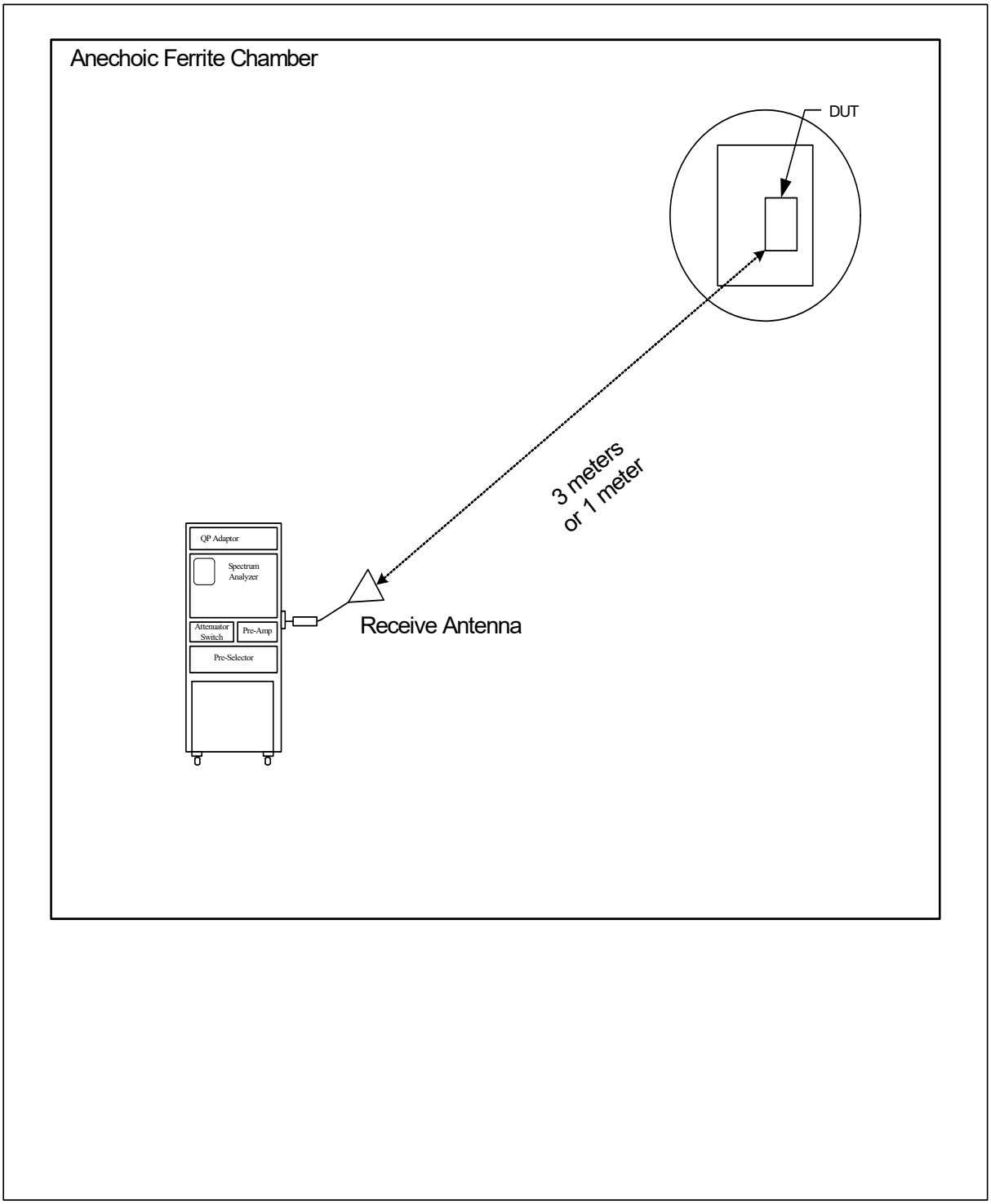
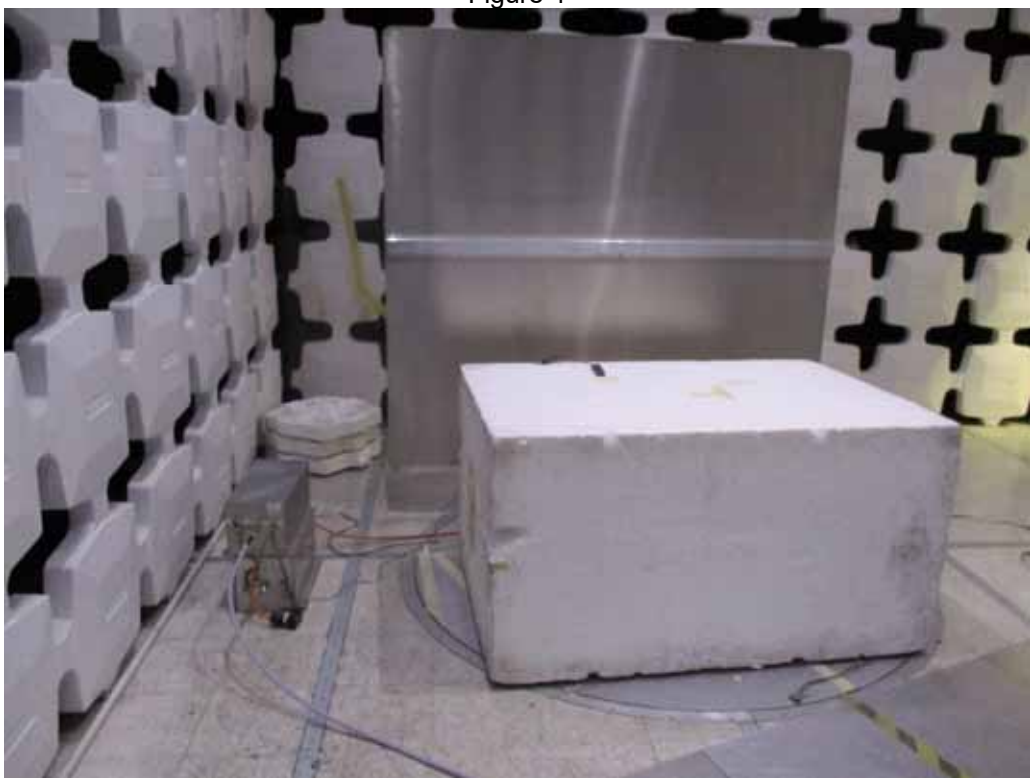


Figure 2: BLOCK DIAGRAM OF TEST SETUP FOR RADIATED EMISSIONS ABOVE 18GHZ

Figure 3

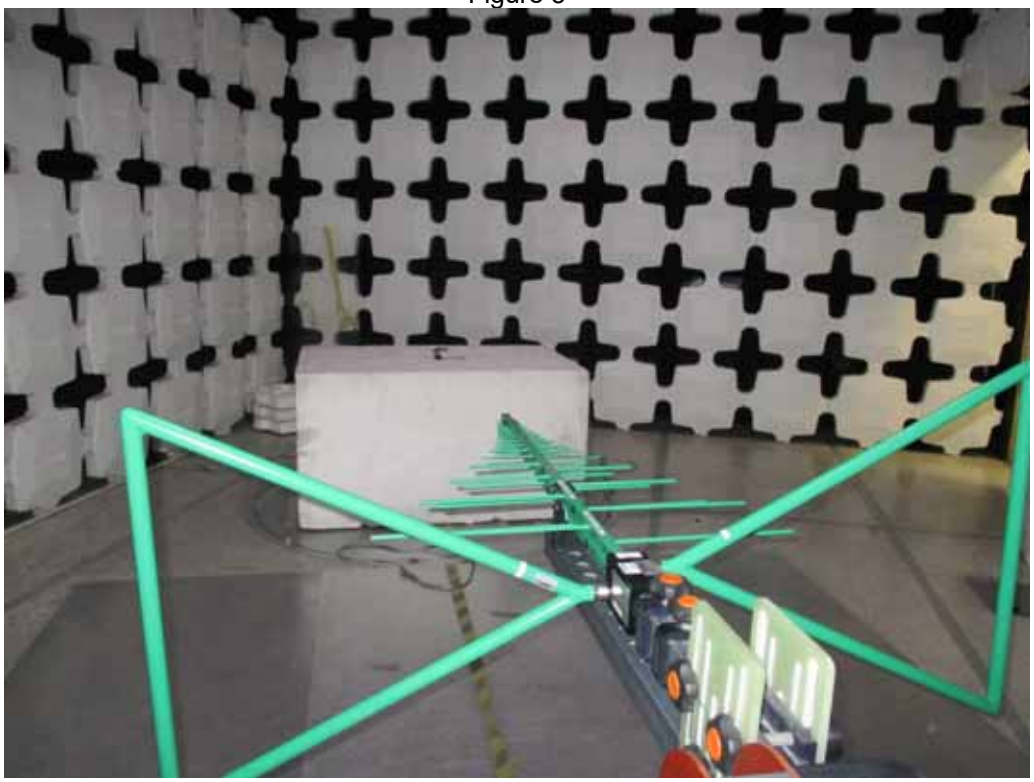
Photograph of the EUT

Figure 4

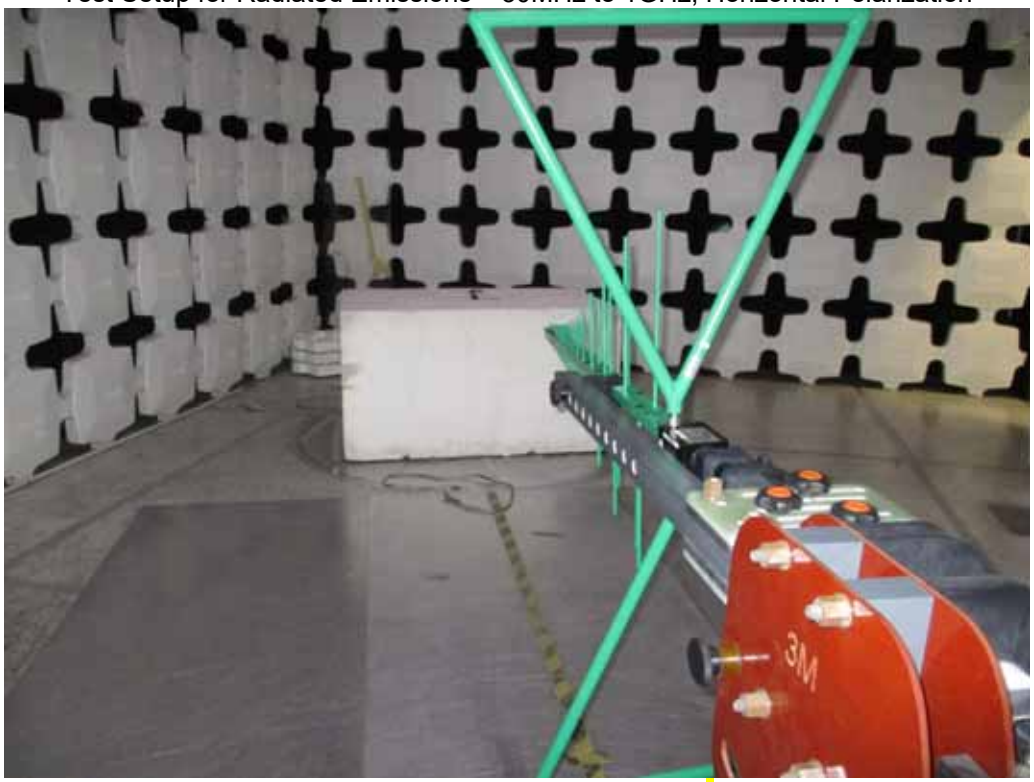


Test Setup for Conducted Emissions

Figure 5



Test Setup for Radiated Emissions – 30MHz to 1GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 30MHz to 1GHz, Vertical Polarization

Figure 6

Test Setup for Radiated Emissions – 1GHz to 18GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 1GHz to 18GHz, Vertical Polarization

Figure 7

Test Setup for Radiated Emissions – 18GHz to 25GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 18GHz to 25GHz, Vertical Polarization

FCC Part 15 Subpart C, Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	MASTER LOCK
Model	:	6440ENT
DUT Revision	:	
Serial Number	:	SAMPLE #1
DUT Mode	:	TRANSMIT AT 2440MHz
Line Tested	:	115V, 60Hz HIGH
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	TESTED WITH TRIAD POWER SUPPLY, M/N: WS8U120-1500
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Feb 27, 2019 01:40:13 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

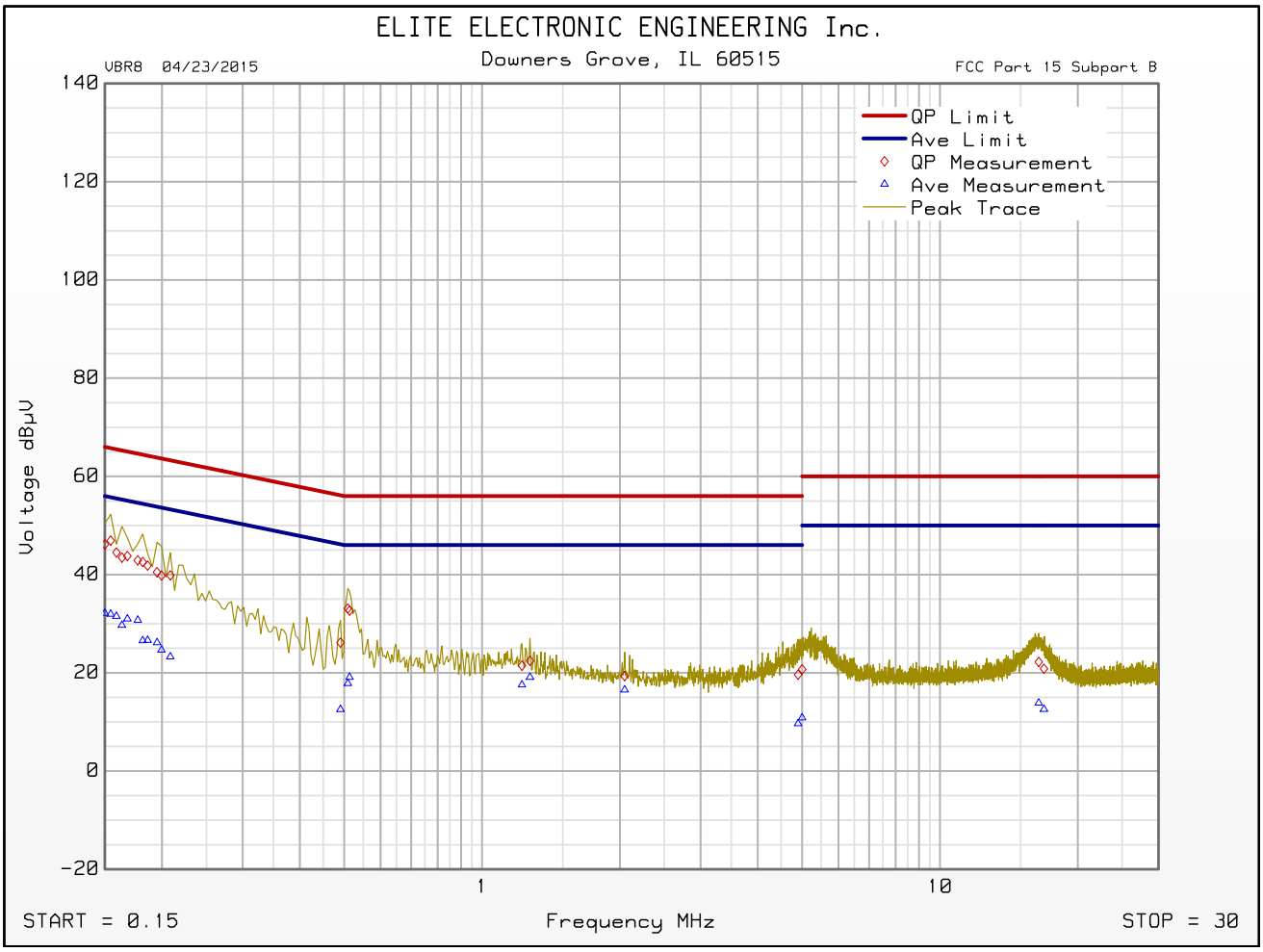
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.155	46.9	65.8		32.0	55.8	
0.491	26.2	56.2		12.5	46.2	
0.509	33.1	56.0		17.8	46.0	
1.222	21.5	56.0		17.6	46.0	
1.273	22.4	56.0		19.1	46.0	
2.048	19.4	56.0		16.5	46.0	
5.000	20.7	56.0		10.9	46.0	
16.430	22.2	60.0		13.9	50.0	
16.871	20.8	60.0		12.6	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 04/23/2015

Manufacturer	:	MASTER LOCK
Model	:	6440ENT
DUT Revision	:	
Serial Number	:	SAMPLE #1
DUT Mode	:	TRANSMIT AT 2440MHz
Line Tested	:	115V, 60Hz HIGH
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	TESTED WITH TRIAD POWER SUPPLY, M/N: WS8U120-1500
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Feb 27, 2019 01:40:13 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart C Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	MASTER LOCK
Model	:	6440ENT
DUT Revision	:	
Serial Number	:	SAMPLE #1
DUT Mode	:	TRANSMIT AT 2440MHz
Line Tested	:	115V, 60Hz RETURN
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	TESTED WITH TRIAD POWER SUPPLY, M/N: WS8U120-1500
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Feb 27, 2019 01:11:59 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

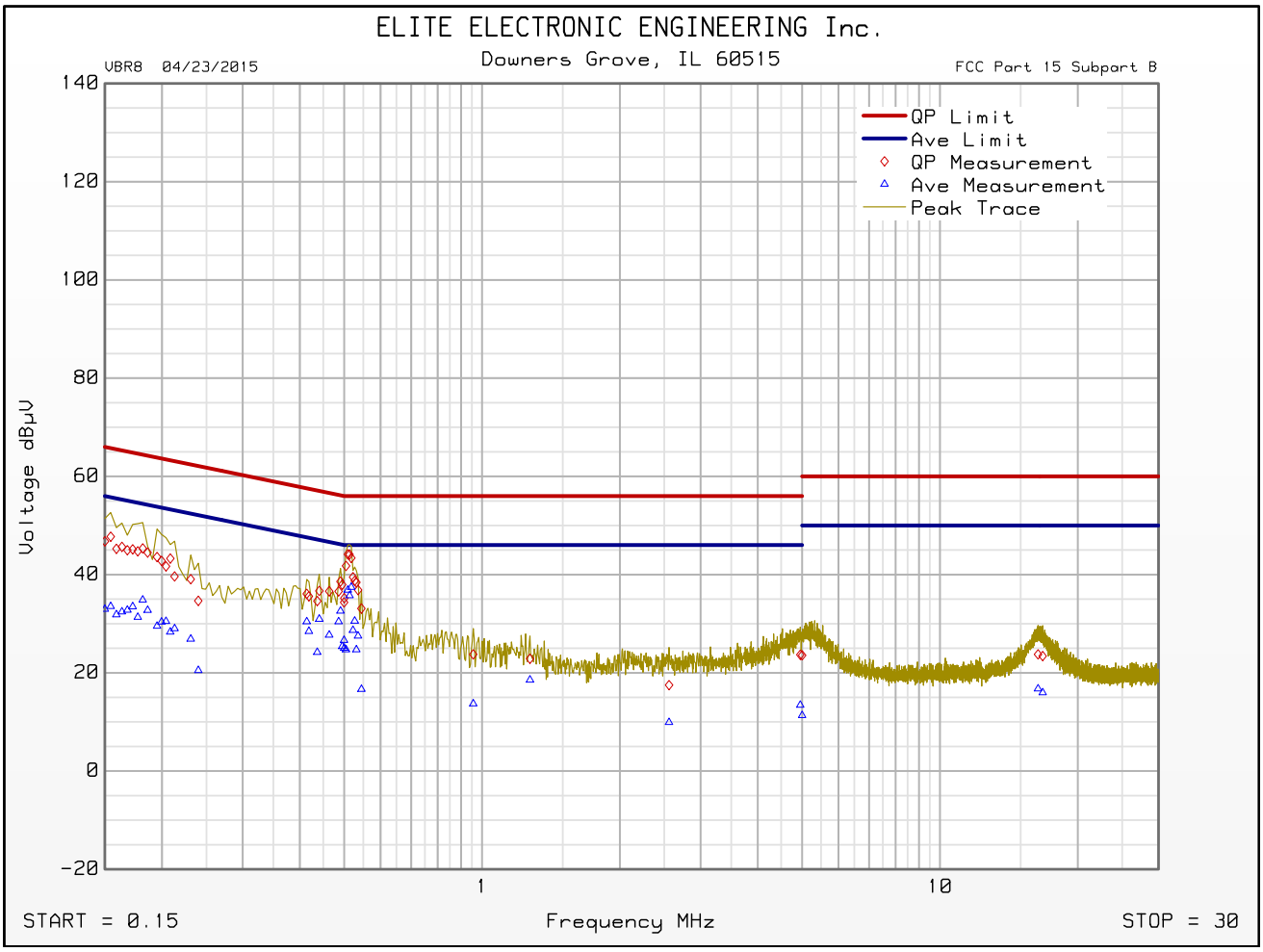
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.155	47.7	65.8		33.5	55.8	
0.491	38.6	56.2		32.6	46.2	
0.509	44.1	56.0		36.9	46.0	
0.518	43.4	56.0		37.4	46.0	
0.957	23.8	56.0		13.7	46.0	
1.273	22.9	56.0		18.6	46.0	
2.561	17.5	56.0		9.9	46.0	
4.954	23.7	56.0		13.4	46.0	
5.000	23.6	56.0		11.3	46.0	
16.371	23.8	60.0		16.8	50.0	
16.759	23.4	60.0		16.0	50.0	

FCC Part 15 Subpart C Conducted Emissions Test

Cumulative Data

VBR8 04/23/2015

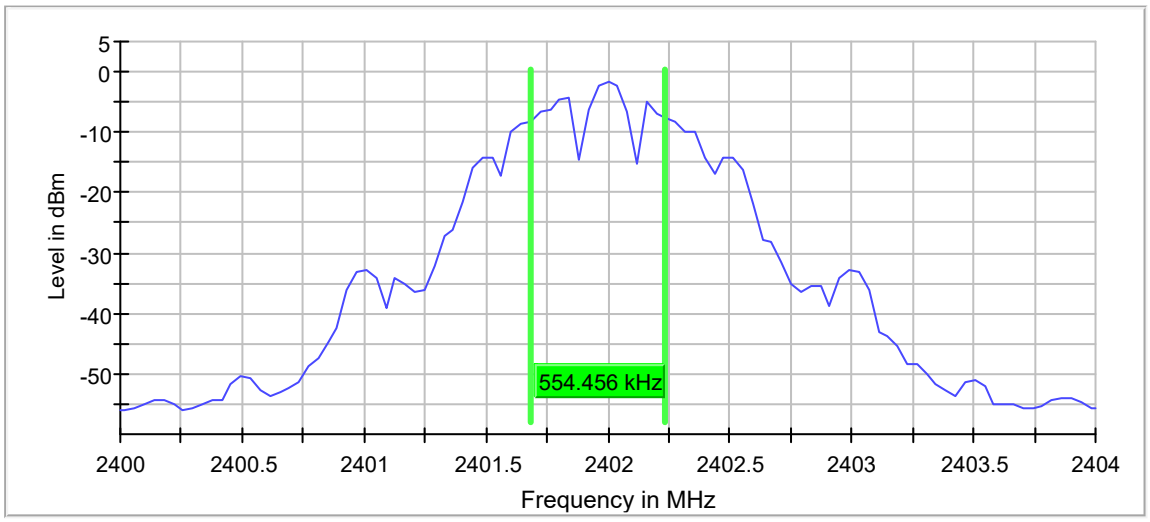
Manufacturer	:	MASTER LOCK
Model	:	6440ENT
DUT Revision	:	
Serial Number	:	SAMPLE #1
DUT Mode	:	TRANSMIT AT 2440MHz
Line Tested	:	115V, 60Hz RETURN
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	TESTED WITH TRIAD POWER SUPPLY, M/N: WS8U120-1500
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Feb 27, 2019 01:11:59 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

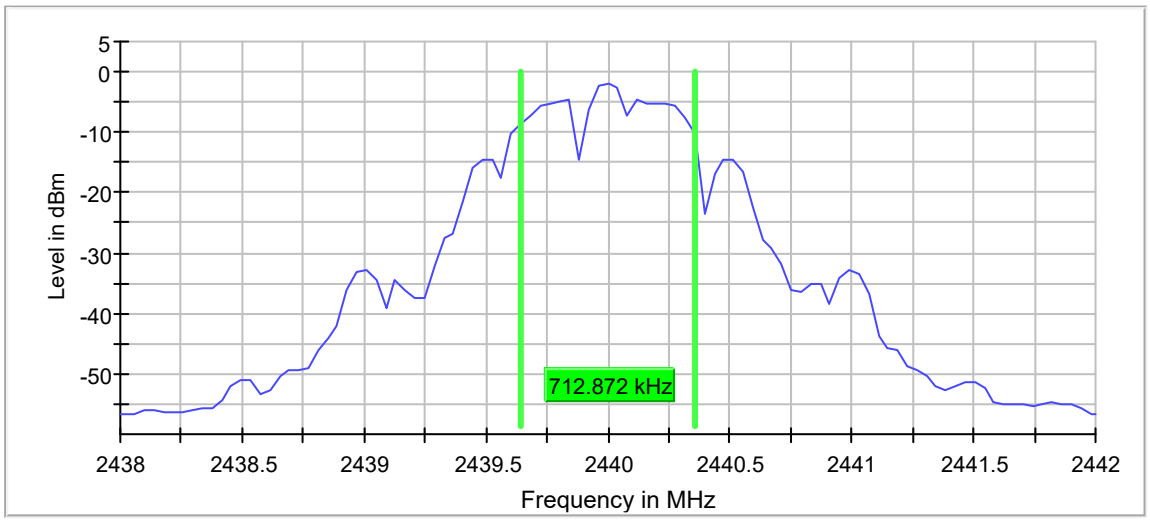
Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2402MHz
Test Performed : 6dB bandwidth
Date :February 27, 2019

DUT Frequency MHz	Bandwidth MHz	Limit Min (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2402	0.554456	0.500000	2401.683168	2402.237624	Pass



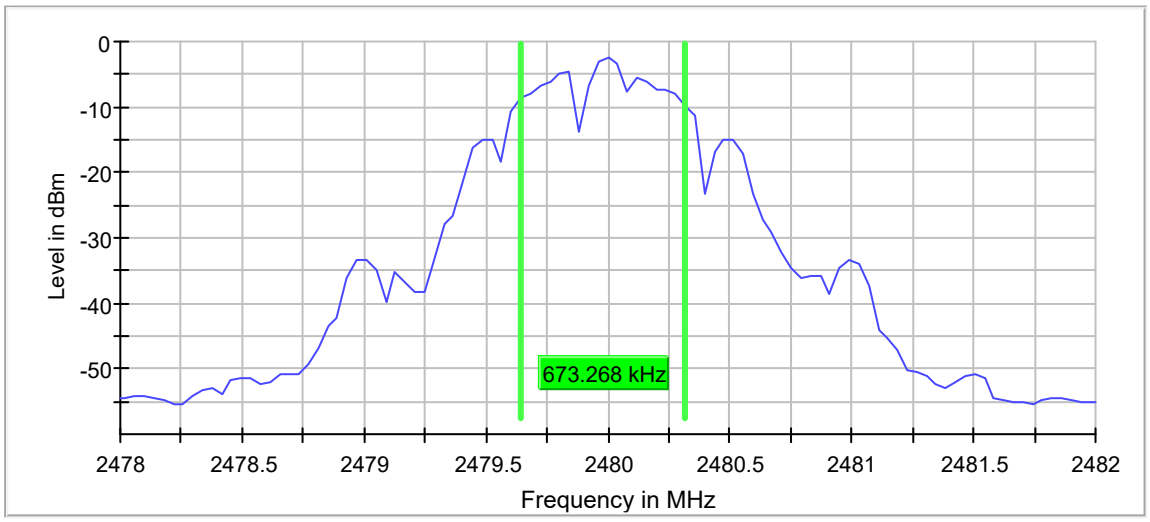
Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2402MHz
Test Performed : 6dB bandwidth
Date :February 27, 2019

DUT Frequency MHz	Bandwidth MHz	Limit Min (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2440	0.712872	0.500000	2439.643564	2440.356436	Pass



Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2402MHz
Test Performed : 6dB bandwidth
Date :February 27, 2019

DUT Frequency MHz	Bandwidth MHz	Limit Min (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2480	0.673268	0.500000	2479.643564	2480.316832	Pass



Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #2
Mode : See Below
Test Performed : FCC 15-247, RSS-247 Peak Output Power
Date :February 27, 2019

Frequency MHz	Measured Peak Power dBm	Power Limit dBm	Result
2402	-0.1	30.0	Pass
2440	-0.3	30.0	Pass
2480	-0.9	30.0	Pass

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2402MHz
Test Performed : FCC 15-247, RSS-247 Peak EIRP
Date :February 26, 2019

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2402.00	H	59.7	-1.3	5.6	3.4	0.9	27.0	-26.1
2402.00	V	53.4	-7.7	5.6	3.4	-5.5	27.0	-32.5

EIRP (dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dB) – Cable Loss (dB)

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2440MHz
Test Performed : FCC 15-247, RSS-247 Peak EIRP
Date :February 26, 2019

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2440.00	H	58.9	-2.4	5.7	3.5	-0.2	27.0	-27.2
2440.00	V	53.8	-7.5	5.7	3.5	-5.3	27.0	-32.3

EIRP (dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dB) – Cable Loss (dB)

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Performed : FCC 15-247, RSS-247 Peak EIRP
Date :February 26, 2019

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2480.00	H	59.1	-1.9	5.8	3.5	0.4	27.0	-26.6
2480.00	V	54.2	-7.5	5.8	3.5	-5.2	27.0	-32.2

EIRP (dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dB) – Cable Loss (dB)

Date: 26.FEB.2019 11:26:43

Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2402MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time = 2.172msec

Date: 26.FEB.2019 11:27:26

Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2402MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time in 100msec = 2.172msec x 40 pulses = 86.88msec
	: Duty Cycle Correction Factor = 20 x log (1/(86.88msec/100msec))
	: Duty Cycle Correction Factor = 1.22dB

Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2440MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time = 2.176msec

Date: 26.FEB.2019 15:57:49

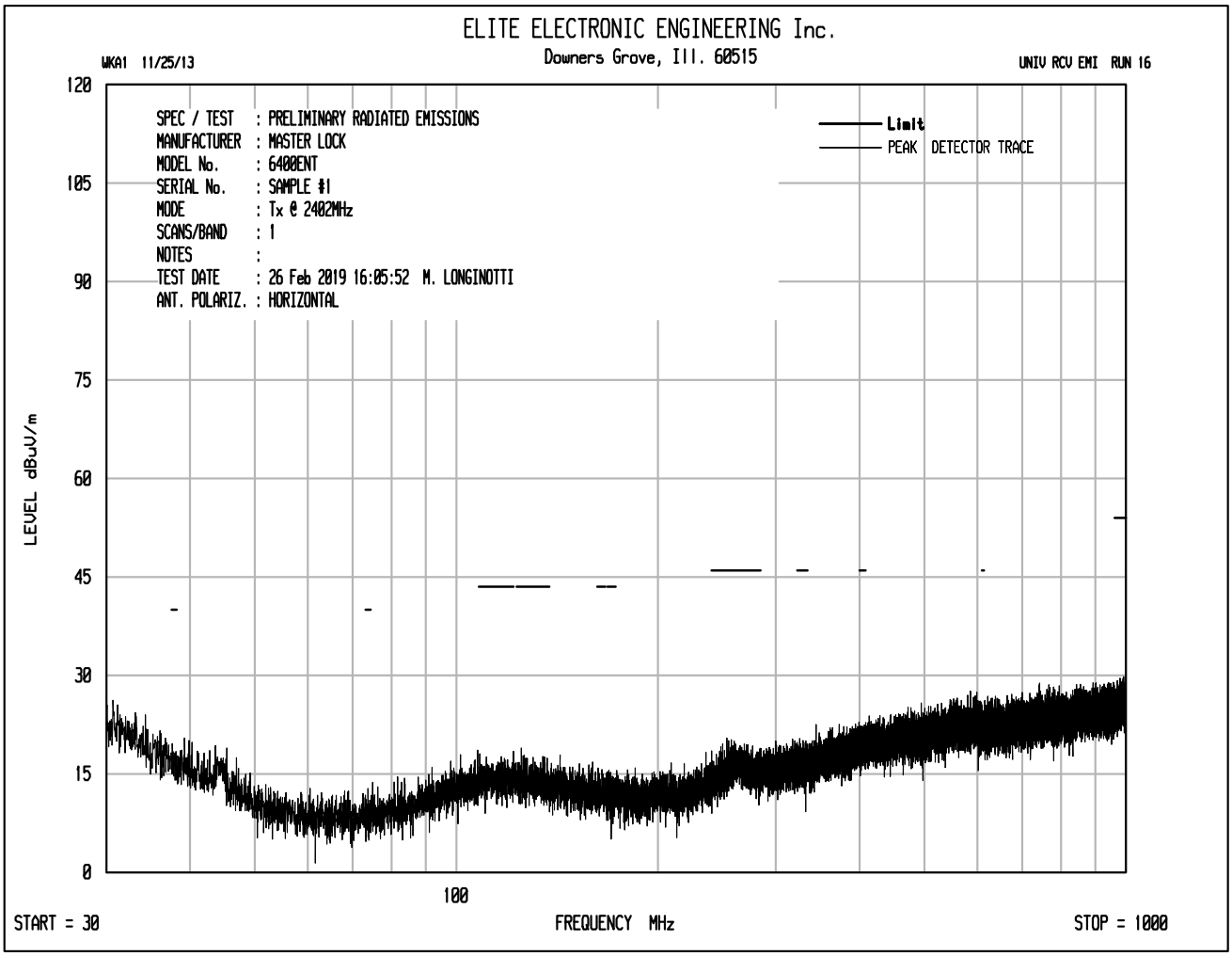
Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2440MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time in 100msec = 2.176msec x 40 pulses = 87.04msec
	: Duty Cycle Correction Factor = 20 x log (1/(87.04msec/100msec))
	: Duty Cycle Correction Factor = 1.21dB

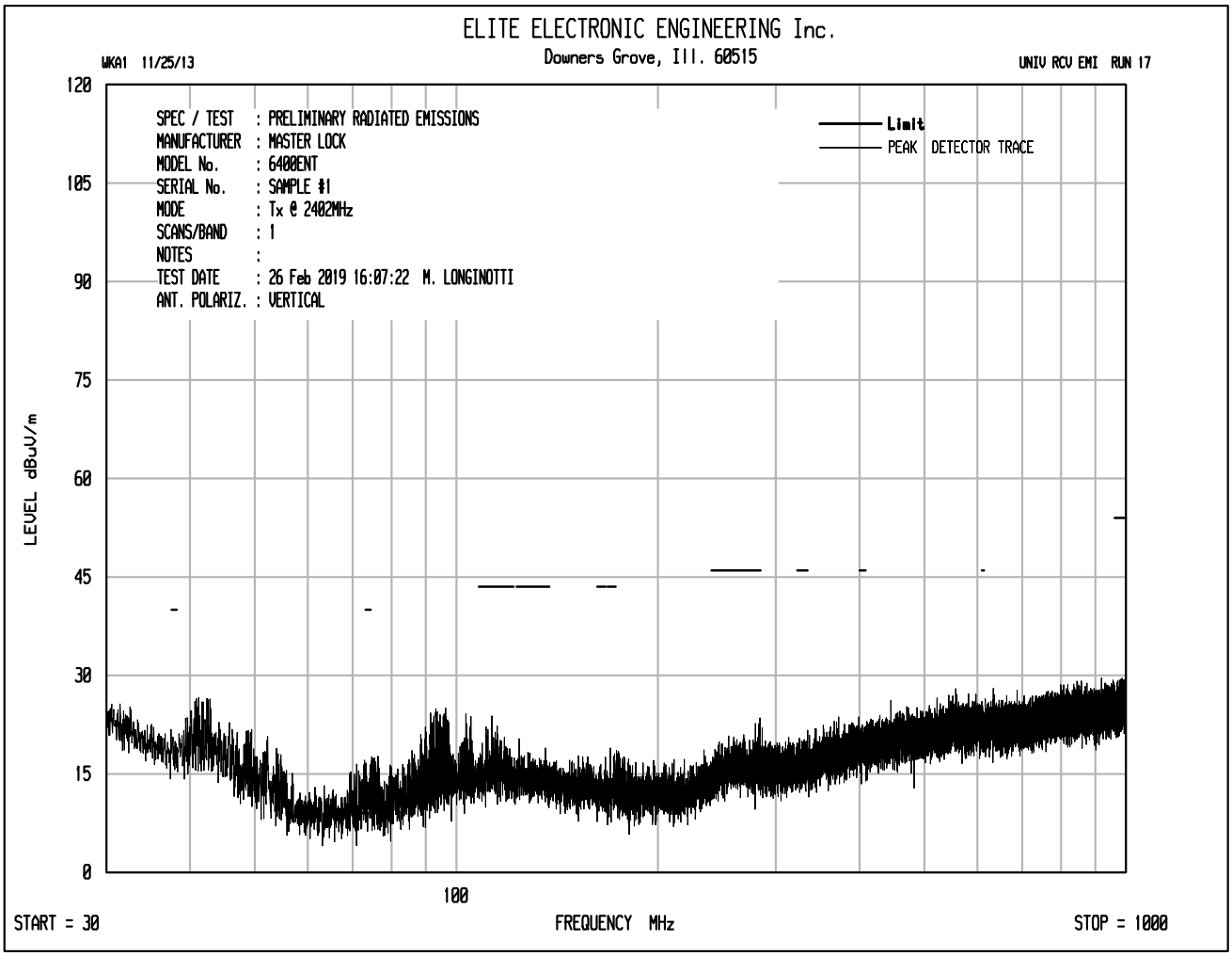
Date: 26.FEB.2019 10:42:00

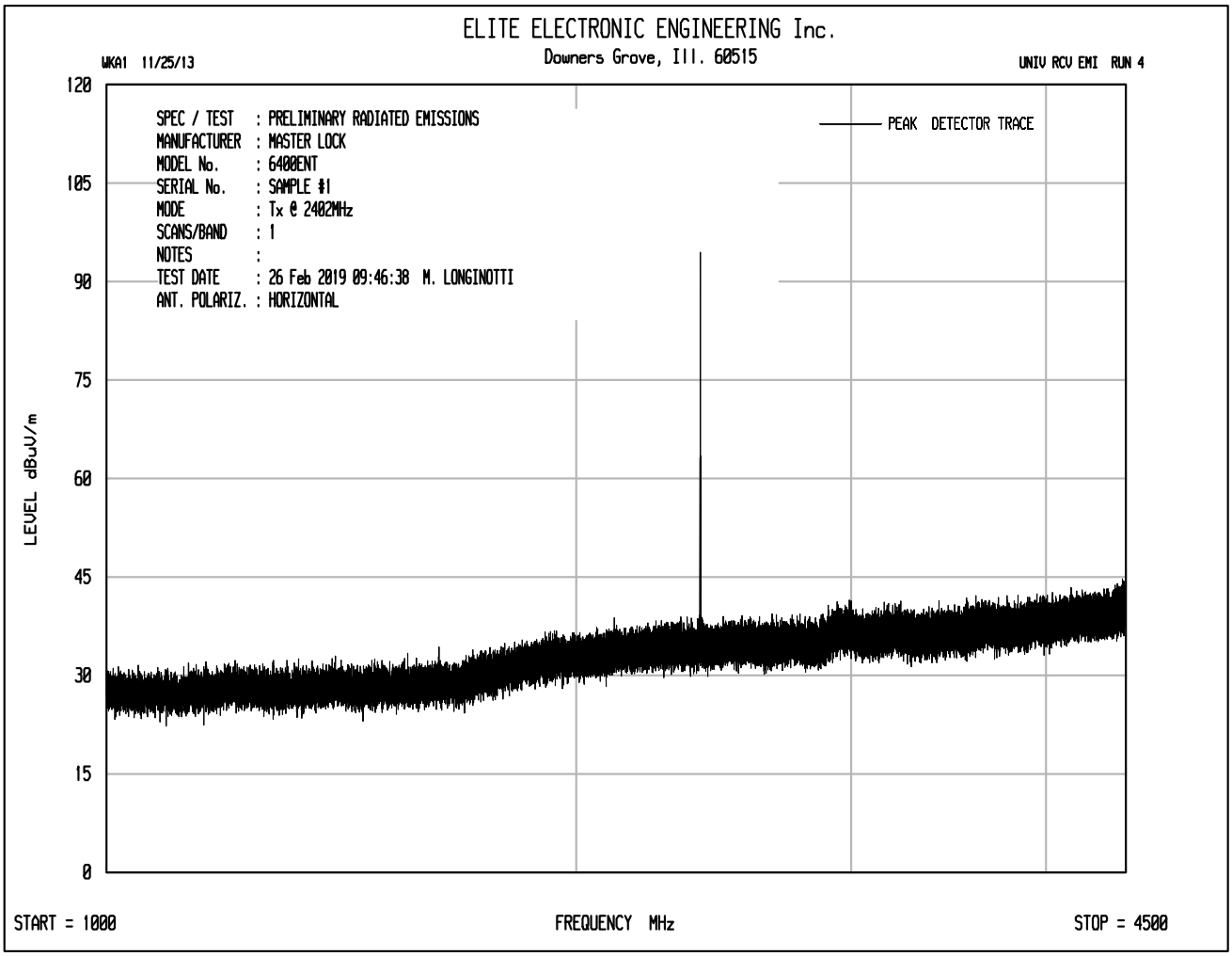
Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2480MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time = 2.172msec

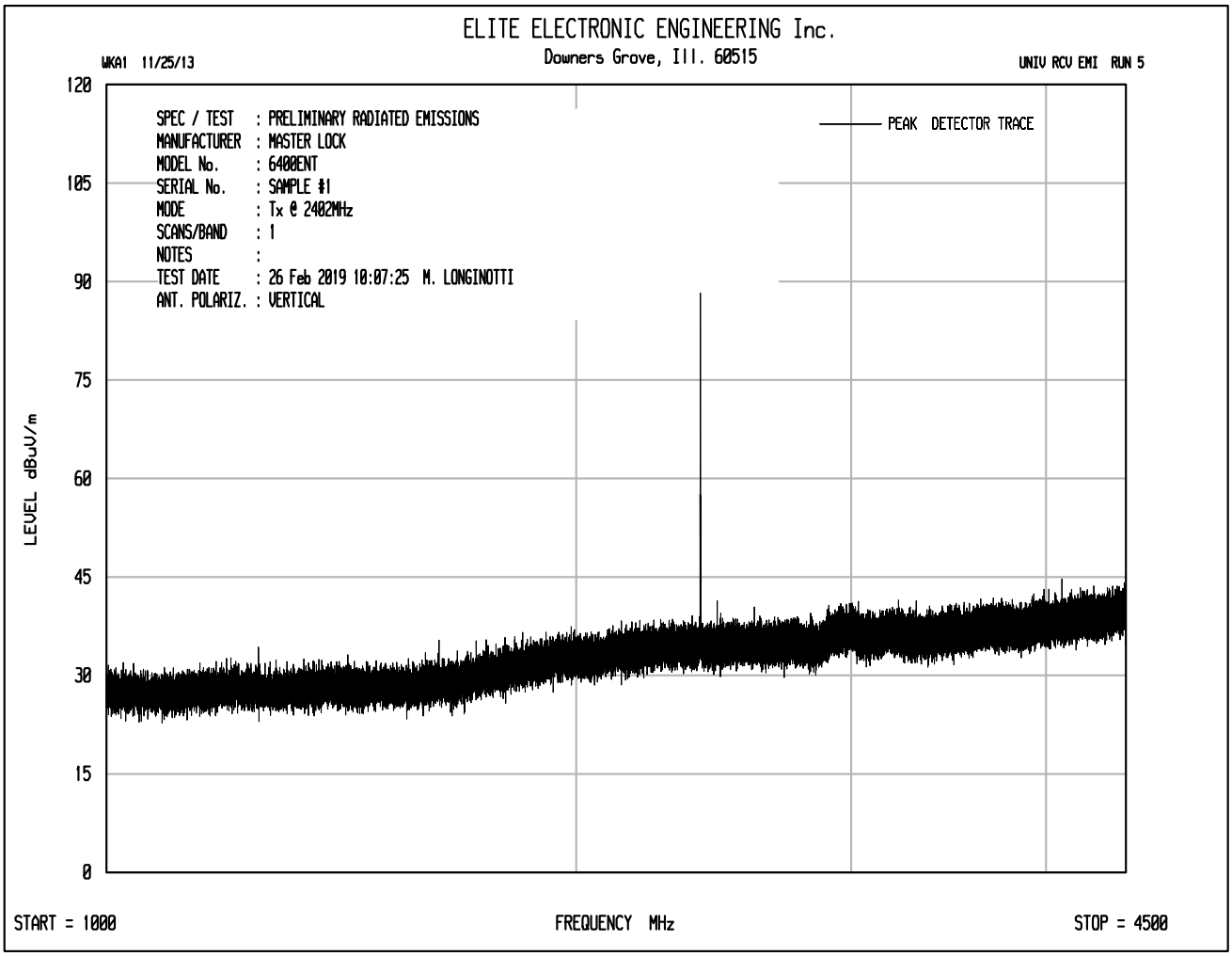
Date: 26.FEB.2019 10:42:41

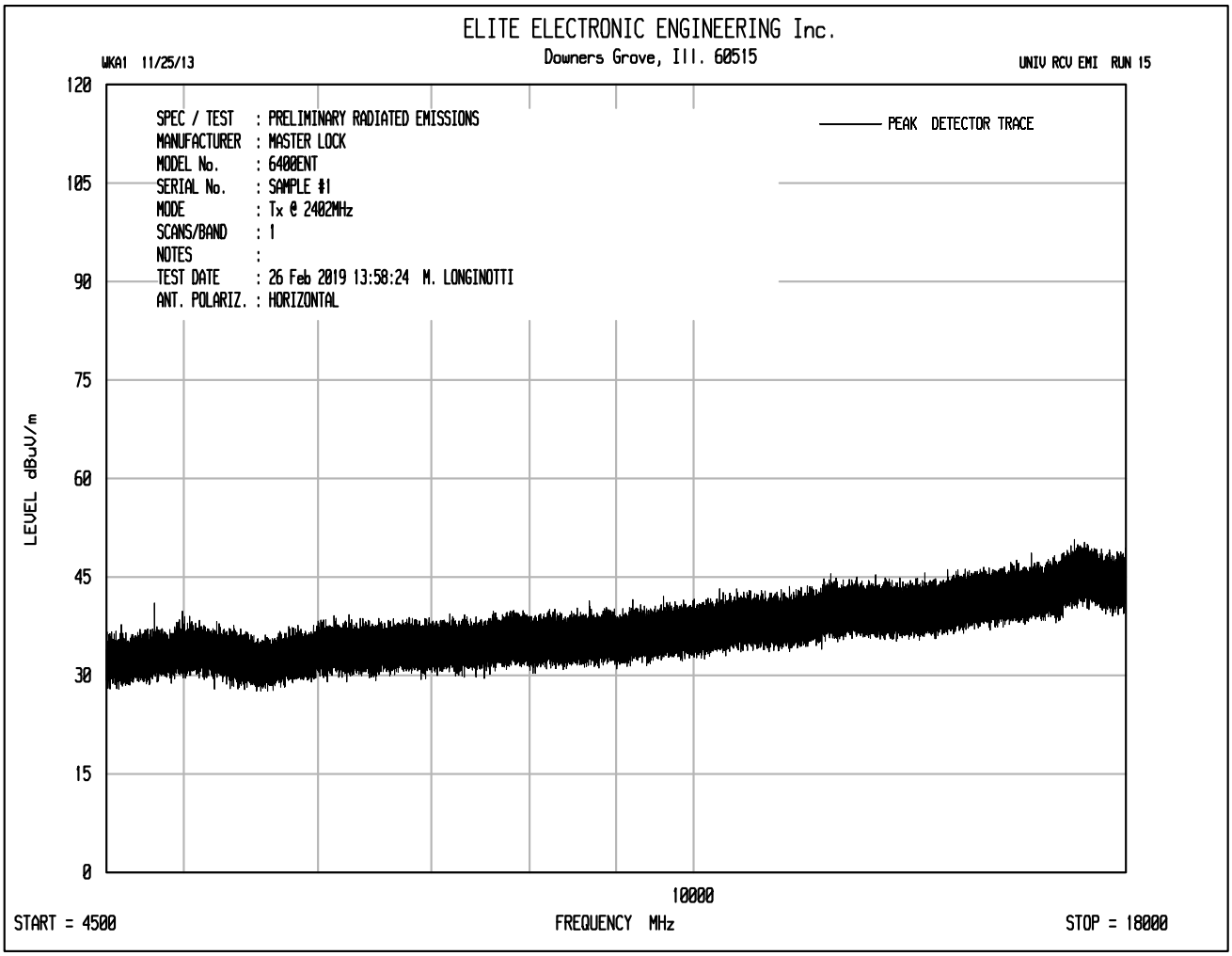
Manufacturer	: Master Lock Company
Test Item	: BLE Relay
Model No.	: 6440ENT
Serial No.	: Sample #1
Test Mode	: Transmit at 2440MHz
Test Performed	: Duty Cycle
Test Date	: February 26, 2019
Notes	: Pulse on time in 100msec = 2.172msec x 40 pulses = 86.88msec
	: Duty Cycle Correction Factor = 20 x log (1/(86.88msec/100msec))
	: Duty Cycle Correction Factor = 1.22dB

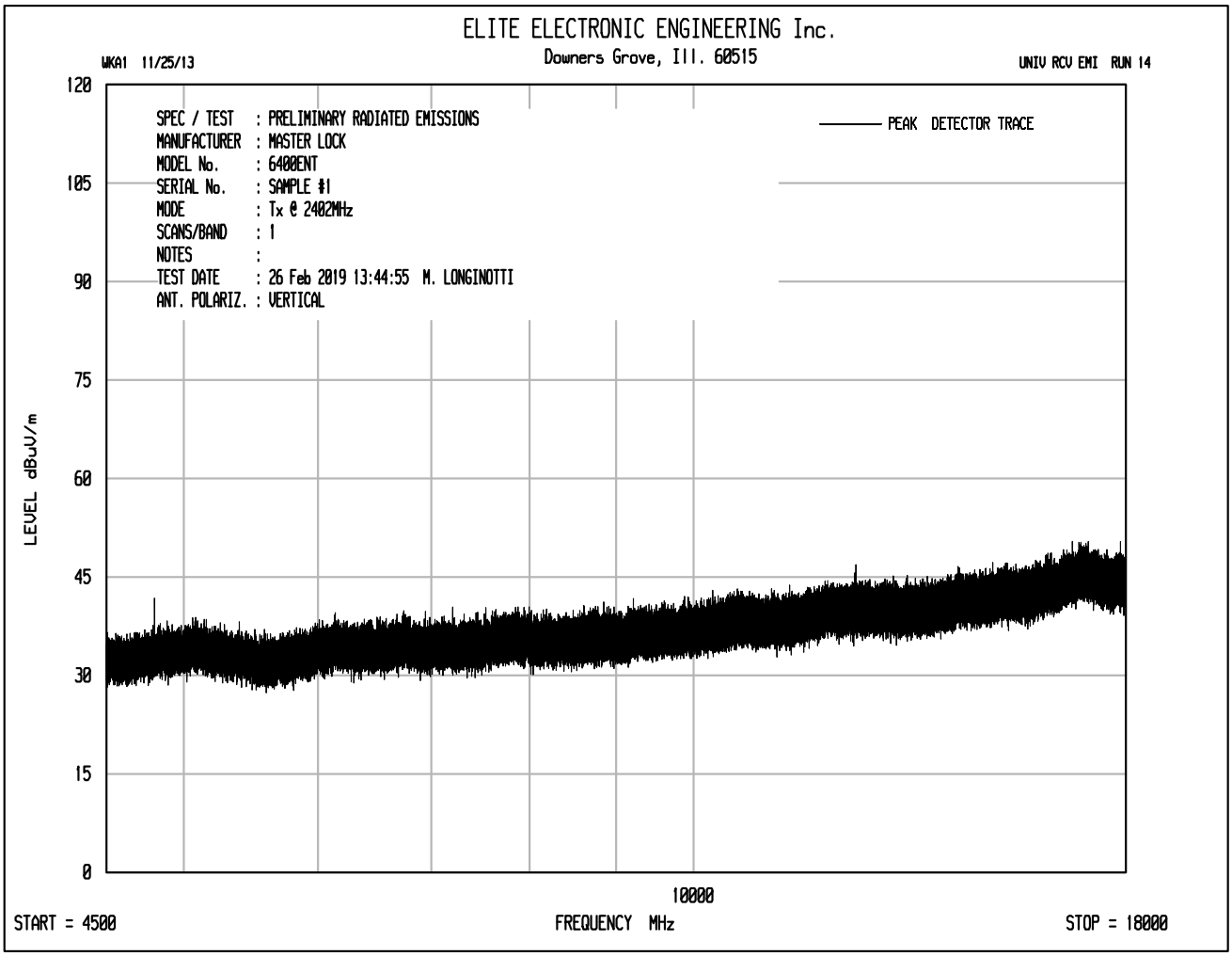

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 16
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:05:52 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

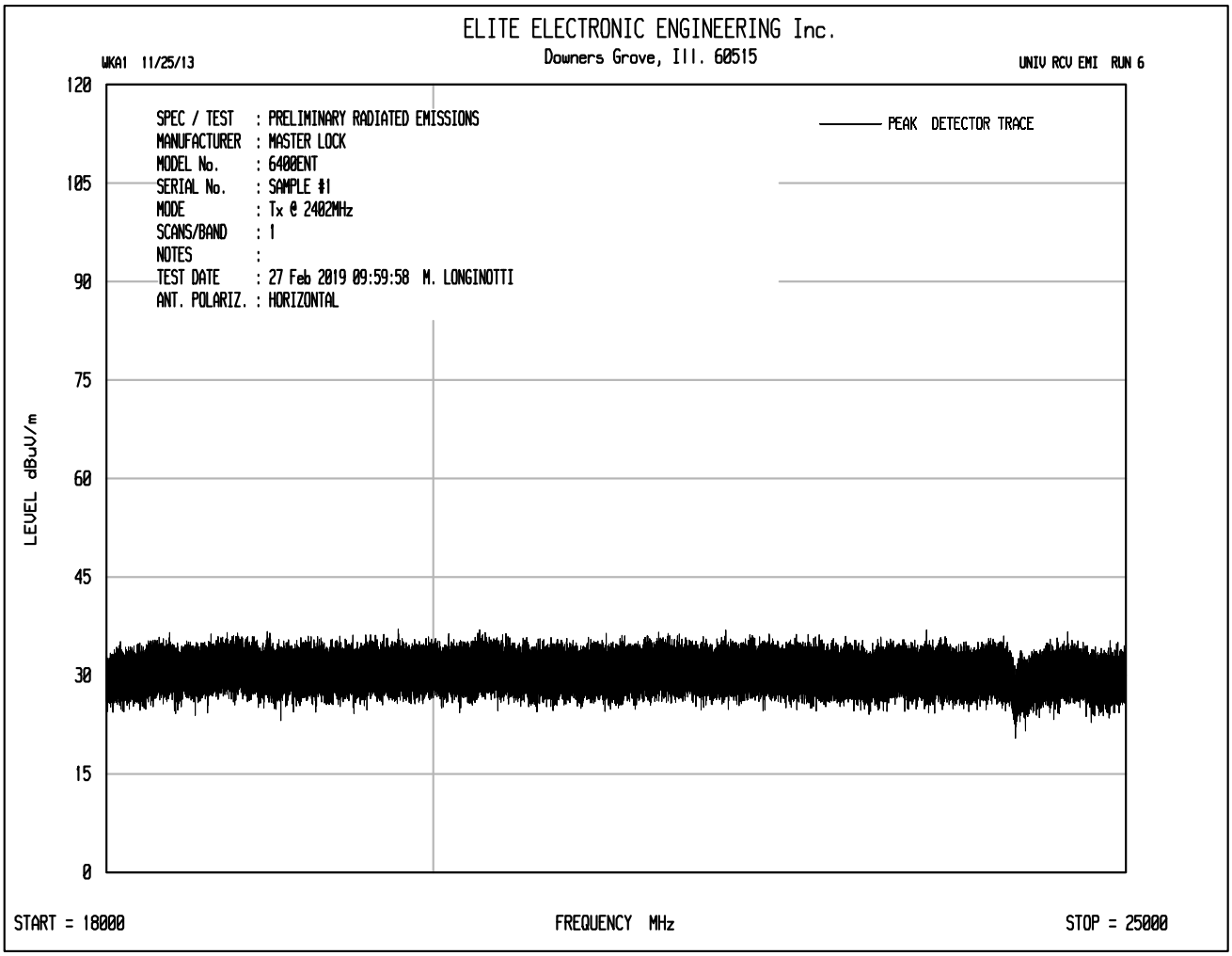

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 17
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:07:22 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

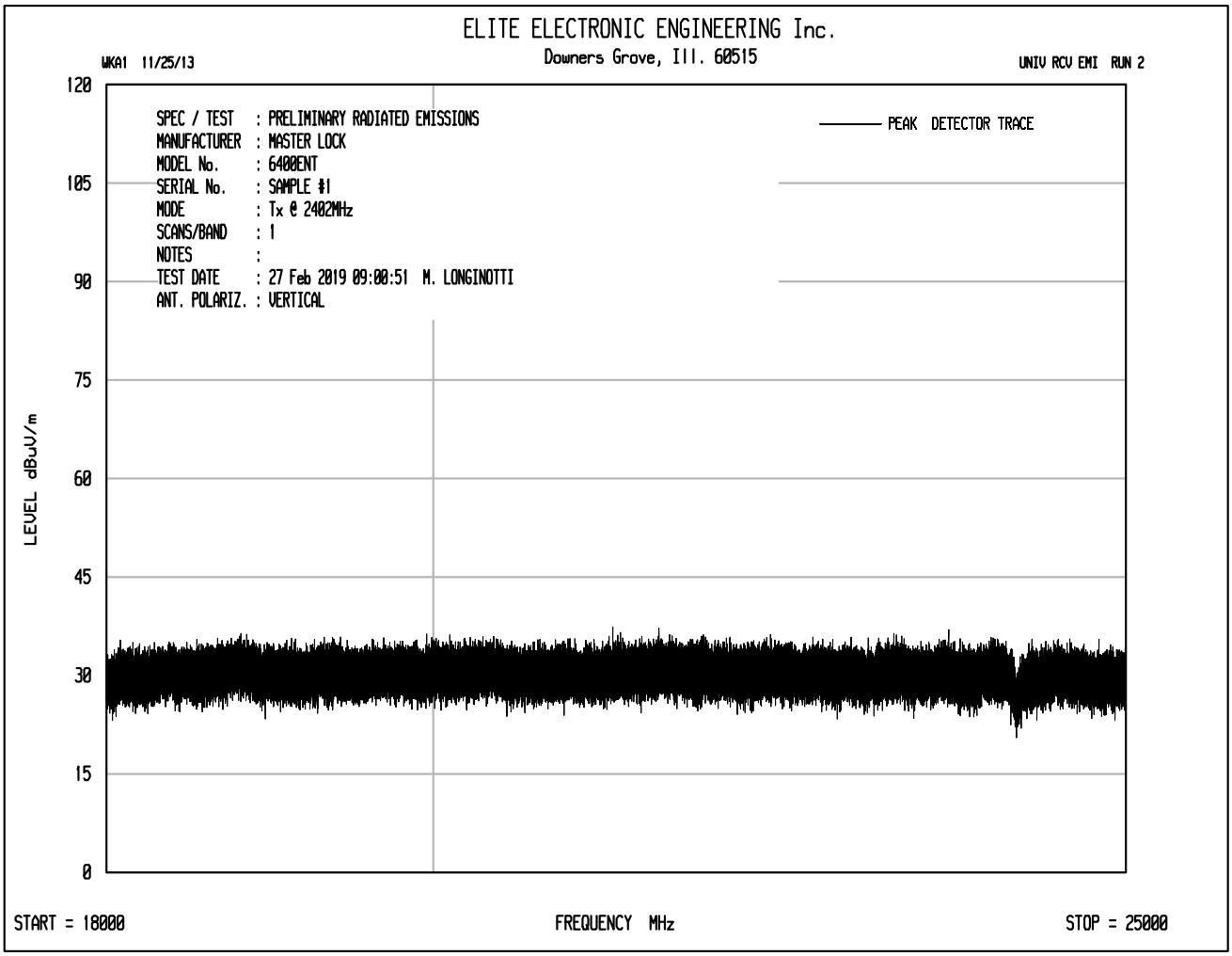

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 09:46:38 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 10:07:25 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 15
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 13:58:24 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 14
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 13:44:55 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 09:59:58 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2402MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 09:00:51 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2402MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
4804.00	H	50.5		4.8	36.9	-39.3	52.9	441.5	5000.0	-21.1
4804.00	V	51.2		4.8	36.9	-39.3	53.6	478.6	5000.0	-20.4
12010.00	H	48.8	Ambient	8.0	41.7	-39.2	59.4	929.3	5000.0	-14.6
12010.00	V	49.4	Ambient	8.0	41.7	-39.2	60.0	995.8	5000.0	-14.0
19216.00	H	34.6	Ambient	2.2	40.4	-28.8	48.4	263.2	5000.0	-25.6
19216.00	V	35.2	Ambient	2.2	40.4	-28.8	49.0	282.0	5000.0	-25.0

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2402MHz
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

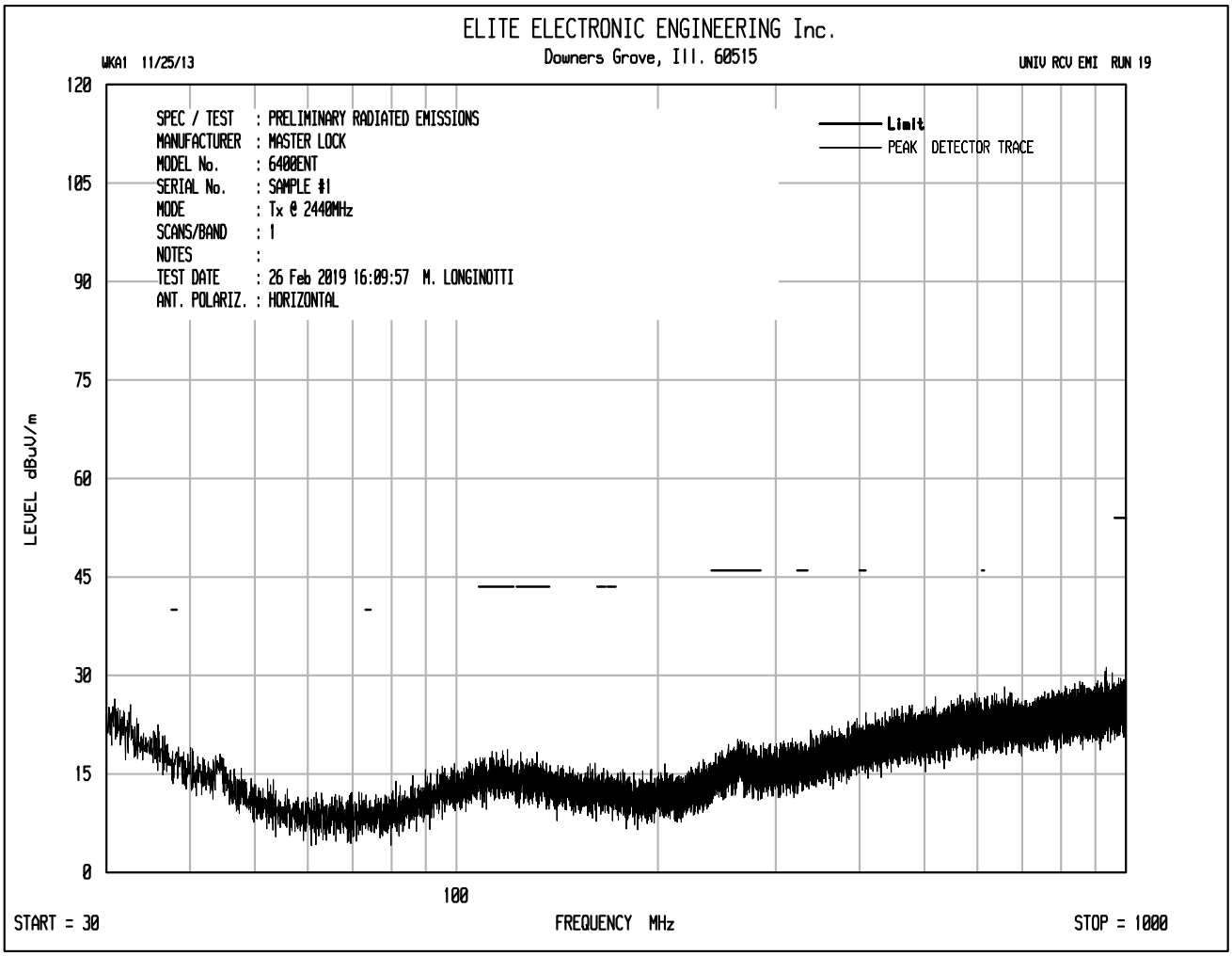
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4804.00	H	38.2	Ambient	4.8	36.9	-39.3	1.2	41.8	123.3	500.0	-12.2
4804.00	V	39.0	Ambient	4.8	36.9	-39.3	1.2	42.6	135.2	500.0	-11.4
12010.00	H	34.1	Ambient	8.0	41.7	-39.2	1.2	45.9	196.9	500.0	-8.1
12010.00	V	34.1	Ambient	8.0	41.7	-39.2	1.2	45.9	196.9	500.0	-8.1
19216.00	H	20.5	Ambient	2.2	40.4	-28.8	1.2	35.5	59.7	500.0	-18.5
19216.00	V	20.5	Ambient	2.2	40.4	-28.8	1.2	35.5	59.7	500.0	-18.5

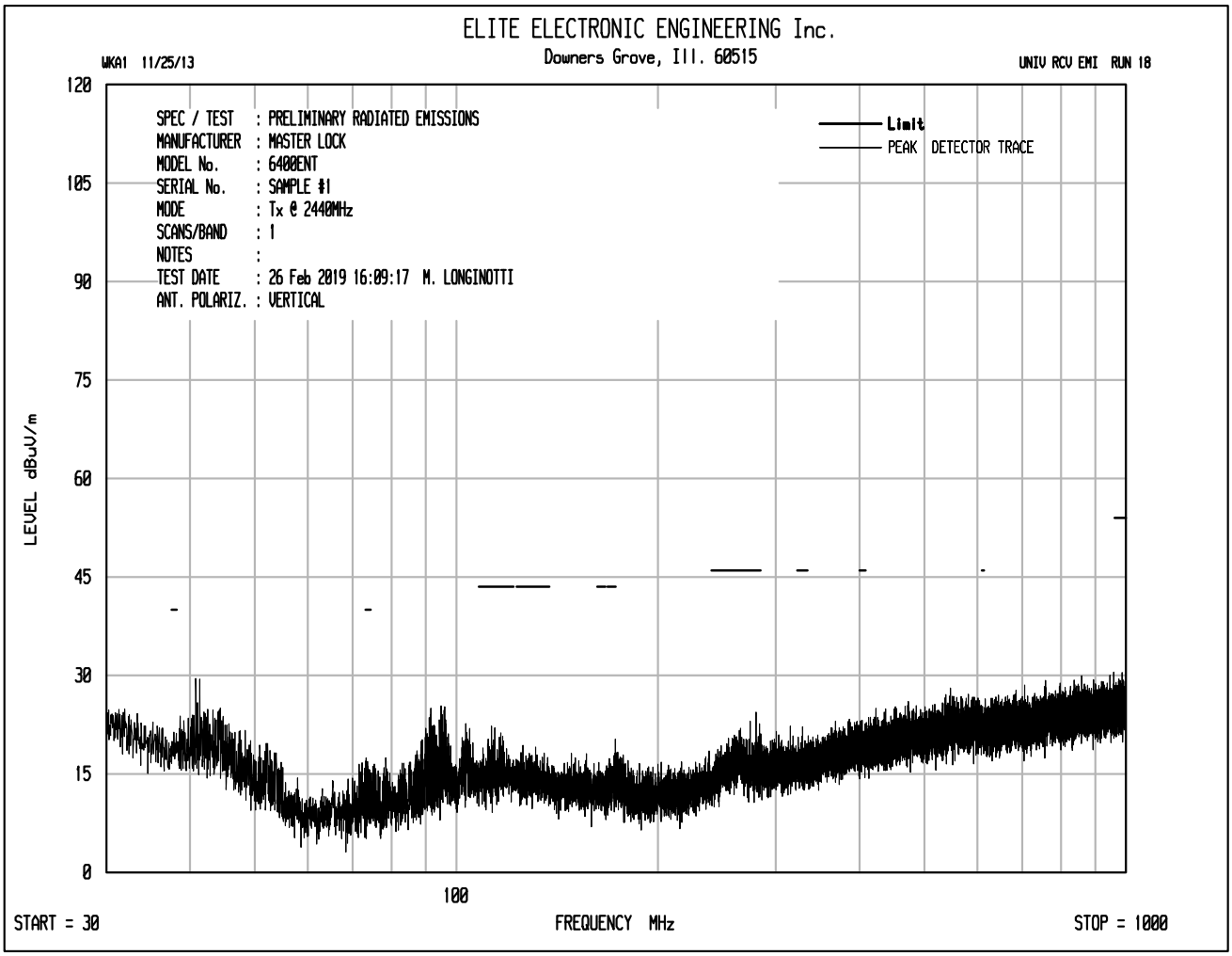
Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

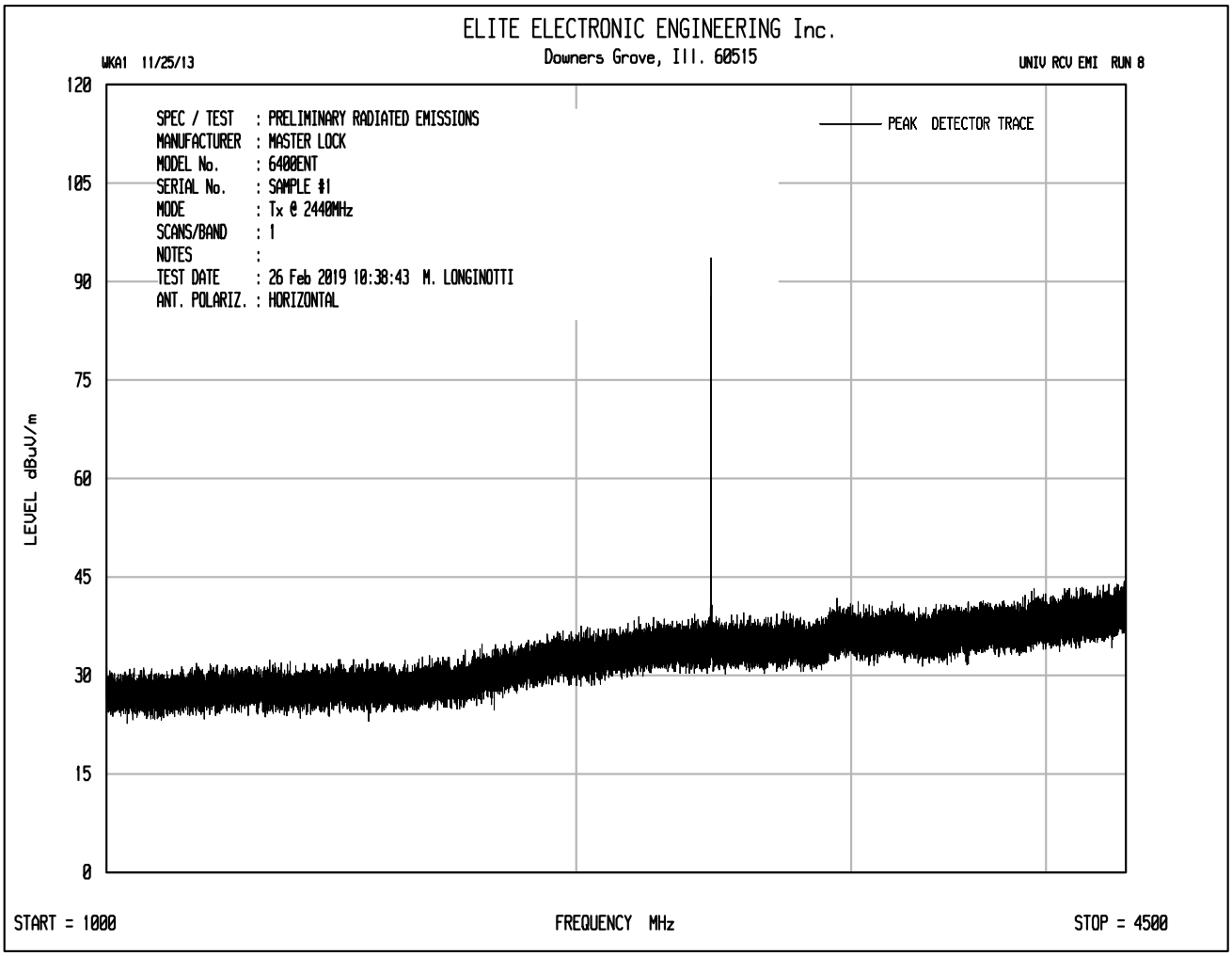
Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2402MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

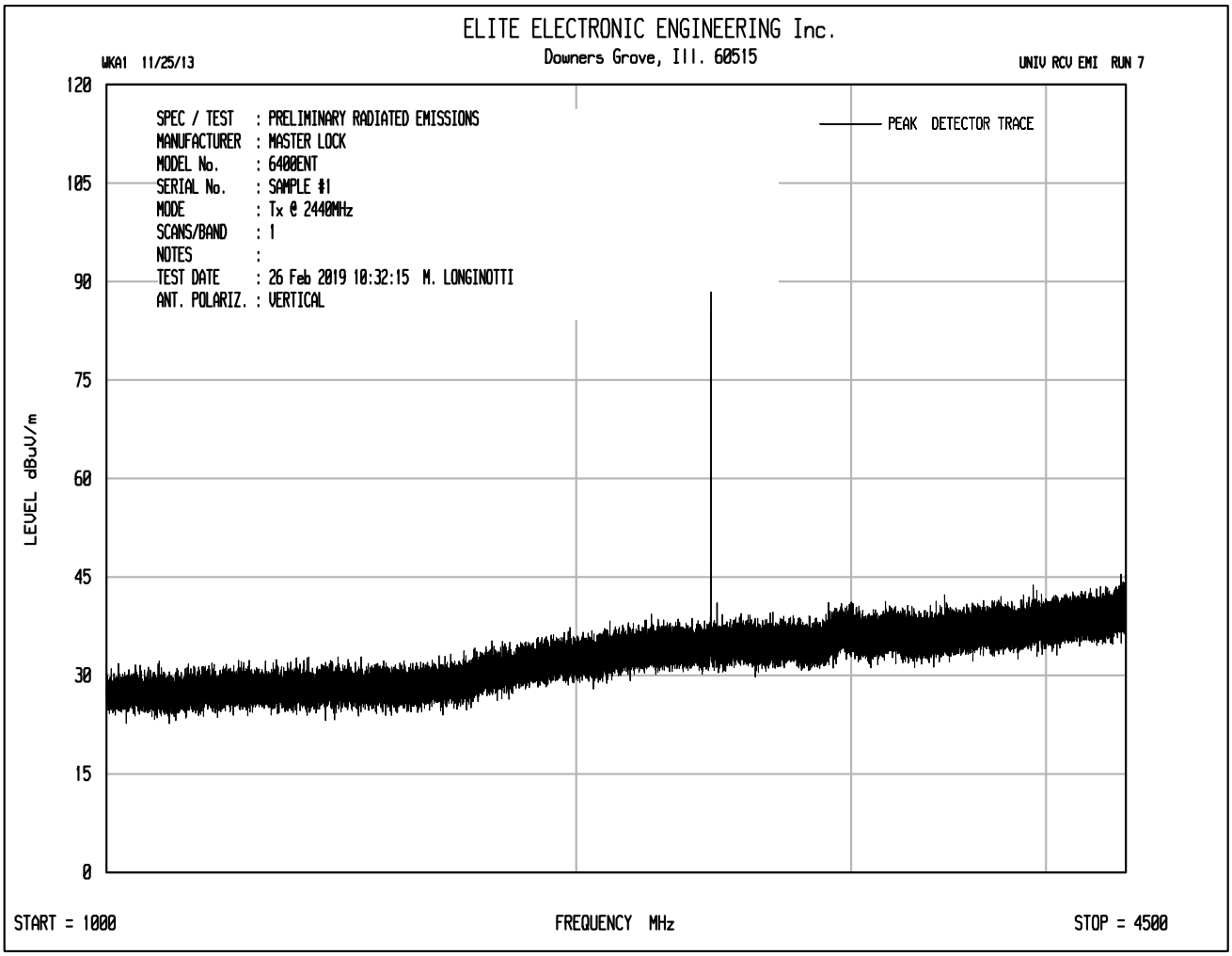
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2402.00	H	59.3		3.4	33.6	0.0	96.4	65712.1		
2402.00	V	53.0		3.4	33.6	0.0	90.1	31816.0		
7206.00	H	42.0		6.1	38.1	-39.4	46.8	219.1	6571.2	-29.5
7206.00	V	42.2		6.1	38.1	-39.4	47.0	224.2	6571.2	-29.3
9608.00	H	37.4		6.8	39.2	-39.3	44.1	161.1	6571.2	-32.2
9608.00	V	36.9		6.8	39.2	-39.3	43.6	152.1	6571.2	-32.7
14412.00	H	37.1	Ambient	8.7	42.0	-38.3	49.5	299.6	6571.2	-26.8
14412.00	V	38.2	Ambient	8.7	42.0	-38.3	50.6	340.0	6571.2	-25.7
16814.00	H	38.0	Ambient	9.4	45.0	-37.5	55.0	560.0	6571.2	-21.4
16814.00	V	38.7	Ambient	9.4	45.0	-37.5	55.7	607.0	6571.2	-20.7
21618.00	H	24.4	Ambient	2.2	40.6	-28.9	38.3	82.4	6571.2	-38.0
21618.00	V	24.5	Ambient	2.2	40.6	-28.9	38.4	83.3	6571.2	-37.9
24020.00	H	24.7	Ambient	2.2	40.6	-30.2	37.3	73.7	6571.2	-39.0
24020.00	V	26.0	Ambient	2.2	40.6	-30.2	38.6	85.6	6571.2	-37.7

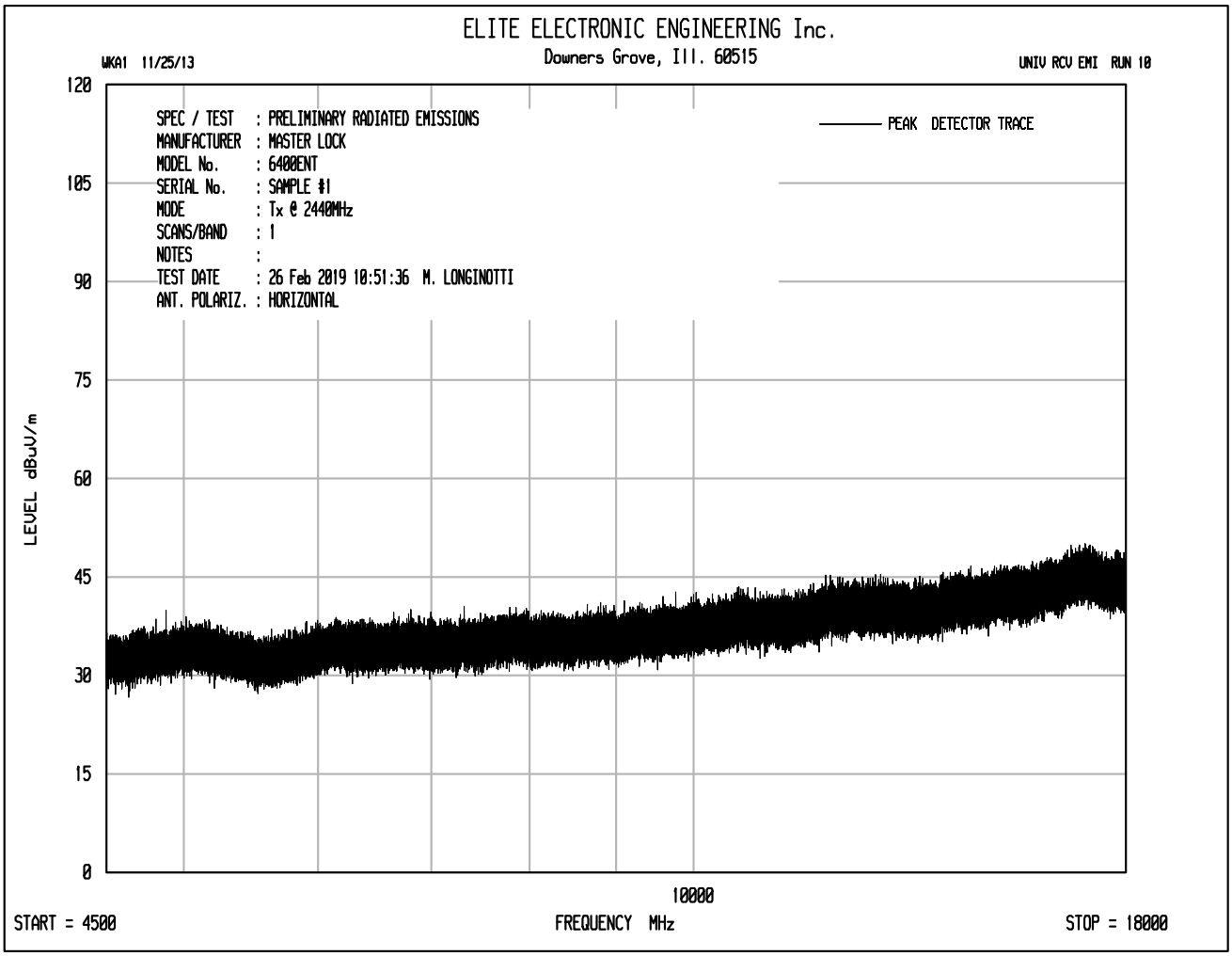
Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

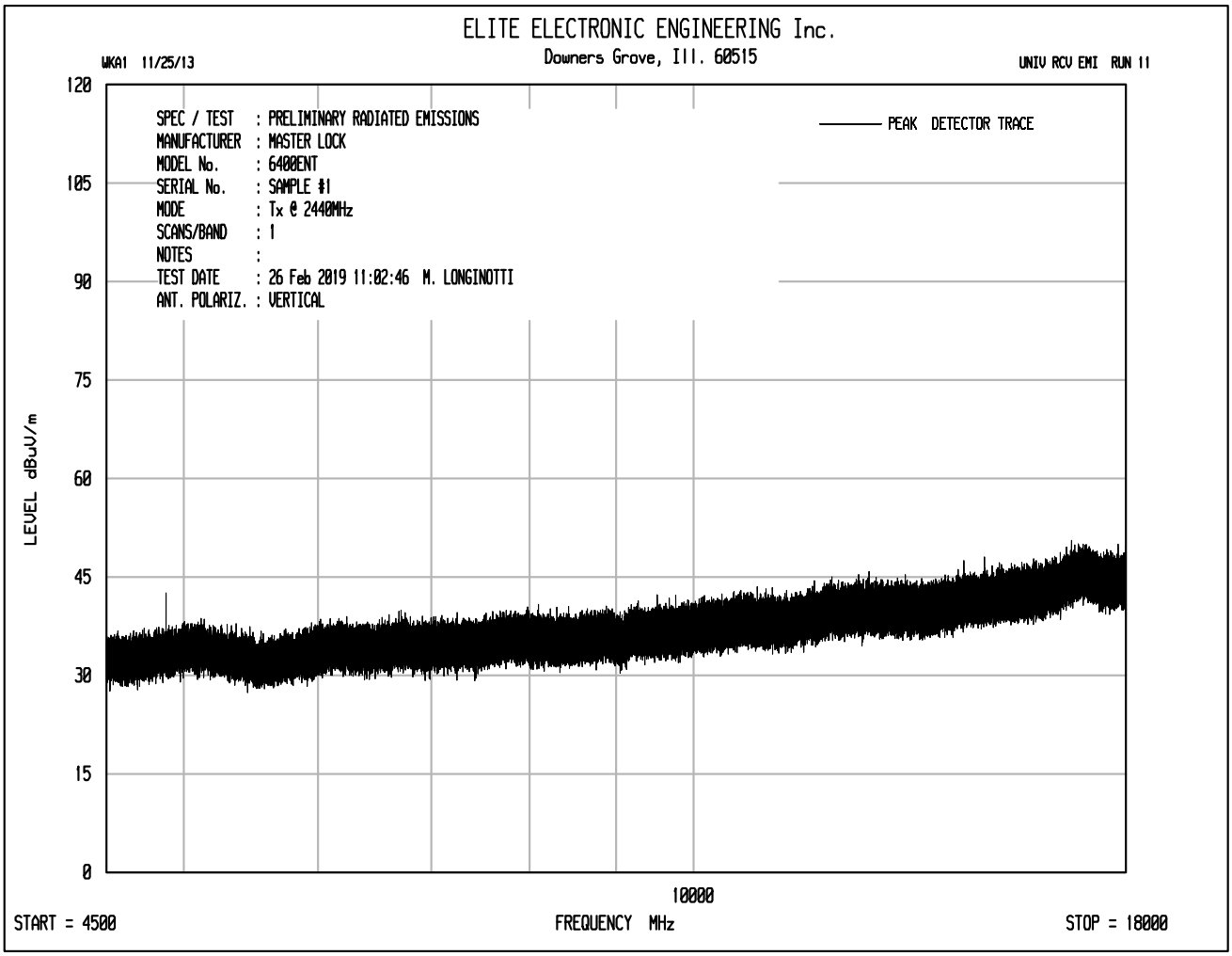

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 19
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:09:57 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

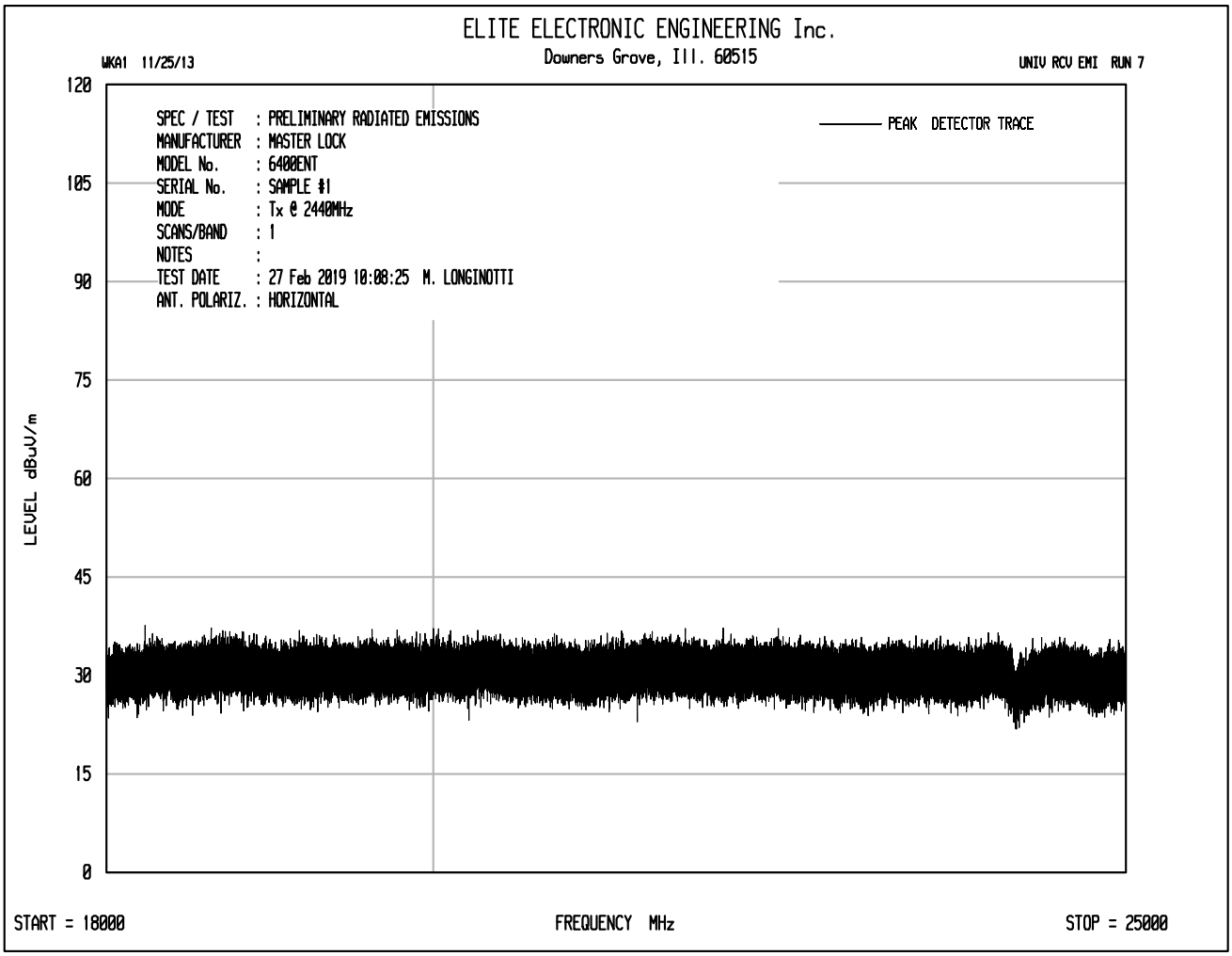

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 18
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:09:17 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

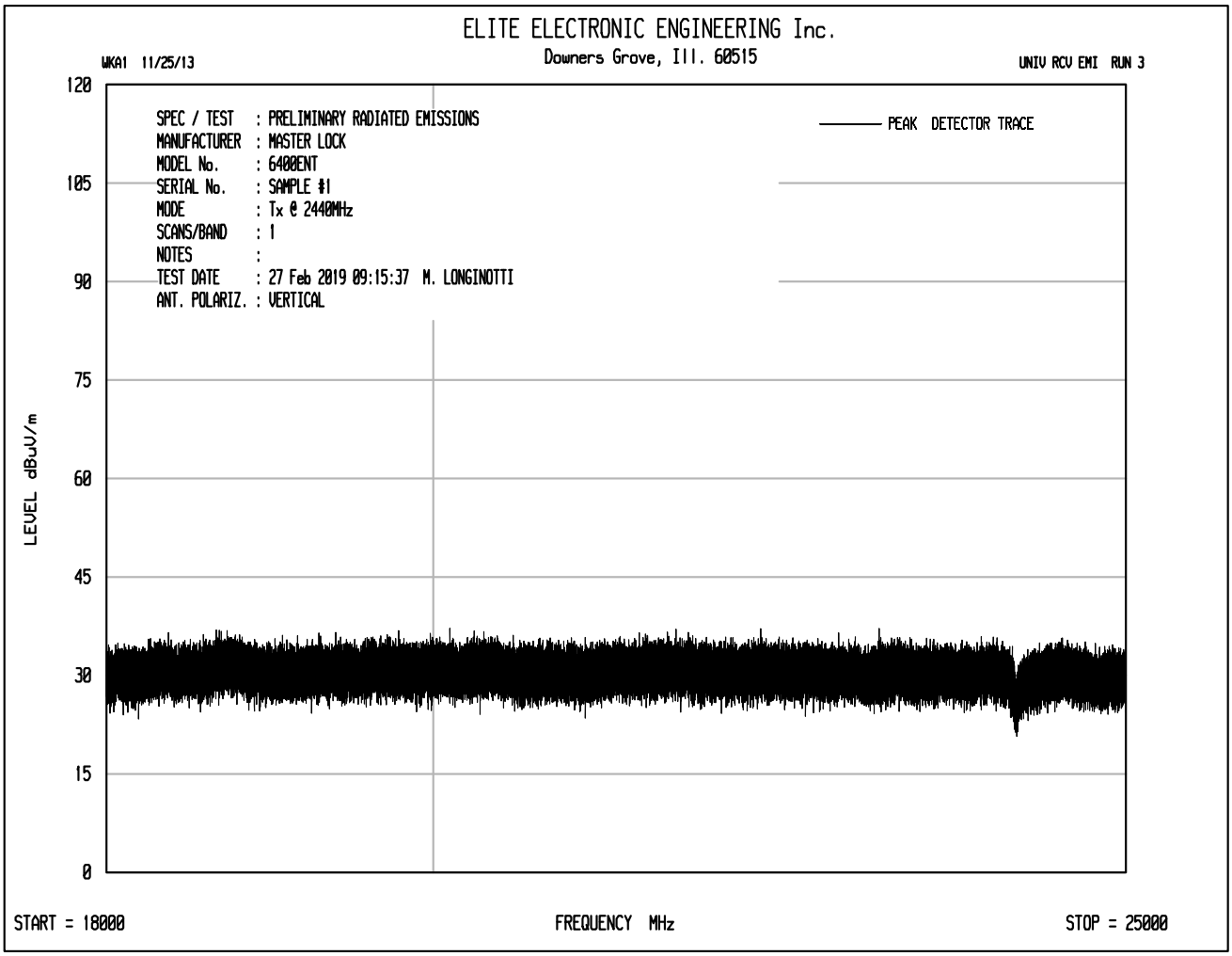

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 10:38:43 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 10:32:15 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 10:51:36 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 11:02:46 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 10:08:25 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2440MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 09:15:37 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2440MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
4880.00	H	50.3	Ambient	4.9	36.7	-39.3	52.5	421.8	5000.0	-21.5
4880.00	V	51.6	Ambient	4.9	36.7	-39.3	53.8	489.9	5000.0	-20.2
7320.00	H	50.6	Ambient	6.2	38.1	-39.4	55.5	593.4	5000.0	-18.5
7320.00	V	50.5	Ambient	6.2	38.1	-39.4	55.4	586.6	5000.0	-18.6
12200.00	H	48.5	Ambient	8.0	41.8	-39.1	59.2	912.7	5000.0	-14.8
12200.00	V	48.8	Ambient	8.0	41.8	-39.1	59.5	944.7	5000.0	-14.5
19520.00	H	34.4	Ambient	2.2	40.4	-28.7	48.3	259.2	5000.0	-25.7
19520.00	V	34.6	Ambient	2.2	40.4	-28.7	48.5	265.2	5000.0	-25.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2440MHz
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

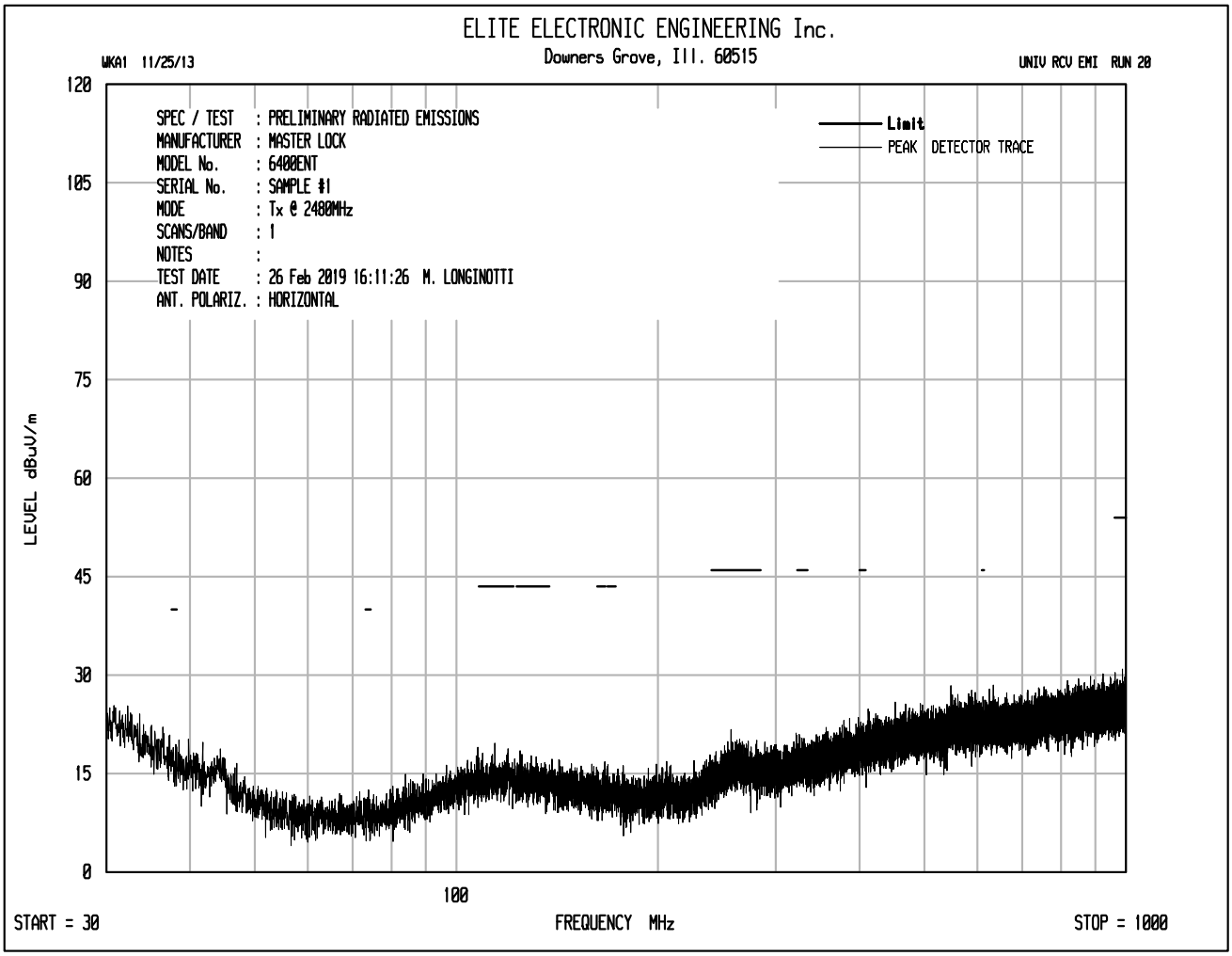
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4880.00	H	37.2	Ambient	4.9	36.7	-39.3	1.2	40.6	107.3	500.0	-13.4
4880.00	V	39.4	Ambient	4.9	36.7	-39.3	1.2	42.8	138.2	500.0	-11.2
7320.00	H	38.50	Ambient	6.2	38.1	-39.4	1.2	44.6	169.4	500.0	-9.4
7320.00	V	38.0	Ambient	6.2	38.1	-39.4	1.2	44.1	159.9	500.0	-9.9
12200.00	H	34.0	Ambient	8.0	41.8	-39.1	1.2	45.9	197.6	500.0	-8.1
12200.00	V	34.1	Ambient	8.0	41.8	-39.1	1.2	46.0	199.9	500.0	-8.0
19520.00	H	19.9	Ambient	2.2	40.4	-28.7	1.2	35.0	56.1	500.0	-19.0
19520.00	V	20.0	Ambient	2.2	40.4	-28.7	1.2	35.1	56.8	500.0	-18.9

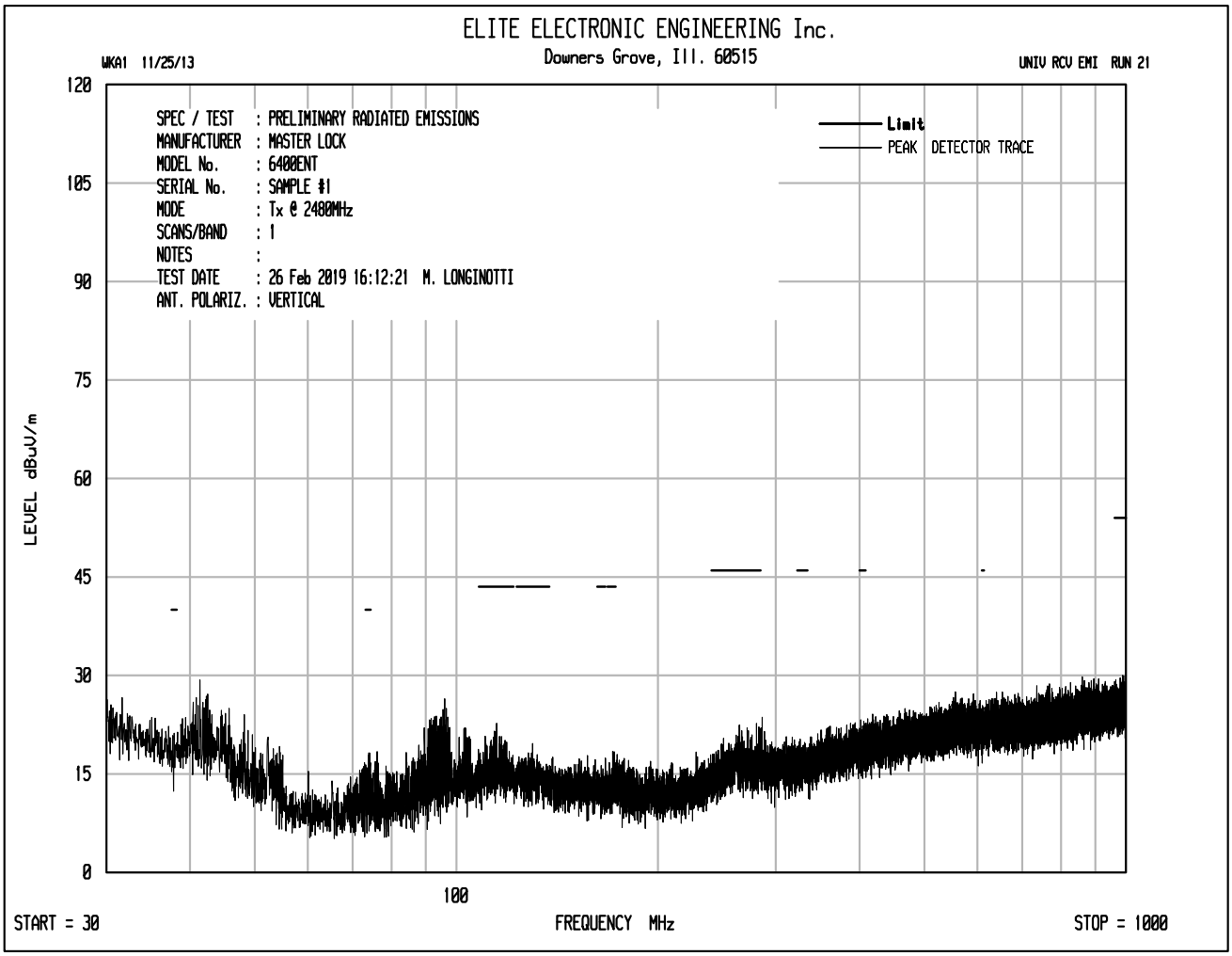
Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

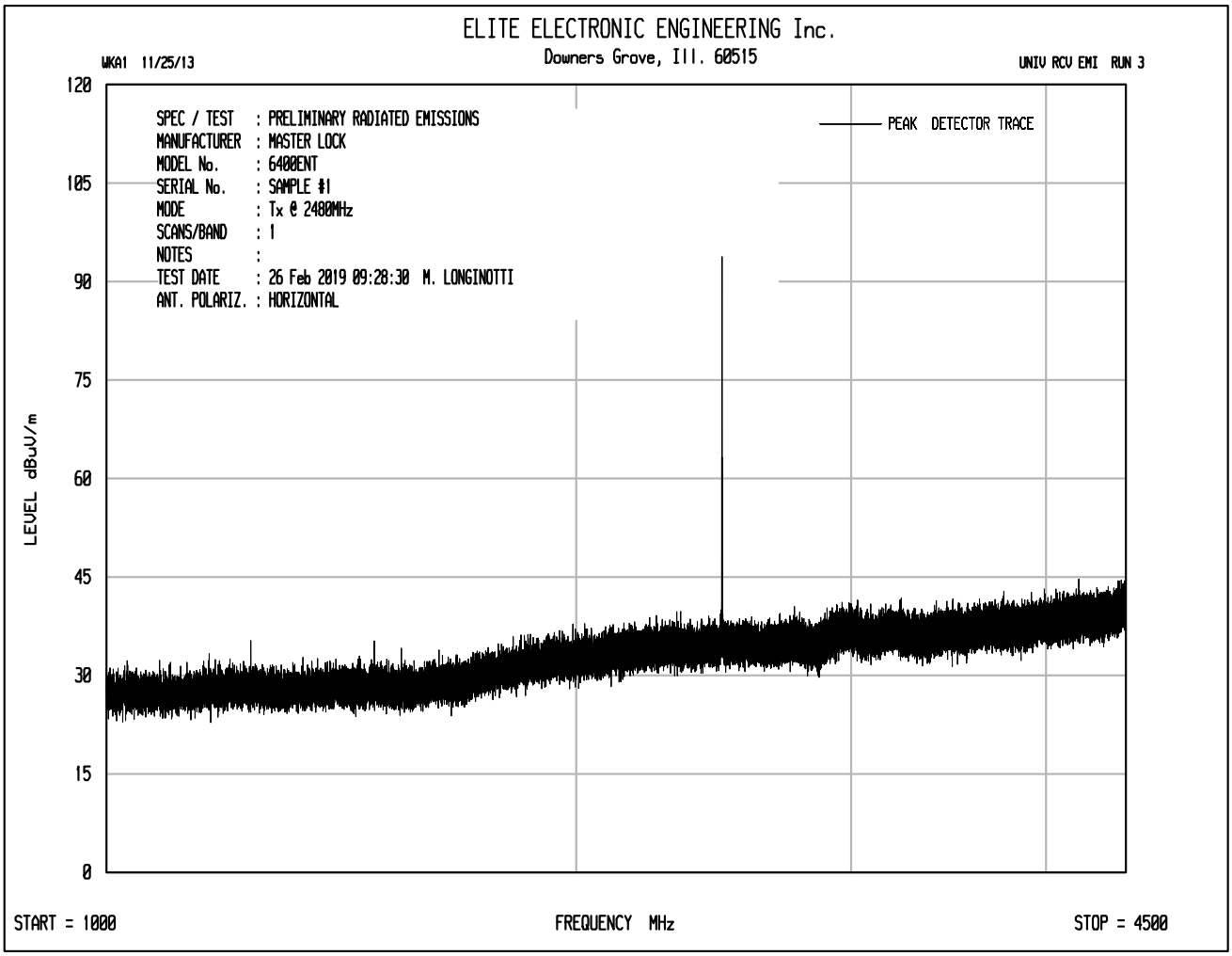
Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2440MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

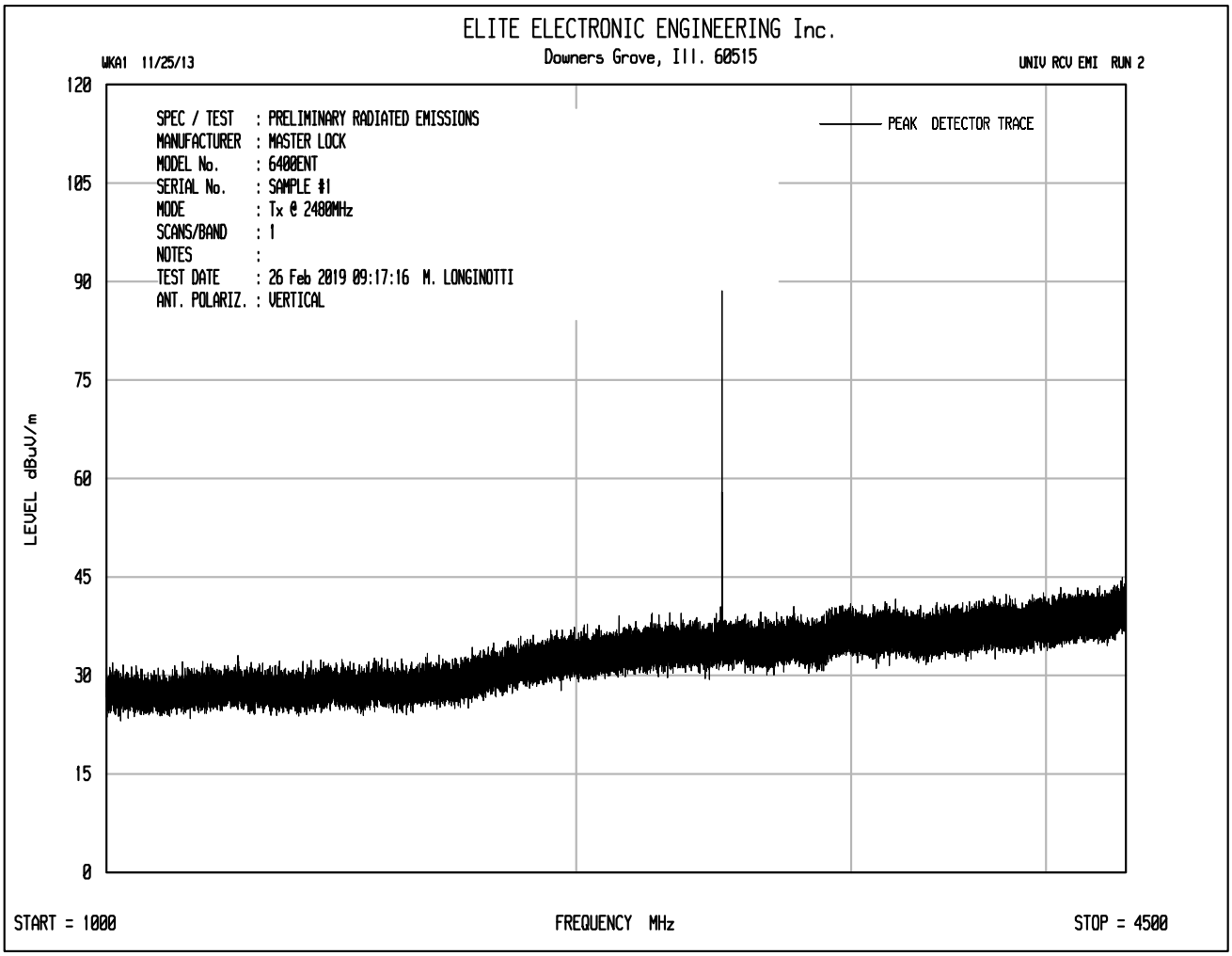
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2440.00	H	58.6		3.5	33.6	0.0	95.6	60507.1		
2440.00	V	53.4		3.5	33.6	0.0	90.4	33251.1		
9760.00	H	42.4		6.9	39.4	-39.3	49.4	295.8	6050.7	-26.2
9760.00	V	42.3		6.9	39.4	-39.3	49.3	292.4	6050.7	-26.3
14640.00	H	37.8	Ambient	8.8	42.4	-38.2	50.8	346.2	6050.7	-24.8
14640.00	V	37.1	Ambient	8.8	42.4	-38.2	50.1	319.4	6050.7	-25.5
17080.00	H	37.2	Ambient	9.5	45.0	-37.6	54.2	513.2	6050.7	-21.4
17080.00	V	38.6	Ambient	9.5	45.0	-37.6	55.6	602.9	6050.7	-20.0
21960.00	H	25.2	Ambient	2.2	40.6	-29.4	38.6	85.0	6050.7	-37.0
21960.00	V	25.0	Ambient	2.2	40.6	-29.4	38.4	83.1	6050.7	-37.2
24400.00	H	24.7	Ambient	2.2	40.6	-30.4	37.1	71.7	6050.7	-38.5
24400.00	V	25.0	Ambient	2.2	40.6	-30.4	37.4	74.2	6050.7	-38.2

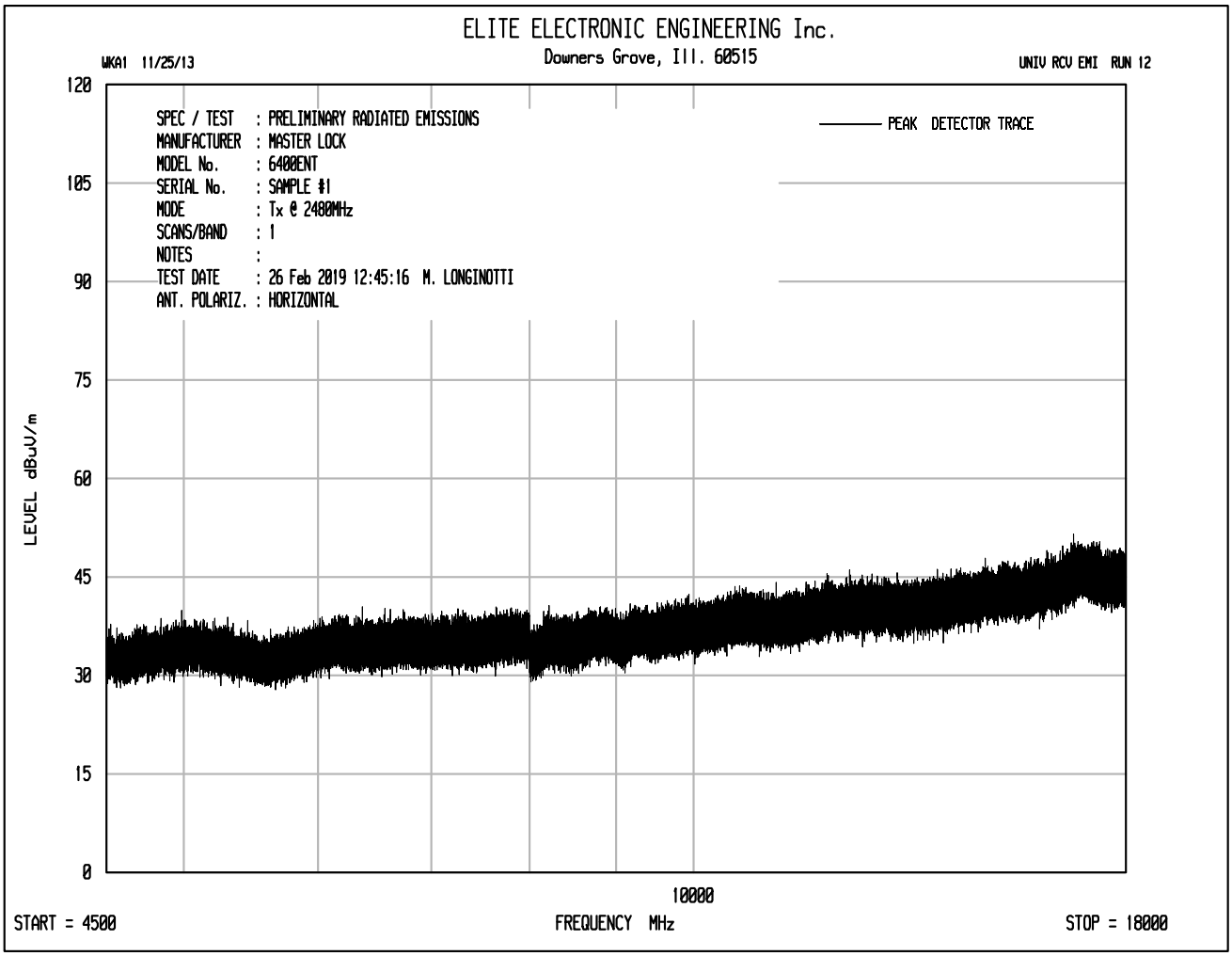
Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

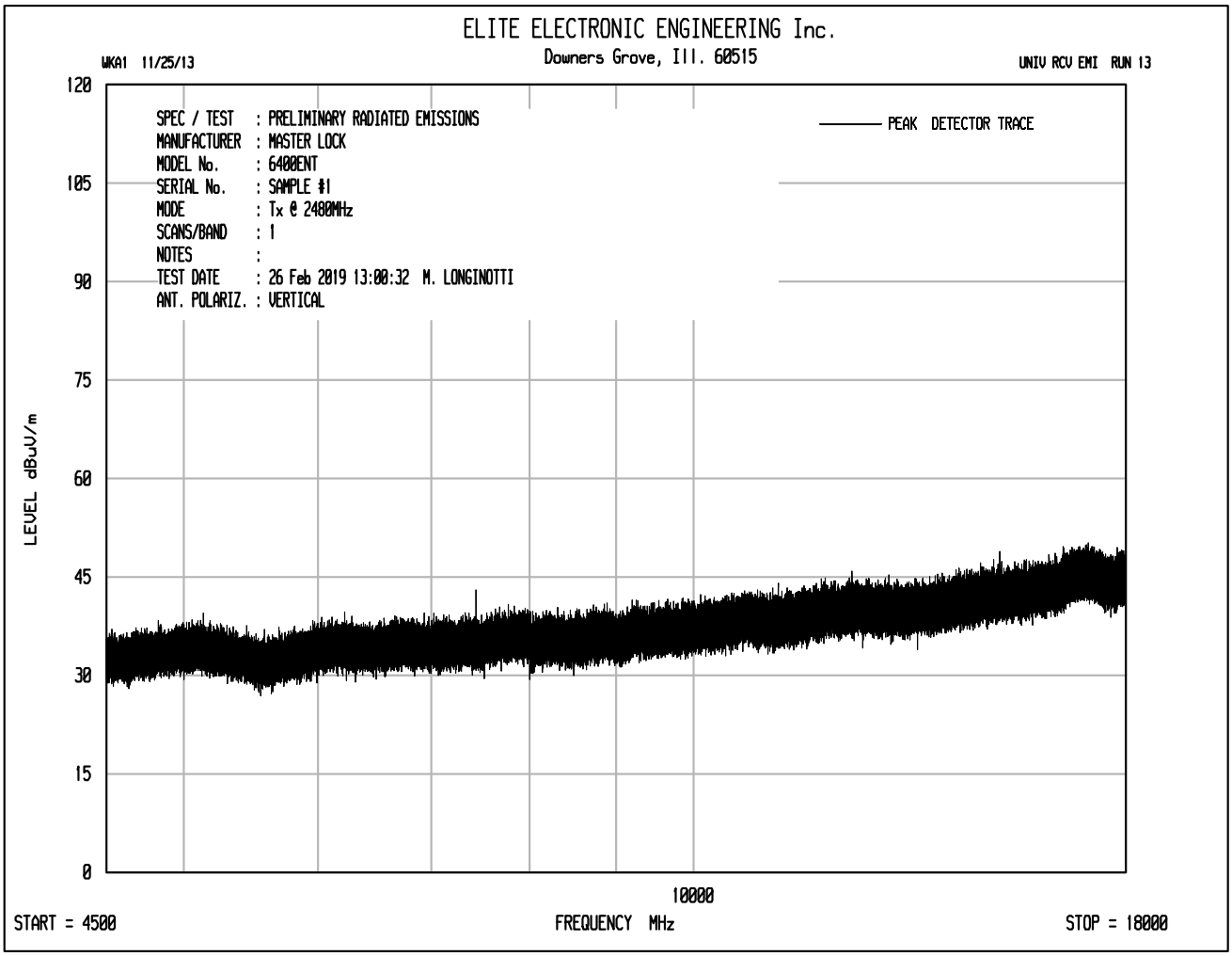

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 20
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:11:26 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

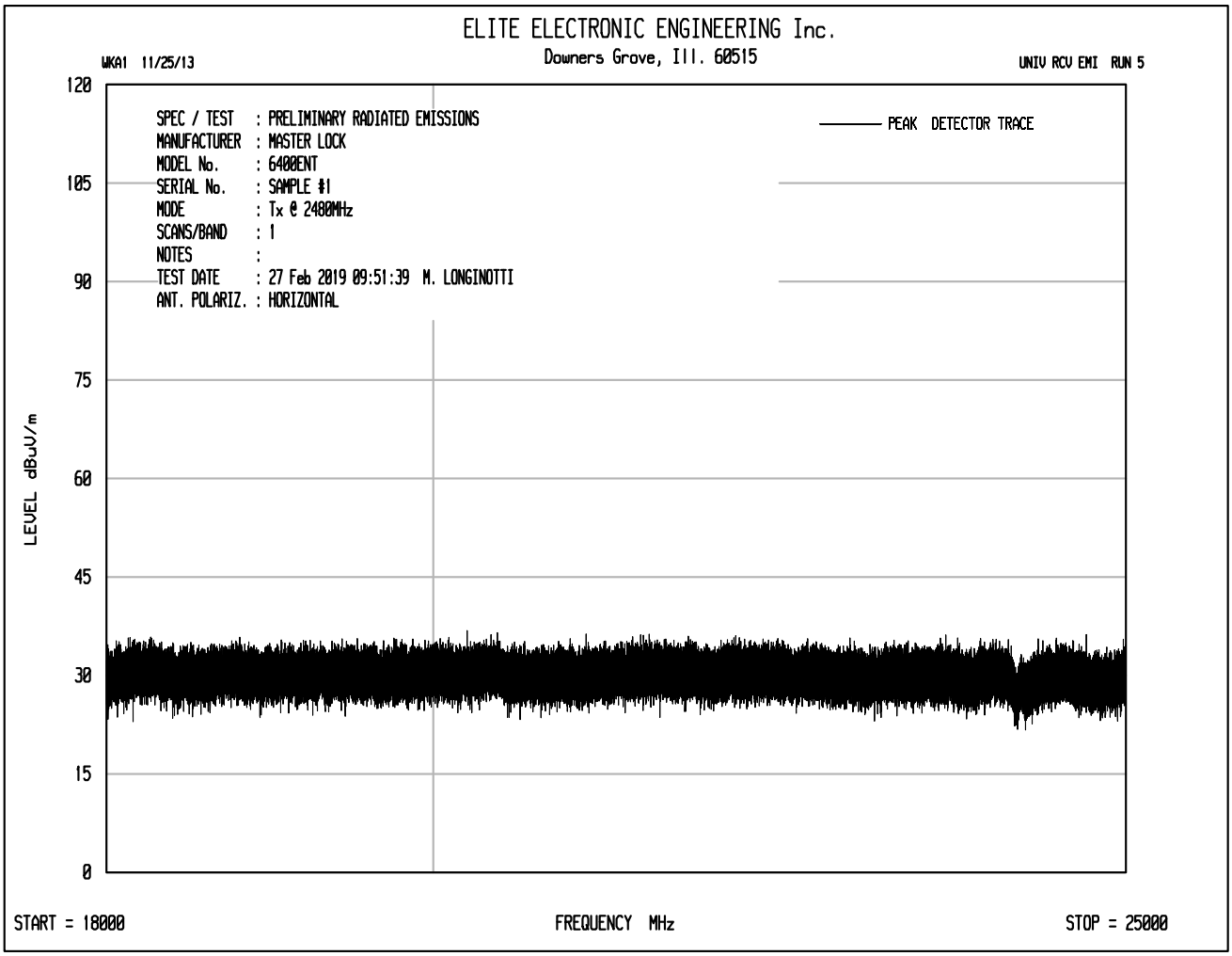

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 21
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 16:12:21 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

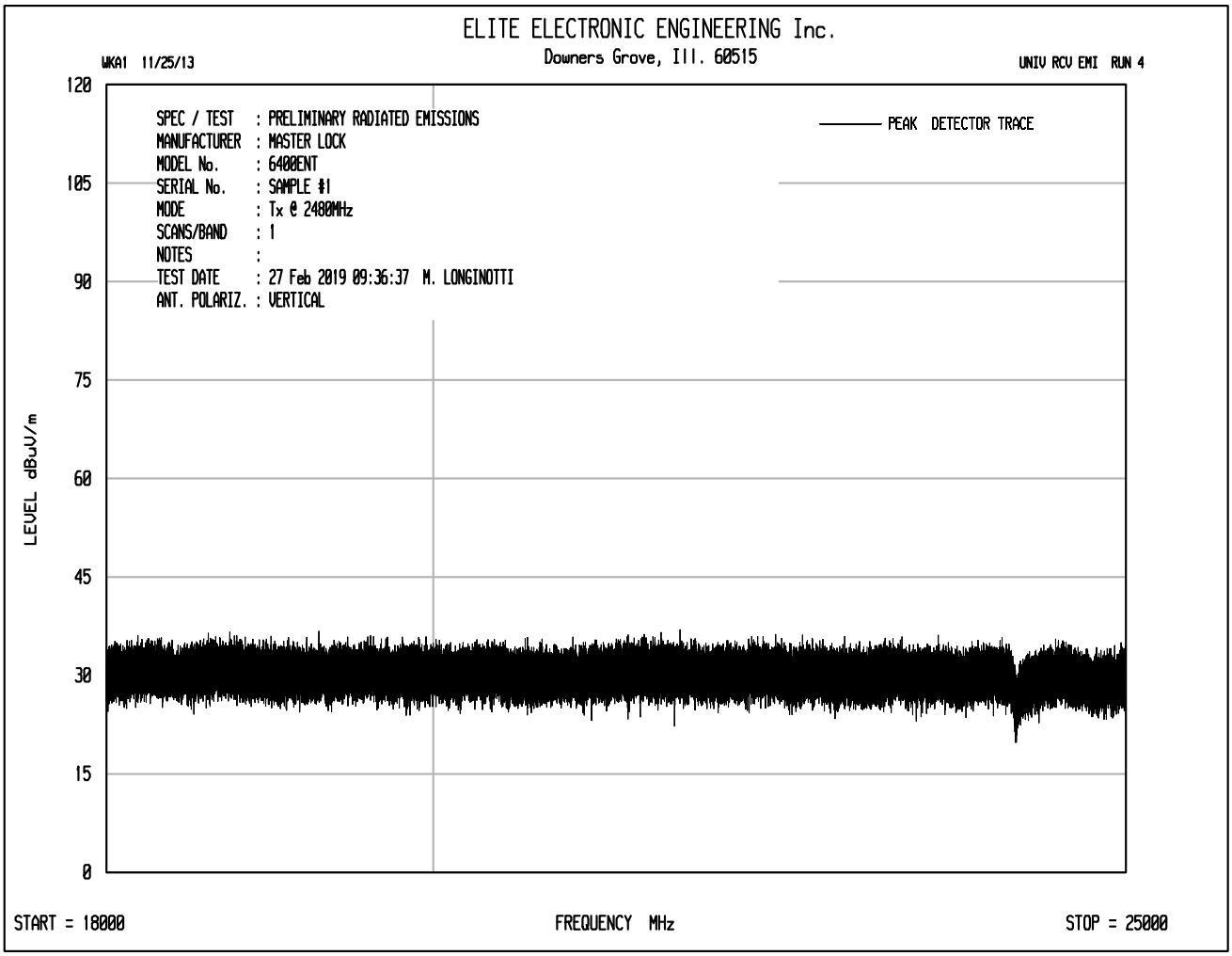

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 09:28:30 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 09:17:16 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 12
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 12:45:16 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 26 Feb 2019 13:00:32 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 09:51:39 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MASTER LOCK
MODEL No. : 6400ENT
SERIAL No. : SAMPLE #1
MODE : Tx @ 2480MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 27 Feb 2019 09:36:37 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
4960.00	H	51.6	Ambient	4.9	37.0	-39.3	54.1	508.2	5000.0	-19.9
4960.00	V	50.7	Ambient	4.9	37.0	-39.3	53.2	458.2	5000.0	-20.8
7440.00	H	51.8	Ambient	6.2	38.2	-39.4	56.8	689.0	5000.0	-17.2
7440.00	V	50.6	Ambient	6.2	38.2	-39.4	55.6	600.1	5000.0	-18.4
12400.00	H	48.6	Ambient	8.0	41.7	-39.0	59.3	925.1	5000.0	-14.7
12400.00	V	48.4	Ambient	8.0	41.7	-39.0	59.1	904.0	5000.0	-14.9
19840.00	H	33.6	Ambient	2.2	40.4	-28.4	47.8	246.7	5000.0	-26.1
19840.00	V	34.2	Ambient	2.2	40.4	-28.4	48.4	264.3	5000.0	-25.5
22320.00	H	35.0	Ambient	2.2	40.6	-29.3	48.5	266.6	5000.0	-25.5
22320.00	V	35.0	Ambient	2.2	40.6	-29.3	48.5	266.6	5000.0	-25.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4960.00	H	36.5	Ambient	4.9	37.0	-39.3	1.2	40.2	102.8	500.0	-13.7
4960.00	V	37.6	Ambient	4.9	37.0	-39.3	1.2	41.3	116.7	500.0	-12.6
7440.00	H	40.40	Ambient	6.2	38.2	-39.4	1.2	46.6	213.4	500.0	-7.4
7440.00	V	38.1	Ambient	6.2	38.2	-39.4	1.2	44.3	163.8	500.0	-9.7
12400.00	H	34.0	Ambient	8.0	41.7	-39.0	1.2	45.9	198.2	500.0	-8.0
12400.00	V	33.7	Ambient	8.0	41.7	-39.0	1.2	45.6	191.5	500.0	-8.3
19840.00	H	19.6	Ambient	2.2	40.4	-28.4	1.2	35.1	56.6	500.0	-18.9
19840.00	V	19.6	Ambient	2.2	40.4	-28.4	1.2	35.1	56.6	500.0	-18.9
22320.00	H	20.8	Ambient	2.2	40.6	-29.3	1.2	35.5	59.8	500.0	-18.4
22320.00	V	20.7	Ambient	2.2	40.6	-29.3	1.2	35.4	59.1	500.0	-18.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : February 26, 2019 and February 27, 2019
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2480.00	H	58.7		3.5	33.6	0.0	95.8	61940.7		
2480.00	V	53.5		3.5	33.6	0.0	90.6	34038.9		
9920.00	H	42.2		7.0	39.6	-39.2	49.5	299.0	6194.1	-26.3
9920.00	V	41.9		7.0	39.6	-39.2	49.2	288.8	6194.1	-26.6
14880.00	H	38.2	Ambient	8.9	42.7	-38.2	51.7	385.2	6194.1	-24.1
14880.00	V	38.1	Ambient	8.9	42.7	-38.2	51.6	380.8	6194.1	-24.2
17360.00	H	38.6	Ambient	9.7	44.2	-37.7	54.7	546.0	6194.1	-21.1
17360.00	V	38.2	Ambient	9.7	44.2	-37.7	54.3	521.5	6194.1	-21.5
24800.00	H	25.6	Ambient	2.2	40.6	-31.2	37.3	73.1	6194.1	-38.6
24800.00	V	24.6	Ambient	2.2	40.6	-31.2	36.3	65.1	6194.1	-39.6

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

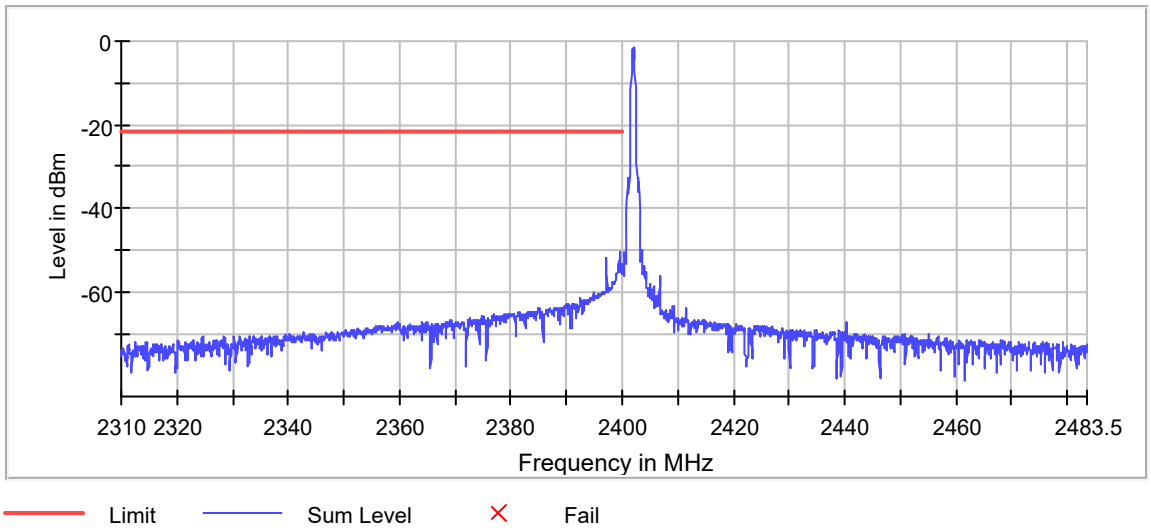
Manufacturer : Master Lock Company
Test Item : BLE Relay
Product No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Low Band Edge
Date : February 27, 2019

Inband Peak

Frequency (MHz)	Level (dBm)
2401.975	-1.5

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.525000	-50.6	29.1	-21.5	PASS
2399.575000	-51.3	29.8	-21.5	PASS
2399.475000	-51.6	30.1	-21.5	PASS
2397.175000	-52.1	30.6	-21.5	PASS
2397.225000	-52.6	31.1	-21.5	PASS
2399.625000	-52.7	31.2	-21.5	PASS
2399.425000	-53.2	31.7	-21.5	PASS
2399.975000	-53.4	31.9	-21.5	PASS
2397.125000	-53.5	32.0	-21.5	PASS
2399.925000	-53.7	32.2	-21.5	PASS
2399.175000	-53.8	32.3	-21.5	PASS
2399.225000	-53.8	32.3	-21.5	PASS
2399.775000	-54.1	32.5	-21.5	PASS
2399.825000	-54.2	32.7	-21.5	PASS
2399.325000	-54.4	32.9	-21.5	PASS



Manufacturer : Master Lock Company
Test Item : BLE Relay
Model No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions at High Band Edge
Date : February 26, 2019
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2483.50	H	22.8		3.5	33.6	0.0	60.0	994.5	5000.0	-14.0
2483.50	V	18.5		3.5	33.6	0.0	55.7	606.2	5000.0	-18.3

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

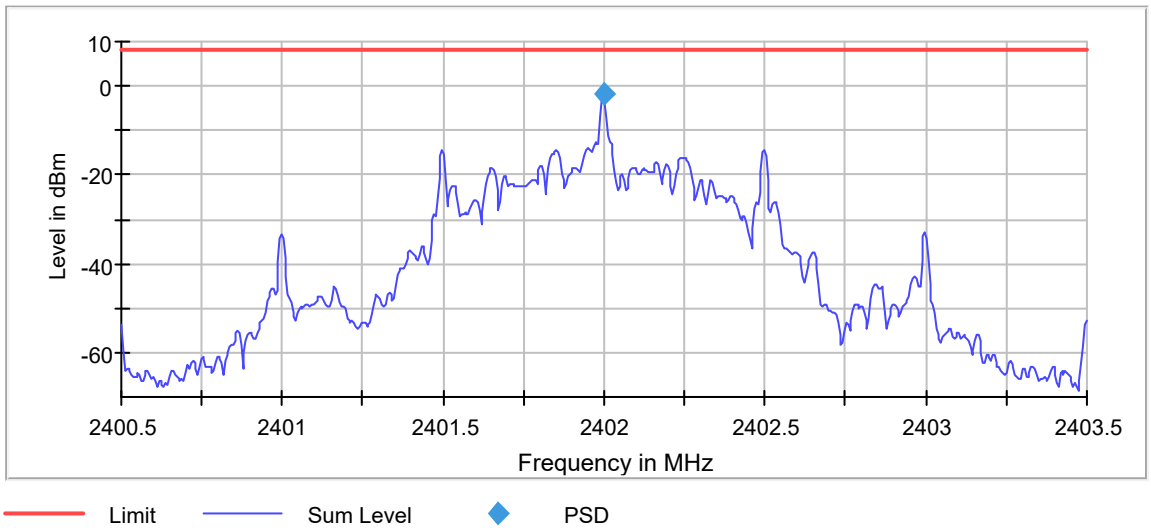
Manufacturer : Master Lock Company
Test Item : BLE Relay
Model No. : 6440ENT
Serial No. : Sample #1
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions at High Band Edge
Date : February 26, 2019
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2483.50	H	2.7		3.5	33.6	0.0	1.2	41.1	113.1	500.0	-12.9
2483.50	V	1.7		3.5	33.6	0.0	1.2	40.1	100.8	500.0	-13.9

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

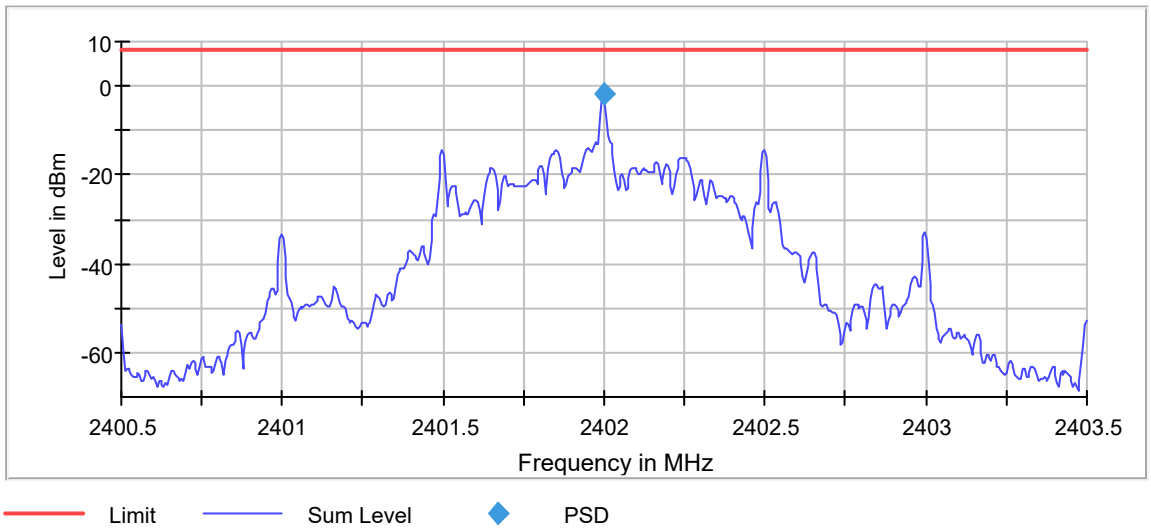
Manufacturer : Master Lock Company
Test Item : BLE Relay
Model No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2402MHz
Test Specification : FCC-15.247, RSS-247 Peak Power Spectral Density
Date : February 27, 2019

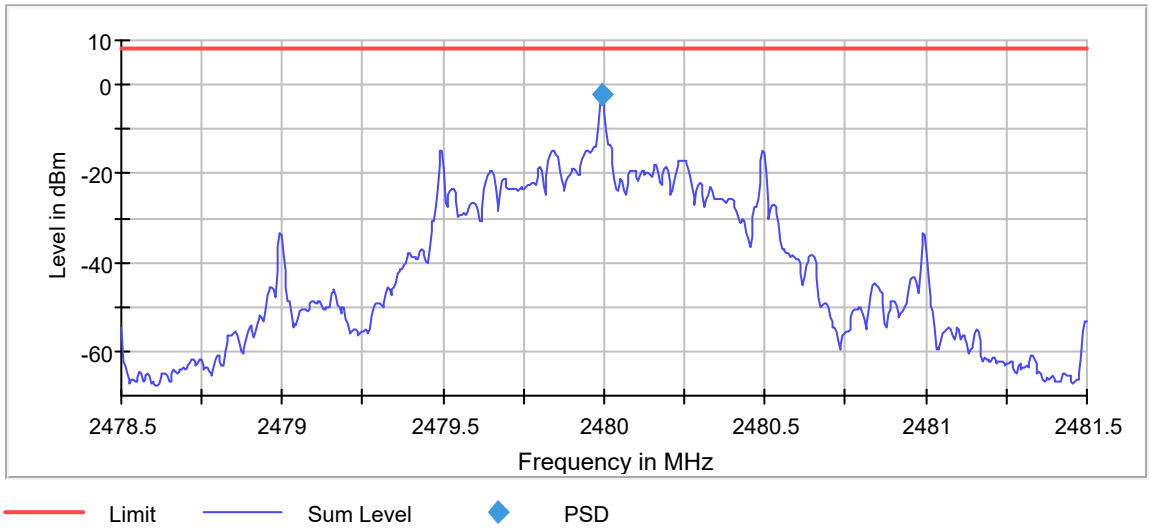
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	RBW (kHz)	Limit Max (dBm)	Result
2402.000000	2401.997500	-1.538	10	8.0	PASS



Manufacturer : Master Lock Company
Test Item : BLE Relay
Model No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2440MHz
Test Specification : FCC-15.247, RSS-247 Peak Power Spectral Density
Date : February 27, 2019

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	RBW (kHz)	Limit Max (dBm)	Result
2440.000000	2439.997500	-1.801	10	8.0	PASS



Manufacturer : Master Lock Company
Test Item : BLE Relay
Model No. : 6440ENT
Serial No. : Sample #2
Mode : Transmit at 2480MHz
Test Specification : FCC-15.247, RSS-247 Peak Power Spectral Density
Date : February 27, 2019

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	RBW (kHz)	Limit Max (dBm)	Result
2480.000000	2479.992500	-2.425	10	8.0	PASS