

Measurement of RF Emissions from a Bluetooth Temperature Monitor Model No. E2000 Transmitter

For Fleetwood Group Inc.

11832 James Street Holland, MI 49424

P.O. Number P69582

Date Tested August 21, 2018 Test Personnel Javier Cardenas

Test Specification FCC "Code of Federal Regulations" Title 47, Part 15,

Subpart C, Section 15.247 for Digital

Modulation Intentional Radiators Operating within

the bands 2400-2483.5MHz ISED Canada – RSS-GEN ISED Canada – RSS-247

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REVISION HISTORY

Revision	Date	Description
— 04 SEP 2018		Initial release



Measurement of RF Emissions from a Bluetooth Temperature Monitor, Model No. E2000 Transmitter

1. Introduction

1.1. Scope of Tests

This report represents the results of the series of radio interference measurements performed on a Fleetwood Group Inc. Bluetooth Temperature Monitor, Model No. E2000, Serial No. 1E10, transmitter (hereinafter referred to as the EUT). The EUT is a digital modulation transmitter. The transmitter was designed to transmit in the 2400-2483.5 MHz band using an integrated antenna. The EUT was manufactured and submitted for testing by Fleetwood Group Inc. located in Holland, MI.

1.2. Purpose

The test series was performed to determine if the EUT meets the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators. The test series was also performed to determine if the EUT meets the radiated RF emission requirements of the ISED Canada Radio Standards Specification, RSS-247. Testing was performed in accordance with ANSI C63.4-2014.

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 Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 22°C and the relative humidity was 30%.

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 2018
- 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"
- Federal Communications Commission Office of Engineering and Technology Laboratory Division Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247, October 4, 2012
- ISED Canada Radio Standards Specification, RSS-Gen, "General Requirements and Information for the Certification of Radiocommunication Equipment", Issue 5, June 2018
- ISED Canada Radio Standards Specification, RSS-247, "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices", Issue 2, June 2017



3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Fleetwood Group Inc., Bluetooth Temperature Monitor, Model No. E2000. A block diagram of the EUT setup is shown as Figure 1.

3.1.1.Power Input

The EUT was powered by an internal 3 VDC coin cell battery.

3.1.2. Grounding

The EUT was ungrounded during the tests.

3.2. Operational Mode

For all tests, the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. The unit was programmed to operate in one of the following modes:

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

3.3. EUT Modifications

No modifications were required for compliance to the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators and the ISED Canada Specification, RSS-247.

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.

Radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified in the requirement.

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 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.

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

Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test	4.3



site) (30 MHz – 1000 MHz)	
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. Powerline Conducted Emissions

5.1.1.Requirements

Since the EUT was powered by internal batteries with no connections for AC power, no conducted emissions tests are required.

5.2. 6dB Bandwidth

5.2.1.Requirement

Per 15.247(a)(2), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

5.2.2.Procedures

The output of the EUT was connected to the spectrum analyzer through 10dB of attenuation.

The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 100kHz and the span was set to greater than the RBW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

5.2.3.Results

The plots on pages 20 through 22 show that the minimum 6 dB bandwidth was 930.694kHz which is greater than minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 2MHz.

5.3. EIRP

5.3.1.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).

5.3.2.Procedures

The EUT was placed on a 1.5 meter high 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 second 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 power output was calculated for low, middle, and high frequencies.

5.3.3.Results

The results are presented on pages 26 through 28. The maximum peak EIRP measured from the transmitter was -0.6 dBm or 0.87 mW which is below the 4 Watt limit.

5.4. Conducted Peak Output Power

5.4.1.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 Watts (36dBm).

5.4.2.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 1 port to the inputs of the ESW 44 EMI Test Receiver via a coaxial cable.
- c) The EUT was powered up and set to Transmit at 2402MHz, low channel.
- d) The following settings were employed on the EMI Test Receiver:

Center Frequency = Transmit frequency of the EUT Frequency Span = 3MHz **RBW** = 1MHz **VBW** = 3MHz Sweep Points = 101 Sweep Time = 4.210 usSweep Count = 100 **Detector Mode** = MaxPeak Trace Mode = Max Hold

- e) Find the maximum peak value of the trace.
- f) Steps (d) and (e) were repeated for the remaining modes listed in section 3.2.

5.4.3.Results

The results are presented on pages 29 and 31. The maximum peak conducted output power from the transmitter was 0.41 mW (-3.4 dBm) which is below the 1 Watt limit.

*NOTE – If the EUT uses an antenna with a gain greater than 6dBi, then the maximum peak conducted output power must be reduced by 1dB for every 1dB of gain above 6dBi the antenna has. Explain the reduced limit. (EXAMPLE: Since the EUT uses a 15dBi gain antenna, and the gain of the antenna exceeds the 6dBi gain antenna by 9dB, the output power must be reduced by 9dB (9dB = (15dBi-6dBi). Therefore the maximum peak conducted output power must not exceed 23dBm (0.2W)).

*NOTE – If the EUT uses an antenna with a gain greater than 6dBi and is used exclusively for fixed, point-to-point operations in the 2400 to 2483.5MHz band, then the maximum peak conducted output power must be reduced by 1dB for every 3dB of gain above 6dBi the antenna has. Explain the reduced limit. (EXAMPLE: Since the EUT uses a 15dBi gain antenna, and the gain of the antenna exceeds the 6dBi gain antenna by 9dB, the output power must be reduced by 3dB (3dB = (15dBi-6dBi/3). Therefore the maximum peak conducted output power must not exceed 27dBm (0.5W)).



*NOTE – If the EUT uses an antenna with a gain greater than 6dBi and is used exclusively for fixed, point-to-point operations in the 5725MHz to 5850MHz range, then the maximum peak conducted output power does NOT have to be reduced.

5.5. Radiated Spurious Emissions Measurements

5.5.1.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	Field Strenght	Measurement distance
MHz	(microvolts/meter)	(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

5.5.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. 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.

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 25.0GHz 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. The waveguide antenna was positioned at a 3 meter distance from the EUT. 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. 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) 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. 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. 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), 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 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. An average detector was used to measure the significant emissions above 1GHz. An average reading was taken.

If the emission is pulsed, the reading can be adjusted by a "duty cycle correction factor" derived from 20*log(on time/100msec). These readings must be no greater than the limits specified in 15.209(a).

5.5.3.Results

Preliminary radiated emissions plots with the EUT transmitting at Low Frequency, Middle Frequency, and High Frequency are shown on pages 32 through 55. Final radiated emissions data are presented on data pages 56 through 64. 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 Figures 3 through 6.



5.6. Band Edge Compliance

5.6.1.Requirement

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.

5.6.2 Procedures

5.6.3.Low Band Edge

- 1) The output of the EUT was connected to the spectrum analyzer through 10dB of attenuation.
- 2) The EUT was set to transmit continuously at the channel closest to the low band-edge.
- 3) To determine the band edge compliance, the following spectrum analyzer settings were used:
 - a. Center frequency = low band-edge frequency.
 - b. 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.
 - c. Resolution bandwidth (RBW) ≥ 1% of the span.
 - d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
 - e. 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.)
 - a. The analyzer's display was plotted using a 'screen dump' utility.

5.6.4. High Band Edge

- 1) The EUT was setup inside the test chamber on a non-conductive stand.
- 2) The EUT was set to transmit continuously at the channel closest to the high band-edge.
- 3) A double ridged waveguide was placed 3 meters away from the EUT. The antenna was connected to the input of a spectrum analyzer.
- 4) The center frequency of the analyzer was set to the high band edge (2483.5MHz)
- 5) The resolution bandwidth was set to 1MHz.
- 6) 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.
- 7) The highest measured peak reading was recorded.
- 8) The highest measured average reading was recorded.

5.6.5.Results

Page 65 shows the low band-edge antenna port conducted emissions compliance results. Page 66 shows the radiated high band-edge compliance results. As can be seen from these plots, the 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



5.7. Power Spectral Density

5.7.1.Requirements

Per section 15.247(d), 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.

5.7.2.Procedures

- 1) The output of the EUT was connected to the spectrum analyzer through 10dB of attenuation.
- 2) The EUT was set to transmit at a mid channel.
- 3) To determine the power spectral density, the following spectrum analyzer settings were used:
 - a. Center frequency = transmit frequency
 - b. Resolution bandwidth (RBW) greater than the 20dB bandwidth.
 - c. Sweep time = auto
 - d. The peak detector and 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
 - e. The analyzer's display was plotted using a 'screen dump' utility.
- 4) This reading corresponds to the peak EIRP measured for the mid channel.
- 5) Turn on Display Line 1 and place it at the peak of the measured level. Turn on Display Line 2 and place it at the corresponding +8dBm level (e.g. if the peak output power is +18dBm then the +8dBm level will be 10dB down from the radiated level and if the peak output power is +6dBm then the +8dBm level will be 2dB above the radiated level.)
- 6) The EUT was then placed in the normal operation mode
- 7) To determine the power spectral density, the following spectrum analyzer settings were used:
 - a. Center frequency = transmit frequency
 - b. Span =1.5times the channel bandwidth
 - c. Resolution bandwidth (RBW) ≥3kHz
 - d. Video bandwidth (VBW) ≥ 3 x RBW
 - e. Sweep time = auto couple
 - f. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The peak detector and 'Max-Hold' function was engaged.
 - g. The analyzer's display was plotted using a 'screen dump' utility.
 - h. If the measured value exceeds the +8dBm limit, reduce the RBW (no less than 3kHz) and repeat step 7.

5.7.3.Results

Pages 67 through 69 show the power spectral density results. As can be seen from the plots, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated. The test series was witnessed by Fleetwood Group Inc. personnel.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Fleetwood Group Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that the Fleetwood Group Inc. Bluetooth Temperature Monitor, Model No. E2000, digital modulation transmitter, Serial No. 1E10, did fully meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band, when tested per ANSI C63.4-2014.



It was also determined that the Fleetwood Group Inc. Bluetooth Temperature Monitor, Model No. E2000, digital modulation transmitter, Serial No. 1E10, did fully meet the radiated RF emission requirements of the ISED Canada Radio Standards Specification, RSS-247 when tested per ANSI C63.4-2014.

8. 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 as operated by Fleetwood Group Inc. personnel. 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.

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

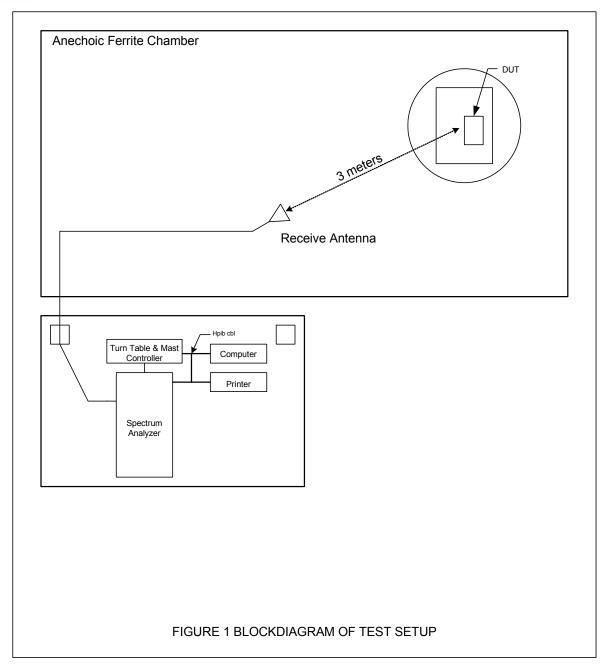
Table 9-1 Equipment List

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	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	4/5/2018	4/5/2019
CDY0	WORKSTATION	ELITE	WORKSTATION	n/a	WINDOWS 7	n/a	n/a
GRE1	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	2/13/2018	2/13/2019
GSFB	OSP120 BASE UNIT	ROHDE & SCHWARZ	OSP120	101246	n/a	10/10/2017	10/10/2018
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	n/a	18-26.5GHZ	n/a	n/a
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2057	0.03-2GHZ	11/9/2017	11/9/2018
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/10/2018	4/10/2020
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/22/2018	3/22/2020
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	12/7/2017	12/7/2018
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW45	101592	2HZ-44GHZ	2/20/2018	2/20/2019
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	1	n/a	n/a	n/a
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	n/a	n/a	n/a
XPR0	HIGH PASS FILER	K&L MICROWAVE	11SH10-4800/X20000	1	4.8-20GHZ	9/12/2017	9/12/2019

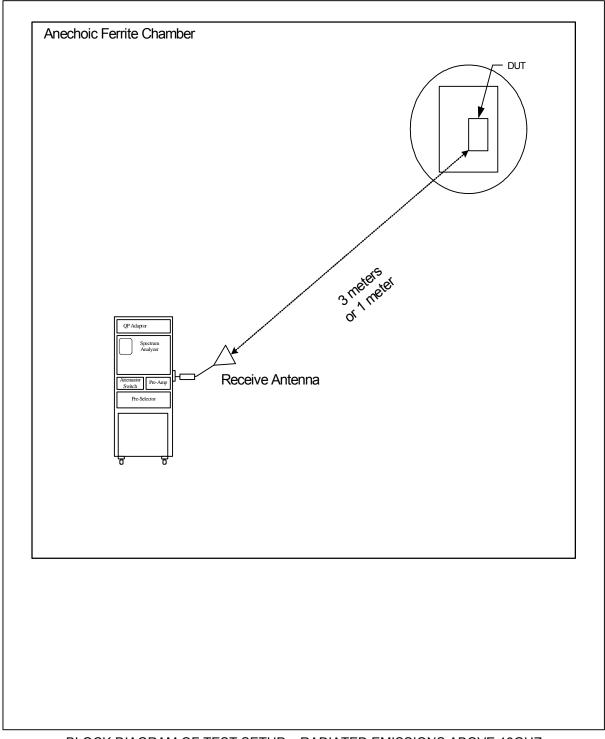
I/O: Initial Only N/A: Not Applicable

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.









BLOCK DIAGRAM OF TEST SETUP - RADIATED EMISSIONS ABOVE 18GHZ





Figure 2 – Photograph of EUT





Figure 3 – Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization



Figure 4 – Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization



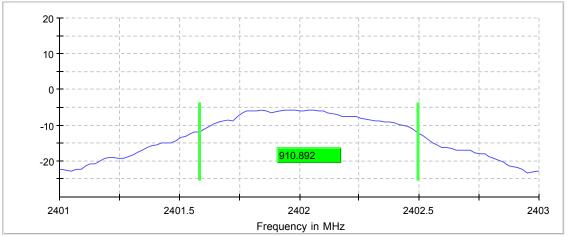


Figure 5 – Test Setup for Radiated Emissions, 1GHz to 25GHz – Horizontal Polarization



Figure 6 – Test Setup for Radiated Emissions, 1GHz to 25GHz – Vertical Polarization





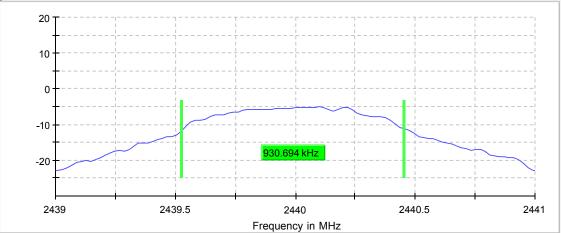
Model Number : E2000 Serial Number : 1E10

Test : **6dB Bandwidth** Mode : Tx 2402MHz

Parameters : 6dB Bandwidth = 910.892kHz

Date : August 22,2018





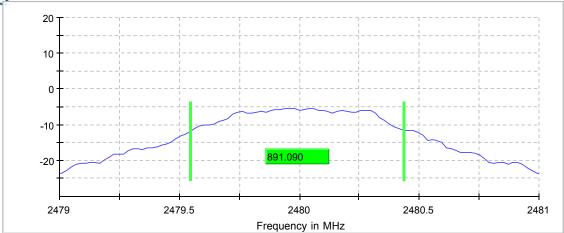
Model Number : E2000 Serial Number : 1E10

Test : **6dB Bandwidth** Mode : Tx 2440MHz

Parameters : 6dB Bandwidth = 930.694kHz

Date : August 22,2018





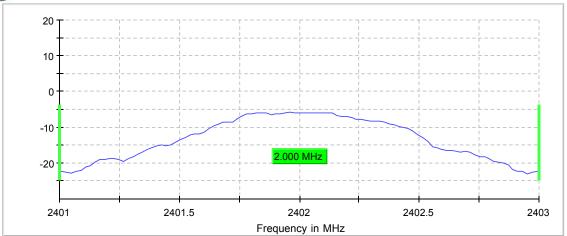
Model Number : E2000 Serial Number : 1E10

Test : **6dB Bandwidth** Mode : Tx 2480MHz

Parameters : 6dB Bandwidth = 891.090kHz

Date : August 22,2018





Model Number : E2000 Serial Number : 1E10

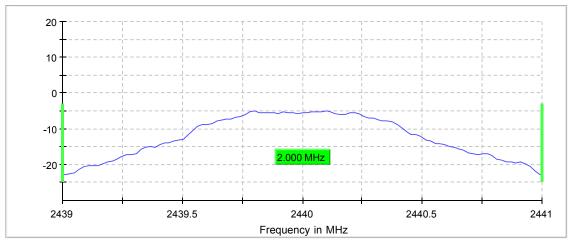
Test : 99% Bandwidth Mode : Tx 2402MHz

Parameters : 99% Bandwidth = 2MHz

: Max Level = -5.8dBm

Date : August 22,2018





Model Number : E2000 Serial Number : 1E10

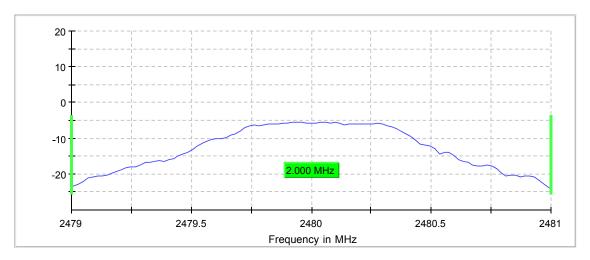
Test : 99% Bandwidth Mode : Tx 2440MHz

Parameters : 99% Bandwidth = 2MHz

: Max Level = -5.1dBm

Date : August 22,2018





Model Number : E2000 : 1E10 Serial Number

: 99% Bandwidth Test Mode : Tx 2480MHz

Parameters : 99% Bandwidth = 2MHz

: Max Level = -5.5dBm

: August 22,2018 Date

Notes



Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2402.00	Н	55.3	-6.1	5.8	2.7	-3.1	36.0	-39.1
2402.00	V	50.9	-9.7	5.8	2.7	-6.6	36.0	-42.6

Model Number : E2000
Serial Number : 1E10
Test : Peak EIRP
Mode : Tx 2402MHz

Parameters : Peak EIRP= -3.1dBm

: Max Level = 36.0dBm

Date : August 21,2018



Freq.	Ant	Wide BW Meter Reading	Matched Sig. Gen. Reading	Equivalent Antenna Gain	Cable Loss	EIRP	Limit	Margin
(MHz)	Pol	(dBuV)	(dBm)	(dB)	(dB)	(dBm)	(dBm)	(dB)
2440.00	Н	57.9	-3.6	5.9	2.8	-0.6	36.0	-36.6
2440.00	V	50.7	-10.9	5.9	2.8	-7.8	36.0	-43.8

Model Number : E2000 Serial Number : 1E10 Test : **Peak EIRP** Mode : Tx 2440MHz

Parameters : Peak EIRP= -0.6dBm

: Max Level = 36.0dBm

Date : August 21,2018



Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2480.00	Н	55.6	-6.2	5.9	2.8	-3.1	36.0	-39.1
2480.00	V	50.2	-11.0	5.9	2.8	-7.9	36.0	-43.9

Model Number : E2000 : 1E10 Serial Number : Peak EIRP Test

Mode : Tx 2480MHz Parameters

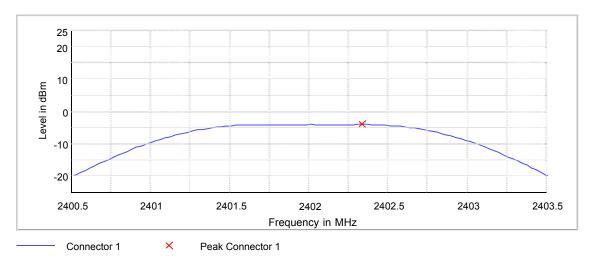
: Peak EIRP= -3.1dBm

: Max Level = 36.0dBm

Date : August 21,2018

Notes





Model Number : E2000 Serial Number : 1E10

Test : Peak Output Power

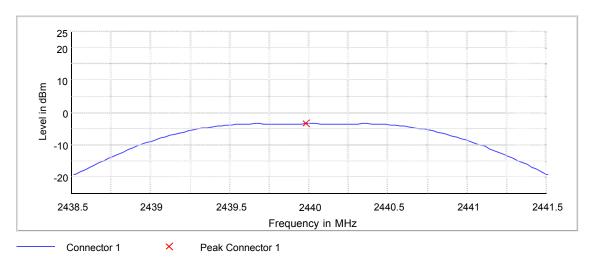
Mode : Tx 2402MHz

Parameters : Peak Output Power = -3.9dBm

: Max Level = 30.0dBm

Date : August 22,2018





Model Number : E2000 Serial Number : 1E10

Test : Peak Output Power

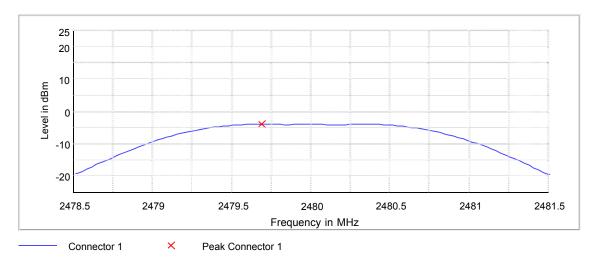
Mode : Tx 2440MHz

Parameters : Peak Output Power = -3.4dBm

: Max Level = 30.0dBm

Date : August 22,2018





Model Number : E2000 Serial Number : 1E10

Test : Peak Output Power

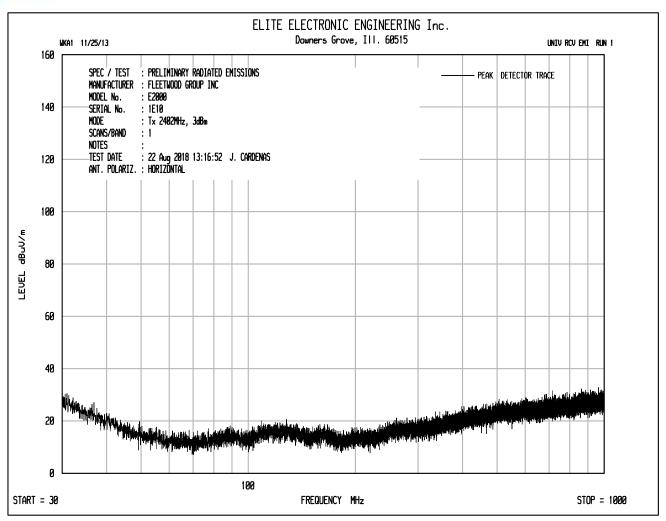
Mode : Tx 2480MHz

Parameters : Peak Output Power = -3.8dBm

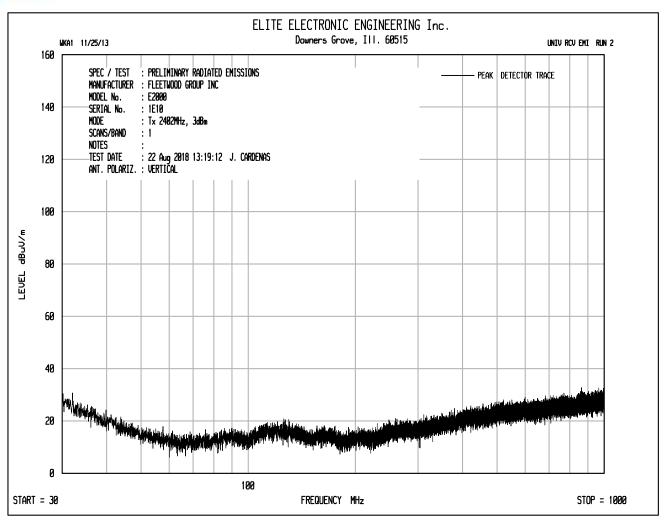
: Max Level = 30.0dBm

Date : August 22,2018

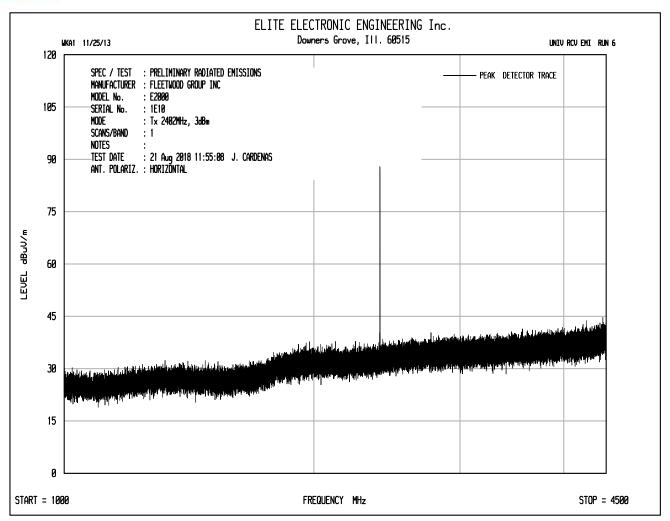




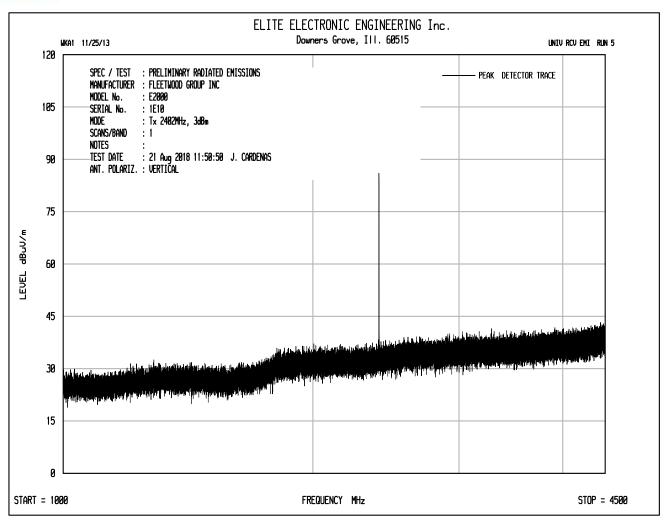




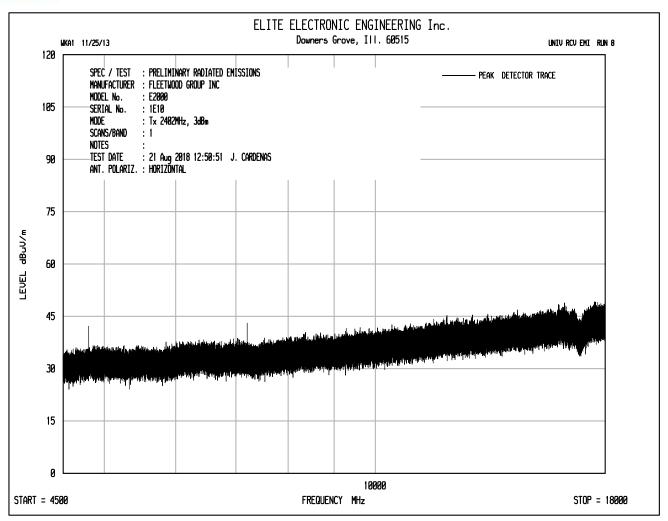




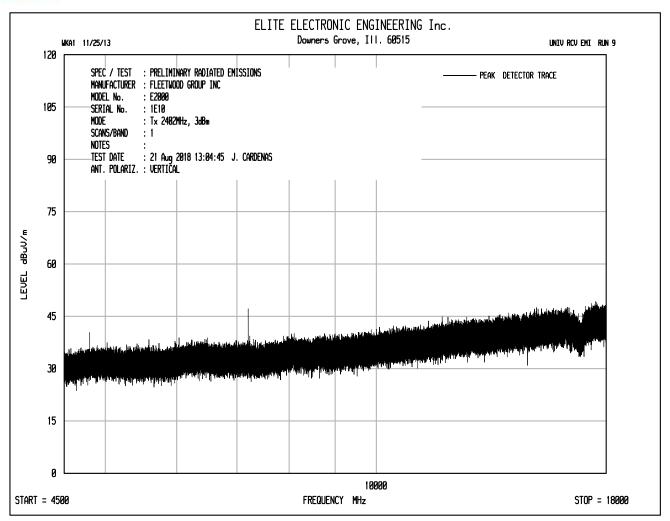




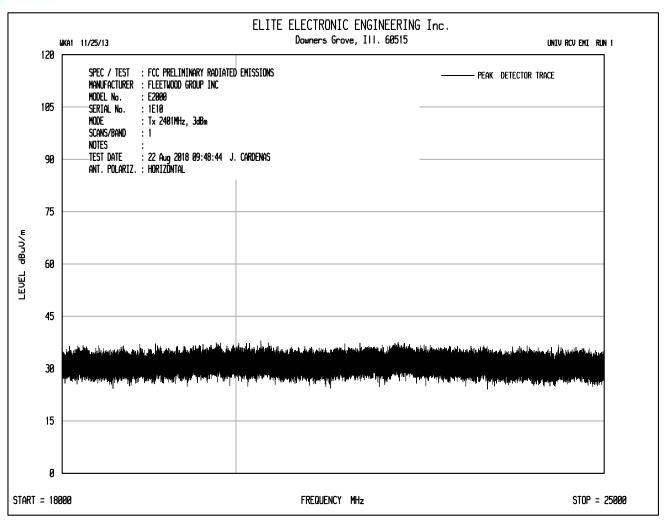




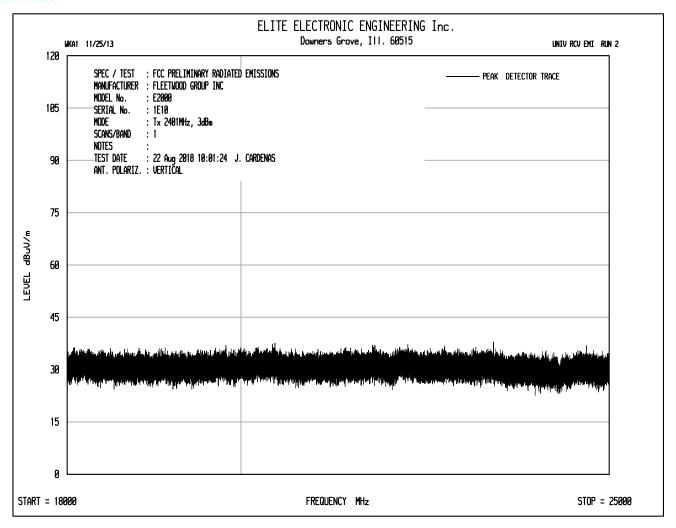




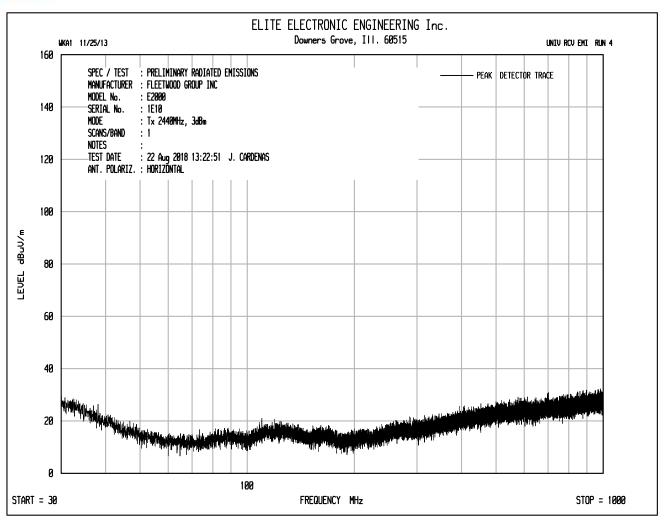




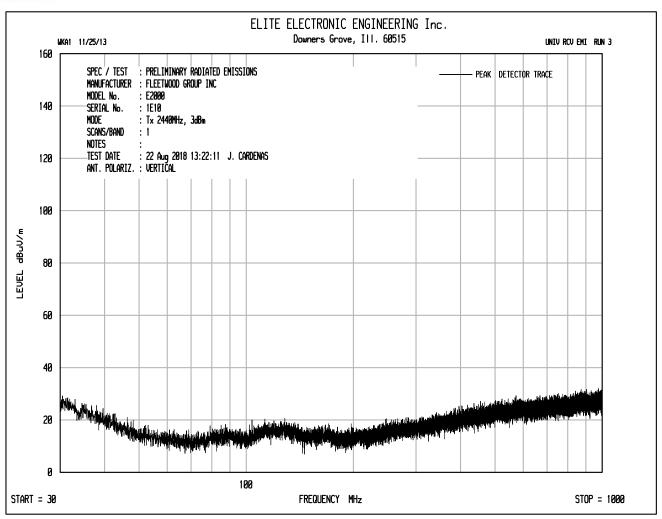




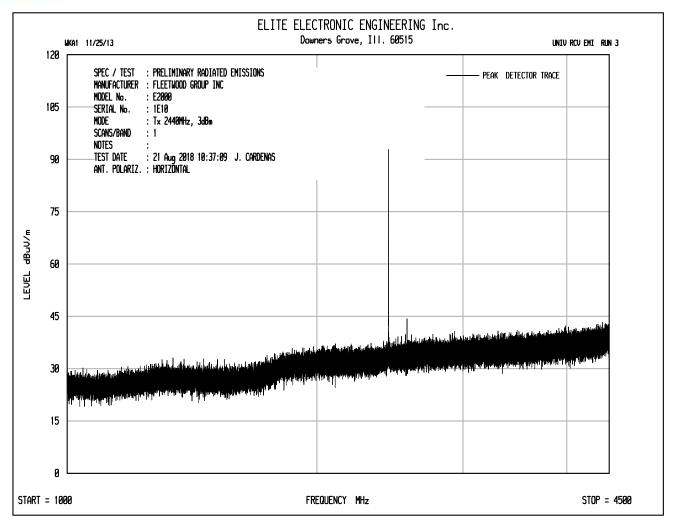




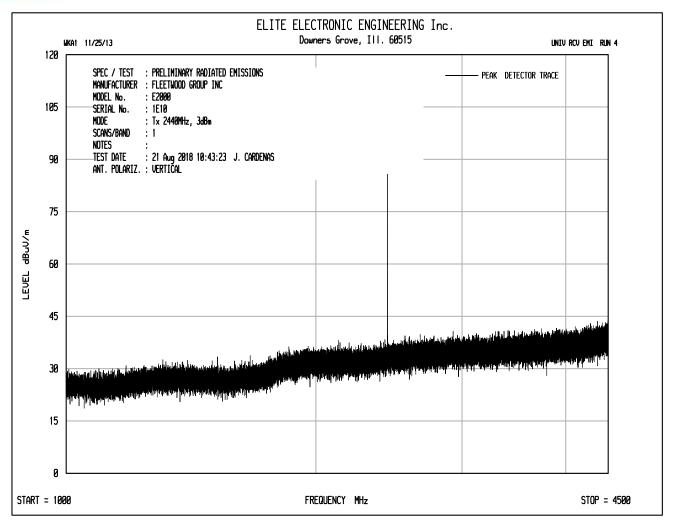




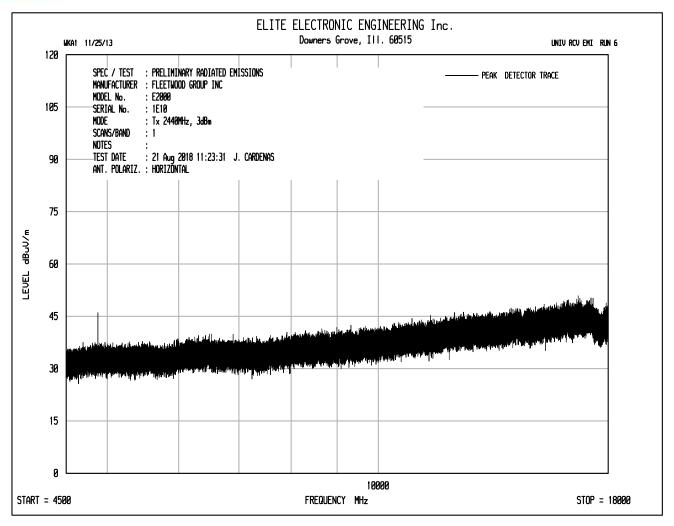




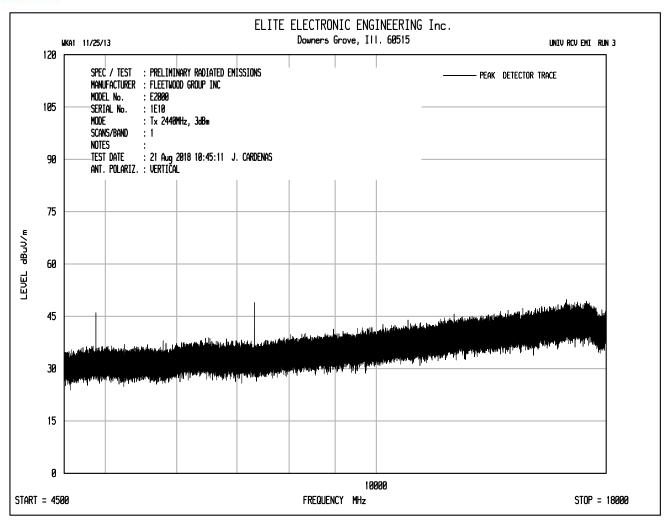




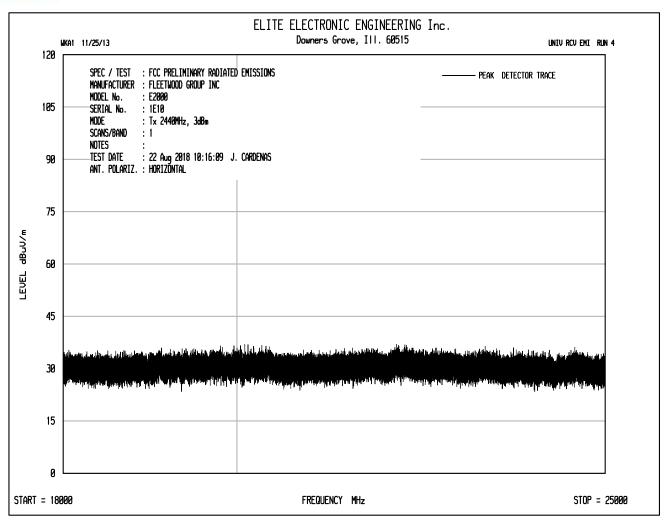




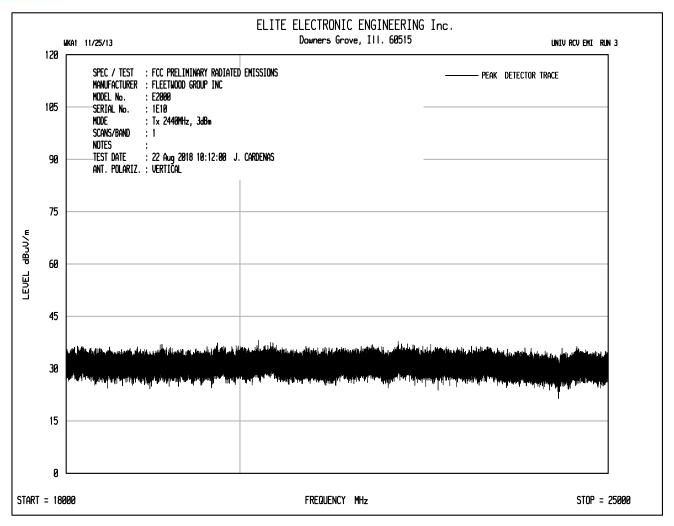




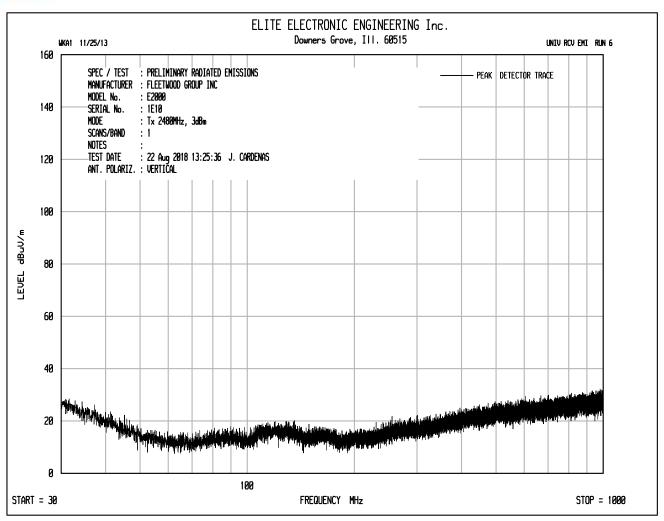




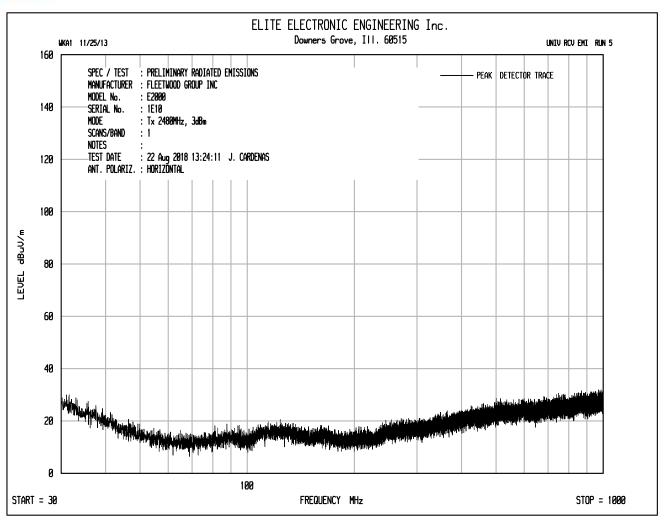




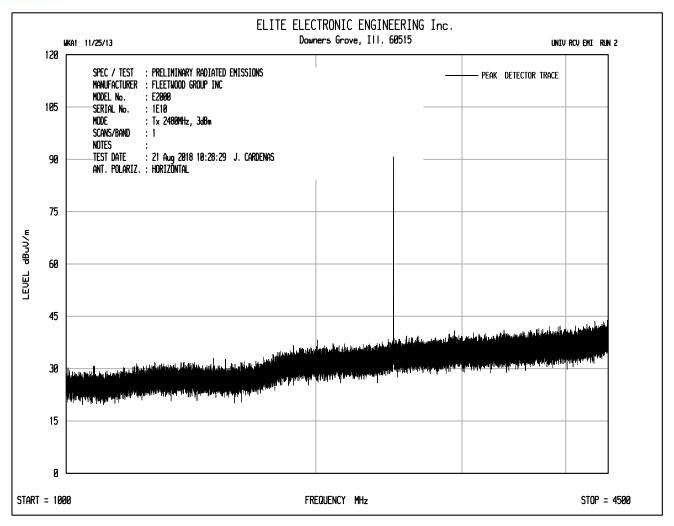




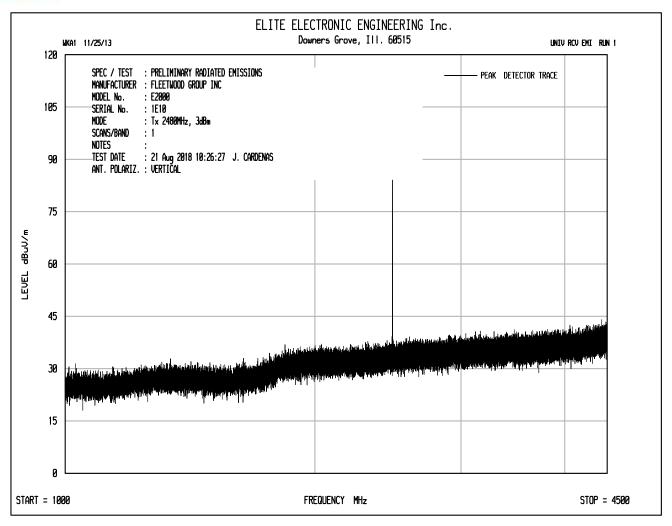




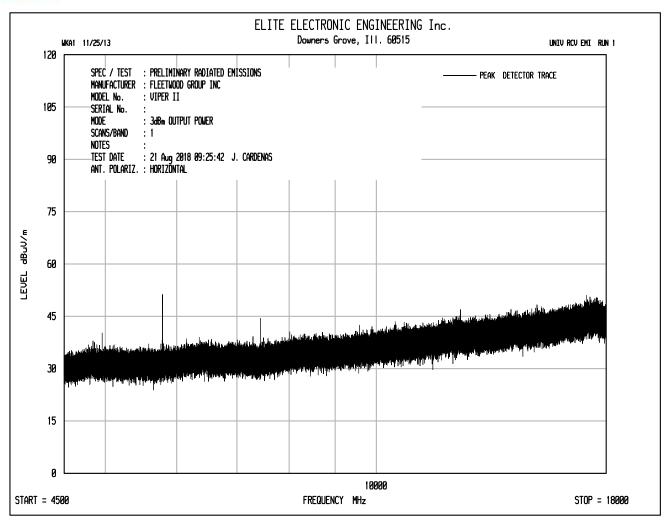




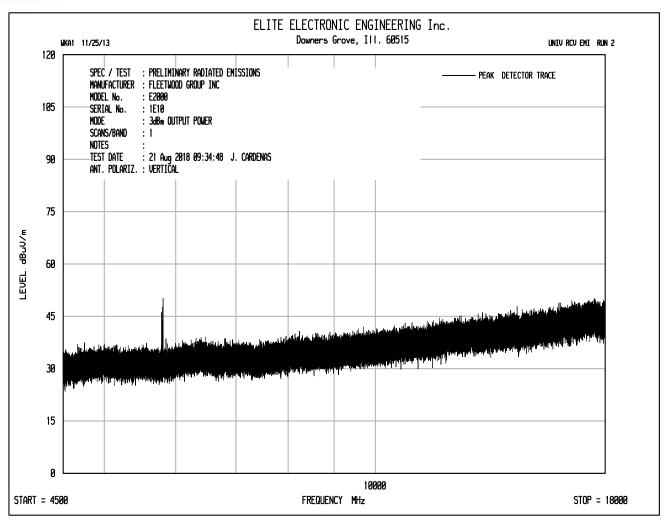




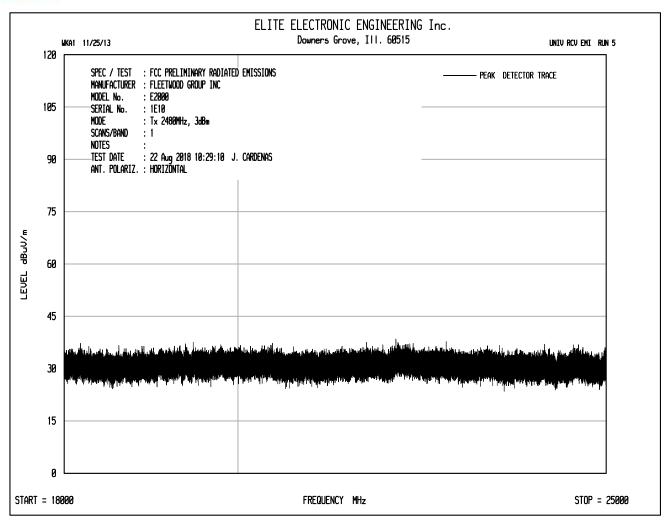




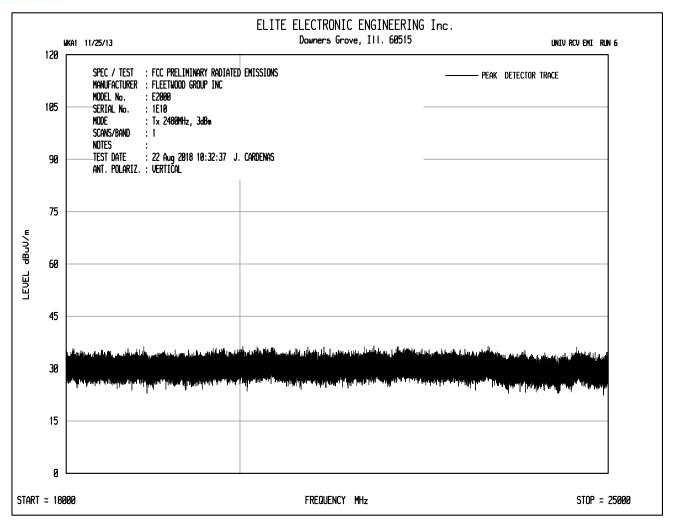














Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2402MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 1MHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4804.00	Н	52.2		4.8	34.6	-39.3	52.3	413.1	5000.0	-21.7
4804.00	V	51.9		4.8	34.6	-39.3	52.0	396.8	5000.0	-22.0
12010.00	Н	49.7	*	8.0	38.7	-39.2	57.3	729.3	5000.0	-16.7
12010.00	V	49.1	*	8.0	38.7	-39.2	56.6	676.7	5000.0	-17.4
19216.00	Н	37.1	*	2.2	40.4	-28.8	50.9	348.9	5000.0	-23.1
19216.00	V	36.7	*	2.2	40.4	-28.8	50.5	336.7	5000.0	-23.4

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2402MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Average Detector with a 1MHz Resolution Bandwidth

								Average	Average	Average	
		Meter		CBL	Ant	Pre	Duty	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	Cycle	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4804.00	Н	42.5		4.8	34.6	-39.3	0.0	42.7	135.7	500.0	-11.3
4804.00	V	40.8		4.8	34.6	-39.3	0.0	40.9	111.1	500.0	-13.1
12010.00	Н	35.0	*	8.0	38.7	-39.2	0.0	42.6	134.6	500.0	-11.4
12010.00	V	34.6	*	8.0	38.7	-39.2	0.0	42.1	127.3	500.0	-11.9
19216.00	Н	21.0	*	2.2	40.4	-28.8	0.0	34.8	54.9	500.0	-19.2
19216.00	V	20.6	*	2.2	40.4	-28.8	0.0	34.4	52.6	500.0	-19.6

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions Not in Restricted Bands

Mode : Tx 2402MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 100kHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
2402.00	Н	54.5		3.4	32.0	0.0	89.9	31362.0		
2402.00	V	50.7		3.4	32.0	0.0	86.1	20132.8		
7206.00	Н	48.0		6.1	35.7	-39.4	50.3	328.8	3136.2	-19.6
7206.00	V	50.5		6.1	35.7	-39.4	52.9	440.5	3136.2	-17.0
9608.00	Н	39.4	*	6.8	36.6	-39.3	43.6	151.0	3136.2	-26.3
9608.00	V	40.2	*	6.8	36.6	-39.3	44.3	164.2	3136.2	-25.6
14412.00	Н	38.3	*	8.7	39.6	-38.3	48.3	260.7	3136.2	-21.6
14412.00	V	38.9	*	8.7	39.6	-38.3	48.9	280.0	3136.2	-21.0
16814.00	Н	34.3	*	9.4	41.7	-37.5	48.0	250.0	3136.2	-22.0
16814.00	V	34.1	*	9.4	41.7	-37.5	47.7	242.9	3136.2	-22.2
21618.00	Н	26.8	*	2.2	40.6	-28.9	40.7	108.6	3136.2	-29.2
21618.00	V	26.8	*	2.2	40.6	-28.9	40.7	108.4	3136.2	-29.2
24020.00	Н	27.1	*	2.2	40.6	-30.2	39.8	97.6	3136.2	-30.1
24020.00	V	26.7	*	2.2	40.6	-30.2	39.3	92.3	3136.2	-30.6

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2440MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 1MHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4880.00	Н	54.4		4.9	34.5	-39.3	54.5	531.6	5000.0	-19.5
4880.00	V	53.4		4.9	34.5	-39.3	53.5	473.2	5000.0	-20.5
7320.00	Н	53.0		6.2	35.7	-39.4	55.4	587.1	5000.0	-18.6
7320.00	V	52.7		6.2	35.7	-39.4	55.1	571.8	5000.0	-18.8
12200.00	Н	50.5	*	8.0	38.8	-39.1	58.2	813.3	5000.0	-15.8
12200.00	V	50.3	*	8.0	38.8	-39.1	58.0	796.6	5000.0	-16.0
19520.00	Н	36.9	*	2.2	40.4	-28.7	50.7	344.0	5000.0	-23.2
19520.00	V	36.8	*	2.2	40.4	-28.7	50.7	341.3	5000.0	-23.3

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2440MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Average Detector with a 1MHz Resolution Bandwidth

								Average	Average	Average	
		Meter		CBL	Ant	Pre	Duty	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	Cycle	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4880.00	Н	47.3		4.9	34.5	-39.3	0.0	47.3	232.8	500.0	-6.6
4880.00	V	45.8		4.9	34.5	-39.3	0.0	45.9	197.3	500.0	-8.1
7320.00	Н	46.19		6.2	35.7	-39.4	0.0	48.6	269.3	500.0	-5.4
7320.00	V	45.4		6.2	35.7	-39.4	0.0	47.8	244.5	500.0	-6.2
12200.00	Н	35.5		8.0	38.8	-39.1	0.0	43.2	145.0	500.0	-10.8
12200.00	V	35.8		8.0	38.8	-39.1	0.0	43.5	148.8	500.0	-10.5
19520.00	Н	20.8	*	2.2	40.4	-28.7	0.0	34.7	54.3	500.0	-19.3
19520.00	V	20.7	*	2.2	40.4	-28.7	0.0	34.5	53.3	500.0	-19.4

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions Not in Restricted Bands

Mode : Tx 2440MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 100kHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
2440.00	Н	57.5		3.5	32.1	0.0	93.0	44818.9		
2440.00	V	50.5		3.5	32.1	0.0	86.0	19996.8		
9760.00	Н	40.5	*	6.9	36.9	-39.3	45.0	178.1	4481.9	-28.0
9760.00	V	40.4	*	6.9	36.9	-39.3	44.9	176.7	4481.9	-28.1
14640.00	Н	39.3		8.8	39.6	-38.2	49.5	299.4	4481.9	-23.5
14640.00	V	39.0		8.8	39.6	-38.2	49.2	288.9	4481.9	-23.8
17080.00	Н	37.8	*	9.5	41.6	-37.6	51.4	371.1	4481.9	-21.6
17080.00	V	37.4	*	9.5	41.6	-37.6	51.0	356.8	4481.9	-22.0
21960.00	Н	26.6	*	2.2	40.6	-29.4	40.0	99.9	4481.9	-33.0
21960.00	V	26.1	*	2.2	40.6	-29.4	39.5	94.7	4481.9	-33.5
24400.00	Н	27.3	*	2.2	40.6	-30.4	39.7	97.0	4481.9	-33.3
24400.00	V	27.2	*	2.2	40.6	-30.4	39.6	95.4	4481.9	-33.4

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2480MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 1MHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4960.00	Н	53.2		4.9	34.5	-39.3	53.3	461.3	5000.0	-20.7
4960.00	V	51.9		4.9	34.5	-39.3	52.0	398.6	5000.0	-22.0
7440.00	Н	54.8		6.2	35.6	-39.4	57.2	722.3	5000.0	-16.8
7440.00	V	52.5		6.2	35.6	-39.4	54.9	554.9	5000.0	-19.1
12400.00	Н	50.9		8.0	38.8	-39.0	58.7	856.9	5000.0	-15.3
12400.00	V	50.0	*	8.0	38.8	-39.0	57.8	775.2	5000.0	-16.2
19840.00	Н	36.5	*	2.2	40.4	-28.4	50.7	344.1	5000.0	-23.2
19840.00	V	35.7	*	2.2	40.4	-28.4	50.0	314.9	5000.0	-24.0
22320.00	Н	37.8	*	2.2	40.6	-29.3	51.3	368.1	5000.0	-22.7
22320.00	V	37.0	*	2.2	40.6	-29.3	50.5	336.1	5000.0	-23.5

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions in Restricted Bands

Mode : Tx 2480MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Average Detector with a 1MHz Resolution Bandwidth

								Average	Average	Average	
		Meter		CBL	Ant	Pre	Duty	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	Cycle	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
4960.00	Н	45.7		4.9	34.5	-39.3	0.0	45.8	194.8	500.0	-8.2
4960.00	V	41.9		4.9	34.5	-39.3	0.0	42.0	125.5	500.0	-12.0
7440.00	Н	48.32		6.2	35.6	-39.4	0.0	50.7	344.5	500.0	-3.2
7440.00	V	45.2		6.2	35.6	-39.4	0.0	47.6	239.7	500.0	-6.4
12400.00	Н	39.7		8.0	38.8	-39.0	0.0	47.4	235.5	500.0	-6.5
12400.00	V	34.3		8.0	38.8	-39.0	0.0	42.1	127.2	500.0	-11.9
19840.00	Н	20.4	*	2.2	40.4	-28.4	0.0	34.6	53.9	500.0	-19.3
19840.00	V	20.2	*	2.2	40.4	-28.4	0.0	34.4	52.7	500.0	-19.5
22320.00	Н	21.1	*	2.2	40.6	-29.3	0.0	34.6	53.8	500.0	-19.4
22320.00	V	20.8	*	2.2	40.6	-29.3	0.0	34.3	52.0	500.0	-19.7

Checked By



Model Number : E2000 Serial Number : 1E10

Test : FCC 15.247, RSS 247 – Radiated Emissions Not in Restricted Bands

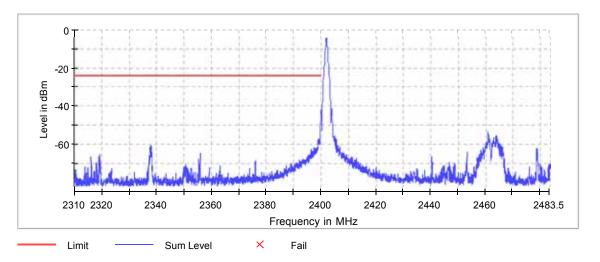
Mode : Tx 2480MHz
Test Distance : 3 meters
Date : August 21,2018

Notes : Peak Detector with a 100kHz Resolution Bandwidth

							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
2480.00	Н	55.3		3.5	32.2	0.0	91.0	35337.6		
2480.00	V	48.9		3.5	32.2	0.0	84.5	16874.7		
9920.00	Н	40.3	*	7.0	37.0	-39.2	45.0	177.2	3533.8	-26.0
9920.00	٧	40.5	*	7.0	37.0	-39.2	45.2	182.0	3533.8	-25.8
14880.00	Н	40.8		8.9	39.7	-38.2	51.2	363.4	3533.8	-19.8
14880.00	V	39.6	*	8.9	39.7	-38.2	50.1	318.4	3533.8	-20.9
17360.00	Н	40.5	*	9.7	41.4	-37.7	53.8	491.4	3533.8	-17.1
17360.00	V	40.3	*	9.7	41.4	-37.7	53.6	478.6	3533.8	-17.4
24800.00	Н	27.4	*	2.2	40.6	-31.2	39.1	90.3	3533.8	-31.9
24800.00	V	27.0	*	2.2	40.6	-31.2	38.7	85.8	3533.8	-32.3

Checked By





: Fleetwood Group Inc. : E2000 Manufacturer

Model Number Serial Number : 1E10

: Low Band Edge Test Mode : Tx 2402MHz Date : August 22,2018

Notes



							Peak	Peak	Peak	
		Meter		CBL	Ant	Pre	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
2483.50	Н	16.6	*	3.5	32.2	0.0	52.3	410.9	5000.0	-21.7
2483.50	V	14.3	*	3.5	32.2	0.0	49.9	313.9	5000.0	-24.0

Model Number : E2000 Serial Number : 1E10

Test : High Band Edge - Peak Measurement

Mode : Tx 2480MHz Date : August 21,2018

Notes :

								Average	Average	Average	
		Meter		CBL	Ant	Pre	Duty	Total	Total	Limit	
Freq.	Ant	Reading		Fac	Fac	Amp	Cycle	dBuV/m	uV/m	uV/m	Margin
MHz	Pol	(dBuV)	Ambient	(dB)	(dB)	(dB)	(dB)	at 3m	at 3 m	at 3 m	(dB)
2483.50	Н	1.9	*	3.5	32.2	0.0	0.0	37.5	75.3	500.0	-16.4
2483.50	V	0.7	*	3.5	32.2	0.0	0.0	36.4	66.0	500.0	-17.6

Manufacturer : Fleetwood Group Inc.

Model Number : E2000 Serial Number : 1E10

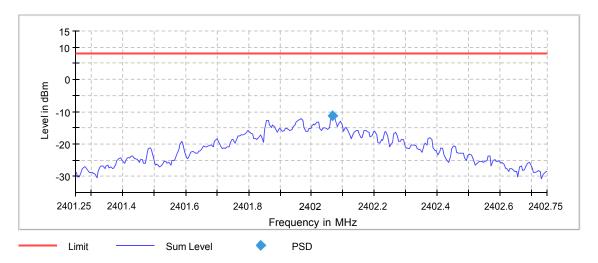
Test : High Band Edge – Average Measurement

Mode : Tx 2480MHz Date : August 21,2018

Notes :

Checked By





Model Number : E2000 Serial Number : 1E10

Test : Power Spectral Density

Mode : Tx 2402MHz

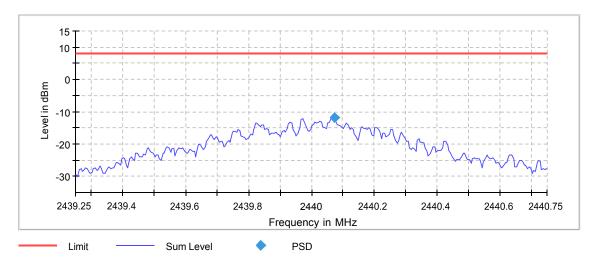
Parameters : Power Spectral Density = -11.362dBm

: Max Level = 8dBm

Date : August 22,2018

Notes :





Model Number : E2000 Serial Number : 1E10

Test : Power Spectral Density

Mode : Tx 2440MHz

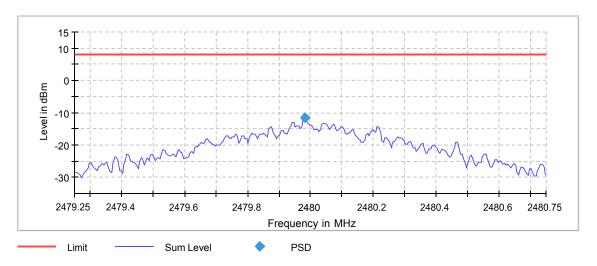
Parameters : Power Spectral Density = -11.730dBm

: Max Level = 8dBm

Date : August 22,2018

Notes :





Model Number : E2000 Serial Number : 1E10

Test : Power Spectral Density

Mode : Tx 2480MHz

Parameters : Power Spectral Density = -11.688dBm

: Max Level = 8dBm

Date : August 22,2018

Notes :