Test Certificate

A sample of the following product received on February 27, 2020 and tested on February 27 and 28 and March 2, 3 and 4, 2020 complied with the requirements of,

- **Subpart B of Part 15 of FCC Rules for Class A digital devices**
- **Innovation, Science and Economic Development Canada Interference Causing Equipment Standard ICES-003, "Information Technology Equipment (ITE) – Limits and methods of measurement", Issue 6, dated January 2016 (Class A)**

given the measurement uncertainties detailed in National Technical Systems report FR-113292.01-FCC Rev 1.

Hexagon Mining
Model HxGN MineProtect OAS-LV

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EMC Test Report

Information Technology Equipment

Class A Digital Device

FCC Part 15
Innovation, Science and Economic Development Canada ICES-003, Issue 6

Model: HxGN MineProtect OAS-LV

COMPANY:	Hexagon Mining 40 E. Congress St. Tucson, AZ 85701
TEST SITE(S):	National Technical Systems 41039 Boyce Road Fremont, CA. 94538-2435
PROJECT NUMBER:	PR113292
REPORT DATE:	March 30, 2020
REISSUE DATE:	April 2, 2020
FINAL TEST DATES:	February 27 and 28 and March 2, 3 and 4, 2020
TOTAL NUMBER OF PAGES:	73

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	March 30, 2020	First release	
1	April 2, 2020	Revised report to update the description of the product on page 10.	David Guidotti

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SCOPE

Governments and standards organizations around the world have published requirements regarding the electromagnetic compatibility (EMC) of electronic equipment. Testing has been performed on the Hexagon Mining model HxGN MineProtect OAS-LV, pursuant to the following standards.

Standard	Title	Standard Date
FCC Part 15, Subpart B	Radio Frequency Devices	October 2018 as Amended
ICES-003, Issue 6	Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement	January 2016

All measurements and evaluations have been in accordance with these specifications, test procedures, and measurement guidelines as outlined in National Technical Systems test procedures, and in accordance with the standards referenced therein (refer to Appendix E). National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

OBJECTIVE

The objective of Hexagon Mining is to verify compliance with FCC and Canada's requirements for digital devices.

STATEMENT OF COMPLIANCE

The tested sample(s) of Hexagon Mining model HxGN MineProtect OAS-LV complied with the requirements of:

Standard/Regulation	Equipment Type/Class	Standard Date
Subpart B of Part 15 of the FCC Rules (CFR title 47)	Class A	2018 as amended
ICES-003, Issue 6	Class A	2016

As specified in Section 15.101 of FCC Part 15, unintentional radiators shall be authorized prior to the initiation of marketing. Based on the description of the EUT, the following criteria per Section 15.101 of FCC Part 15 were applied to the EUT:

Type of device	**Equipment authorization required**
Class A digital devices, peripherals & external switching power supplies	SDoC or Certification

The test results recorded herein are based on a single type test of the Hexagon Mining model HxGN MineProtect OAS-LV and therefore apply only to the tested sample(s). The sample was selected and prepared by Marco Carvalho of Hexagon Mining.

Maintenance of compliance is the responsibility of the company. Any modification of the product that could result in increased emissions or susceptibility should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different enclosure, different line filter or power supply, harnessing and/or interface cable changes, etc.).

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

INFORMATION TECHNOLOGY EQUIPMENT EMISSIONS TEST RESULTS

The following emissions tests were performed on the Hexagon Mining model HxGN MineProtect OAS-LV. The measurements were extracted from the data recorded during testing and represent the highest-amplitude emissions relative to the specification limits. The complete test data is provided in the appendices of this report.

CONDUCTED EMISSIONS (MAINS PORT)

Testing was not performed as the EUT is DC powered.

RADIATED EMISSIONS

Test plan

Configuration	Test	Standard	Test range
LTE R202 Band 2 WiFi Ch 6 (2437 MHz)	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 26 GHz
LTE R202 Band 12 WiFi Ch 36 (5180 MHz)	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 40 GHz
LTE R202 Band 4 WiFi Ch 100 (5500 MHz)	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 40 GHz
LTE R202 Band 5 WiFi Ch 165 (5825 MHz)	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 40 GHz
LTE R204 (Verizon) Band 4 WiFi Ch 1 (2412 MHz)	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 26 GHz
LTE R204 (Verizon) Band 13 Bluetooth	Radiated Spurious Emissions	FCC Part 15B	30 MHz - 26 GHz

Configuration #1

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	33.7 dBµV/m @ 105.75 MHz (-6.3 dB)	Complied
1-26.5 GHz	FCC §15.109(b) Class A FCC Part 15.247	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	47.1 dBµV/m @ 4874.1 MHz (-6.9 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

Configuration #2

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	33.5 dBµV/m @ 105.73 MHz (-6.5 dB)	Complied
1-40 GHz	FCC §15.109(b) Class A FCC Part 27	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	55.9 dBµV/m @ 1415.2 MHz (-26.3 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

Configuration #3

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	36.4 dBµV/m @ 599.99 MHz (-10.6 dB)	Complied
1-40 GHz	FCC §15.109(b) Class A FCC Part 15E, 27	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	48.1 dBµV/m @ 6930.1 MHz (-34.1 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

Configuration #4

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	36.8 dBµV/m @ 599.99 MHz (-10.2 dB)	Complied
1-40 GHz	FCC §15.109(b) Class A FCC Part 15E, 22	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	62.1 dBµV/m @ 17475.4 MHz (-6.1 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

Configuration #5

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	38.9 dBµV/m @ 599.99 MHz (-8.1 dB)	Complied
1-25 GHz	FCC §15.109(b) Class A FCC Part 27, 15.247	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	46.6 dBµV/m @ 4824.0 MHz (-7.4 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

Configuration #6

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) Class A	30-230 MHz, 40 dBµV/m 230-1000 MHz, 47 dBµV/m (10 m limit)	39.5 dBµV/m @ 600.00 MHz (-7.5 dB)	Complied
1-25 GHz	FCC §15.109(b) Class A FCC Part 27, 15.247	49.5 dBµV/m Av 69.5 dBµV/m Pk (10 m limit)	52.3 dBµV/m @ 7205.9 MHz (-1.7 dB)	Complied
Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the 20*log(D1/D2) formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak).				

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of CISPR and therefore no adjustment of the data for measurement uncertainty is required.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Radiated Electric Field	dBµV/m	30-1000 MHz	± 3.6 dB
		1000-40,000 MHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Hexagon Mining model HxGN MineProtect OAS-LV is a Fatigue Monitor Product for drivers. The EUT was treated as tabletop equipment during testing. The electrical rating of the EUT is 9 – 36 (12V Nominal) Volts DC 2 Amps (Max).
The sample was received on February 27, 2020 and tested on February 27 and 28 and March 2, 3 and 4, 2020. The EUT consisted of the following component(s):

Company	Product Name	Model	Description	Article Number	Serial Number	FCC ID
Hexagon Mining	HxGN MineProtect OAS-LV	202	Fatigue Monitor Product	898411	1000004	2AFYJ-OASLV202
Hexagon Mining	HxGN MineProtect OAS-LV	204	Fatigue Monitor Product	905058	4000003	2AFYJ-OASLV204

HIGHEST EUT INTERNAL FREQUENCY SOURCE

The highest internal frequency source (F_x) of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. The highest internal frequency source determines the frequency range of test for radiated emissions.

The highest internal frequency source of the EUT was declared to be 5850 MHz.

Based on the declared highest internal frequency source, the upper frequency range of measurement for the current project were:

FCC Part 15, Subpart B

Highest Internal Frequency Source (MHz)	Upper Frequency Range of Measurement (MHz)	Applicability
Below 1.705	30	
1.705 – 108	1000	
108 – 500	2000	
500 – 1000	5000	
Above 1000	5th harmonic of the highest internal source or 40 GHz, whichever is lower	X

ENCLOSURE

The EUT enclosure is aluminum base plate with Powder Coat finish for protection against corrosion and sunlight (UV). Plastic ABS top enclosure Length (cm) 15 x width (cm) 12 x Height (cm) 5.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at National Technical Systems.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for testing:

Company	Model	Description	Serial Number
EMCO	3115	GNSS re-radiator antenna	-
EMCO	3115	LTE re-radiator antenna	-
-	12 V battery		-

The following equipment was used as remote support equipment for testing:

Company	Model	Description	Serial Number
R&S	CMW 500	LTE call box	WC064877
HP	Bang & Olufsen	Laptop	-

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port		Cable(s)		
From	To	Description	Shielded/Unshielded	Length(m)
GPS	GPS antenna	RF cable	Shielded	2.0
Mini USB	USB memory	USB cable	Shielded	0.3
DC power	Battery	DC Power cable	Unshielded	2.0
Micro USB	Unterminated (future use)	USB cable	Shielded	1.6

EUT OPERATION

During emissions testing the LTE modem was transmitting at the specified band with max power, Wi-Fi or Bluetooth were transmitting with max RF power, Camera was active, writing to SD card and USB stick. GPS was receiving satellites.

EMISSIONS TESTING

RADIATED EMISSIONS

Final test measurements were taken at the National Technical Systems Anechoic Chambers listed below. The test sites contain separate areas for radiated and conducted emissions testing. The sites conform to the requirements of 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* and CISPR 16-1-4:2017 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are registered with the VCCI and are on file with the FCC and Industry Canada.

Site	Registration Numbers			Location
	VCCI	FCC	Canada	
Chamber 4 & 7	Member 1211 Facility Registration A-0169	US1031	US0027	41039 Boyce Road Fremont, CA 94538-2435

.

EMISSIONS MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1:2015 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7 GHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000 MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

Measurements for radiated and conducted emissions are converted to the field strength at an antenna or voltage developed at the LISN (or ISN) measurement port, which is then compared directly with the appropriate specification limit under software control of the test receivers and spectrum analyzers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically. The software used for measurements is NTS EMI Test Software (rev 2.10).

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high-amplitude transient events.

ANTENNAS

A bilog antenna or combination of biconical and log periodic antennas are used to cover the range from 30 MHz to 1000 MHz. Narrowband tuned dipole antennas may be used over the entire 30 to 1000 MHz frequency range for precision measurements of field strength. Above 1000 MHz, horn antennas are used. The antenna calibration factors are included in site factors that are programmed into the test receivers or data collection software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table-mounted devices shall be 80 cm. Floor-mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material up to 12 mm thick if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the company's specifications. An appendix of this report contains the list of test equipment used and calibration information.

EMISSIONS TEST PROCEDURES

EUT AND CABLE PLACEMENT

The standards require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst-case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

RADIATED EMISSIONS

General

FCC Part 15 references the test methods of 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) for emissions measurements. Radiated emissions measurements are performed in two phases, preliminary scan and final maximization.

Preliminary Scan

A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one or more of these with the antenna polarized vertically and one or more of these are performed with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied as necessary to determine the highest emission relative to the limit.

Note that for the frequency range of 1-6 GHz in the “free space” test environment, CISPR 32 allows the antenna to be set at a fixed height equal to the center height of the EUT, except for cases where additional scans are necessary with the antenna height adjusted up and down to ensure the measurement antenna illuminates the entire height of the EUT. However, in cases where a single “free space” test is performed in the 1-6 GHz frequency to simultaneously meet the requirements of FCC Part 15 (ANSI C63.4-2014 test methods) and CISPR 22, the antenna height is by default varied since required by ANSI C63.4.

In the frequency range of 30-1000 MHz, a speaker (with demodulation) is provided in the receiver to aid in discriminating between EUT and ambient emissions if required. Other possible methods for discriminating between EUT and ambient emissions involve scanning with near-field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final Maximization

During final maximization, the highest-amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth that results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

Final measurements in the frequency range of 30-1000 MHz are made using a quasi-peak detector and compared to the quasi-peak limit. Final measurements above 1 GHz are made using average and peak detectors and compared to the average and peak limits respectively.

The diameter of the test volume demonstrated during the test site validation of Chamber 4 was 2.5 m, while the maximum width of the boundary of the EUT, local AE, and associated cabling within the test volume was 2.5 m.

The diameter of the test volume demonstrated during the test site validation of Chamber 7 was 2.5 m, while the maximum width of the boundary of the EUT, local AE, and associated cabling within the test volume was 2.5 m.

When testing above 1 GHz, the receive antenna is restricted to a maximum height of 2.5 m. Maximum emissions are found within this restricted range because emission levels decrease over distance and as the antenna is raised above 2.5 m, the distance from the EUT increases. As a result of the increased measurement distance, at antenna heights above 2.5 m, lower emission levels are measured as compared to emissions levels measured at antenna heights at 2.5 m and below. Final measurements are captured at 3 meters test distance except in cases where a closer test distance is required due to noise-floor considerations of the test-and-measurement equipment.

For measurements above 1 GHz every effort is made to ensure the EUT remains within the cone of radiation of the measurement antenna (i.e. 3 dB beam-width of the antenna). This may include rotating the product and/or angling the measurement antenna. A horn antenna having the beam width *W* at the measurement distance 3 m shown in the table below was used for the measurement. Since the height of the EUT from the turntable was 1.5 m, the antenna height was fixed to 1 m.

Frequency (GHz)	E Plane	H Plane	Θ_{3dB}	3 dB beam width *W* (m) at 3 m
1.0	110	90	90	6.0
2.0	50	59	50	2.8
3.0	40	62	40	2.2
4.0	42	63	42	2.3
5.0	54	42	42	2.3
6.0	48	39	39	2.1

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBµV/m
F_d = Distance Factor in dB
R_c = Corrected Reading in dBµV/m
L_s = Specification Limit in dBµV/m
M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radiated Emissions, 30 - 18,000 MHz, 27-Feb-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Red)	8564E (84125C)	WC055584	10/10/2019	10/10/2020
Micro-Tronics	High Pass Filter 2.7 GHz (High Pass)	HPM50111-01	WC062506	11/25/2019	11/25/2020
Hewlett Packard	Microwave Preamplifier, 1 - 26.5 GHz	8449B	WC064416	7/18/2019	7/18/2020
Filtek Filters	High Pass Filter, 1 GHz	HP12/1000-5BA	WC064427	4/25/2019	4/25/2020
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064454	3/11/2019	3/11/2021
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	WC064492	6/22/2019	6/22/2020
Hewlett Packard	High Pass Filter, 8.2 GHz	84300-80039	WC064496	7/15/2019	7/15/2020
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	WC064584	6/28/2019	6/28/2020
Hewlett Packard	9 KHz-1300 MHz pre-amp	8447F	WC064718	12/2/2019	12/2/2020
SM Electronics	Attenuator	SA18B-10	WC072177	N/A	
Radiated Emissions, 30 - 40,000 MHz, 28-Feb-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Red)	8564E (84125C)	WC055584	10/10/2019	10/10/2020
Hewlett Packard	Microwave Preamplifier Head, 18-40 GHz (Red)	84125C EMI Test Head	WC055586	10/4/2019	10/4/2020
Micro-Tronics	Filter (High Pass)	HPM50111-01	WC062506	11/25/2019	11/25/2020
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064416	7/18/2019	7/18/2020
Filtek Filters	Filter, 1 GHz High Pass	HP12/1000-5BA	WC064427	4/25/2019	4/25/2020
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064454	3/11/2019	3/11/2021
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	WC064492	6/22/2019	6/22/2020
Hewlett Packard	High Pass filter, 8.2 GHz	84300-80039	WC064496	7/15/2019	7/15/2020
A. H. Systems	Antenna, Horn, 18-40GHz	SAS-574	WC064555	7/8/2019	7/8/2021
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	WC064584	6/28/2019	6/28/2020
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	WC064718	12/2/2019	12/2/2020
SM Electronics	Attenuator	SA18B-10	WC072177	N/A	
Radiated Emissions, 1,000 - 25,000 MHz, 02-Mar-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Red)	8564E (84125C)	WC055584	10/10/2019	10/10/2020
Hewlett Packard	Microwave Preamplifier Head, 18-40 GHz (Red)	84125C EMI Test Head	WC055586	10/4/2019	10/4/2020
Micro-Tronics	Filter (High Pass)	HPM50111-01	WC062506	11/25/2019	11/25/2020
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064416	7/18/2019	7/18/2020

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	WC064492	6/22/2019	6/22/2020
A. H. Systems	Antenna, Horn, 18-40GHz	SAS-574	WC064555	7/8/2019	7/8/2021
Radiated Emissions, 1,000 - 40,000 MHz, 03-Mar-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Red)	8564E (84125C)	WC055584	10/10/2019	10/10/2020
Hewlett Packard	Microwave Preamplifier Head, 18-40 GHz (Red)	84125C EMI Test Head	WC055586	10/4/2019	10/4/2020
Micro-Tronics	Filter (High Pass)	HPM50111-01	WC062506	11/25/2019	11/25/2020
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064416	7/18/2019	7/18/2020
Filtek Filters	Filter, 1 GHz High Pass	HP12/1000-5BA	WC064427	4/25/2019	4/25/2020
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
A. H. Systems	Antenna, Horn, 18-40GHz	SAS-574	WC064555	7/8/2019	7/8/2021
SM Electronics	Attenuator	SA18B-10	WC072177	N/A	
Radiated Emissions, 30 - 26,000 MHz, 04-Mar-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Red)	8564E (84125C)	WC055584	10/10/2019	10/10/2020
Hewlett Packard	Microwave Preamplifier Head, 18-40 GHz (Red)	84125C EMI Test Head	WC055586	10/4/2019	10/4/2020
Micro-Tronics	Filter (High Pass)	HPM50111-01	WC062506	11/25/2019	11/25/2020
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064416	7/18/2019	7/18/2020
Filtek Filters	Filter, 1 GHz High Pass	HP12/1000-5BA	WC064427	4/25/2019	4/25/2020
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	WC064455	2/11/2020	2/11/2021
A. H. Systems	Antenna, Horn, 18-40GHz	SAS-574	WC064555	7/8/2019	7/8/2021
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064582	7/3/2018	7/3/2020
SM Electronics	Attenuator	SA18B-10	WC072177	N/A	
Radiated Emissions, 30 - 1,000 MHz, 05-Mar-20					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	WC064455	2/11/2020	2/11/2021
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064582	7/3/2018	7/3/2020
Radiated Emissions, 30 - 1,000 MHz, 06-Mar-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	WC064455	2/11/2020	2/11/2021
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064582	7/3/2018	7/3/2020
Radiated Emissions, 30 - 1,000 MHz, 09-Mar-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	WC064455	2/11/2020	2/11/2021

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064582	7/3/2018	7/3/2020

Appendix B Test Data

TL113292 Pages 22 – 68

Client:	Hexagon Mining	PR Number:	PR113292
Product	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Emissions Standard(s):	FCC 15B, CISPR 32, EN 301 489	Class:	A
Immunity Standard(s):	EN 55024, EN 301 489-1/-3/-17/-52	Environment:	-

EMC Test Data

For The

Hexagon Mining

Product

HxGN MineProtect OAS-LV 202 and 204

Date of Last Test: 3/16/2020

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/27/2020
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #4
Config. Used: 1
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	33.7 dBµV/m @ 105.75 MHz (-6.3 dB)
3	Radiated Emissions 1 GHz - 26.5 GHz Maximized	FCC Class A FCC Part 15.247	Pass	47.1 dBµV/m @ 4874.1 MHz (-6.9 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

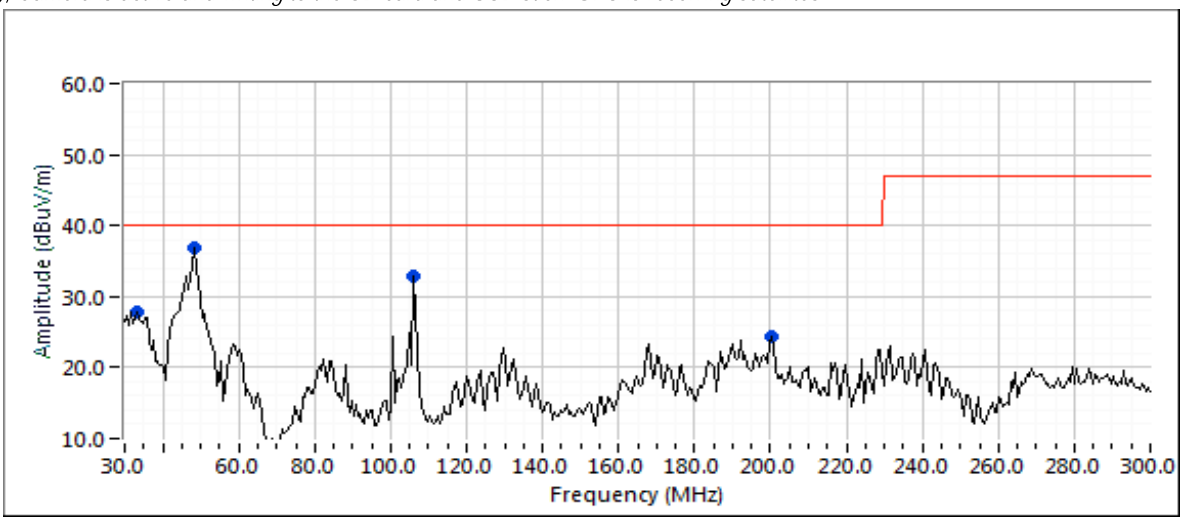
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

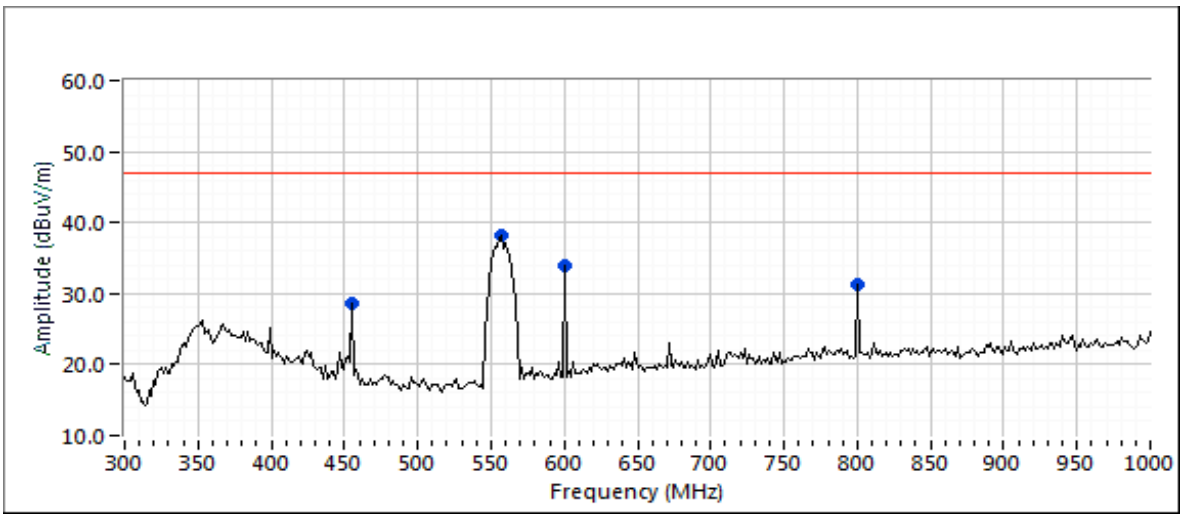
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R202) is transmitting at 1880 MHz (Ch# 18900) with max power, 802.11b Ch#6 transmitting with max RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
33.246	*27.7*	*V*	*40.0*	*-12.3*	*Peak*	*156*	*1.0*	
48.397	*36.8*	*V*	*40.0*	*-3.2*	*Peak*	*26*	*1.0*	
105.752	*33.0*	*H*	*40.0*	*-7.0*	*Peak*	*291*	*2.0*	
200.441	*24.4*	*H*	*40.0*	*-15.6*	*Peak*	*57*	*3.5*	
455.711	*28.6*	*H*	*47.0*	*-18.4*	*Peak*	*74*	*1.0*	
556.713	*38.3*	*H*	*47.0*	*-8.7*	*Peak*	*120*	*3.0*	*LTE and Wi-Fi intermodulation.*
600.200	*34.0*	*H*	*47.0*	*-13.0*	*Peak*	*99*	*2.5*	
800.802	*31.4*	*H*	*47.0*	*-15.6*	*Peak*	*76*	*3.5*	

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
33.537	25.7	V	40.0	-14.3	QP	156	1.1	QP (1.00s)
48.448	29.3	V	40.0	-10.7	QP	38	1.0	QP (1.00s)
105.753	32.6	H	40.0	-7.4	QP	277	2.0	QP (1.00s)
200.001	23.6	H	40.0	-16.4	QP	68	3.3	QP (1.00s)
456.022	28.9	H	47.0	-18.1	QP	69	1.1	QP (1.00s)
557.428	34.3	H	47.0	-12.7	QP	118	3.0	QP (1.00s) - Intermodulation
599.990	35.7	H	47.0	-11.3	QP	111	2.8	QP (1.00s)
800.002	27.7	H	47.0	-19.3	QP	0	1.0	QP (1.00s)

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
105.753	**33.7**	H	40.0	**-6.3**	QP	277	2.0	QP (1.00s)
48.448	32.4	V	40.0	-7.6	QP	38	1.0	QP (1.00s)
599.990	35.7	H	47.0	-11.3	QP	111	2.8	QP (1.00s)
33.537	27.8	V	40.0	-12.2	QP	156	1.1	QP (1.00s)
557.428	34.3	H	47.0	-12.7	QP	118	3.0	QP (1.00s) - Intermodulation
200.001	24.4	H	40.0	-15.6	QP	68	3.3	QP (1.00s)

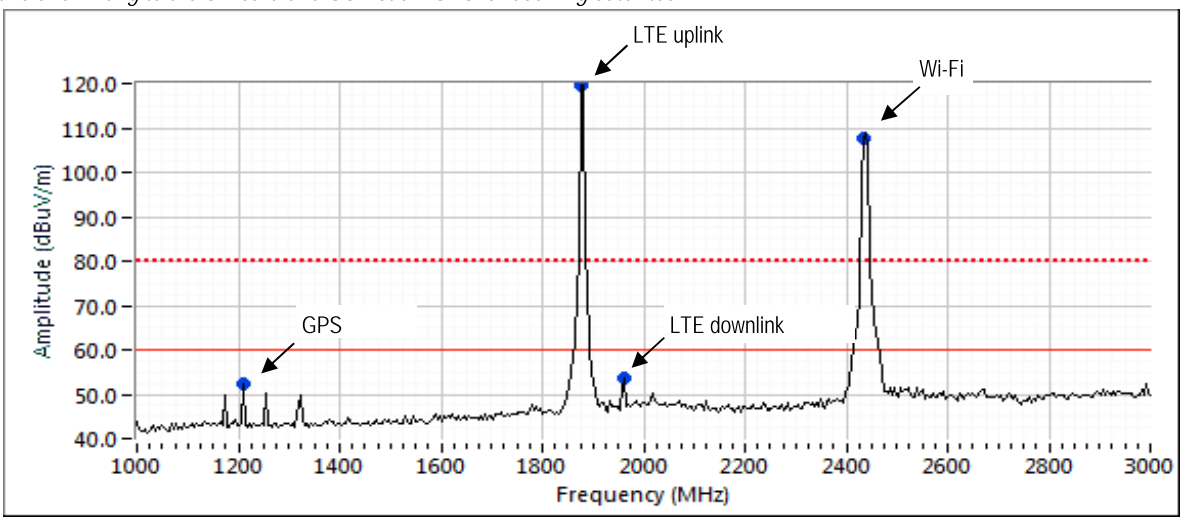
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

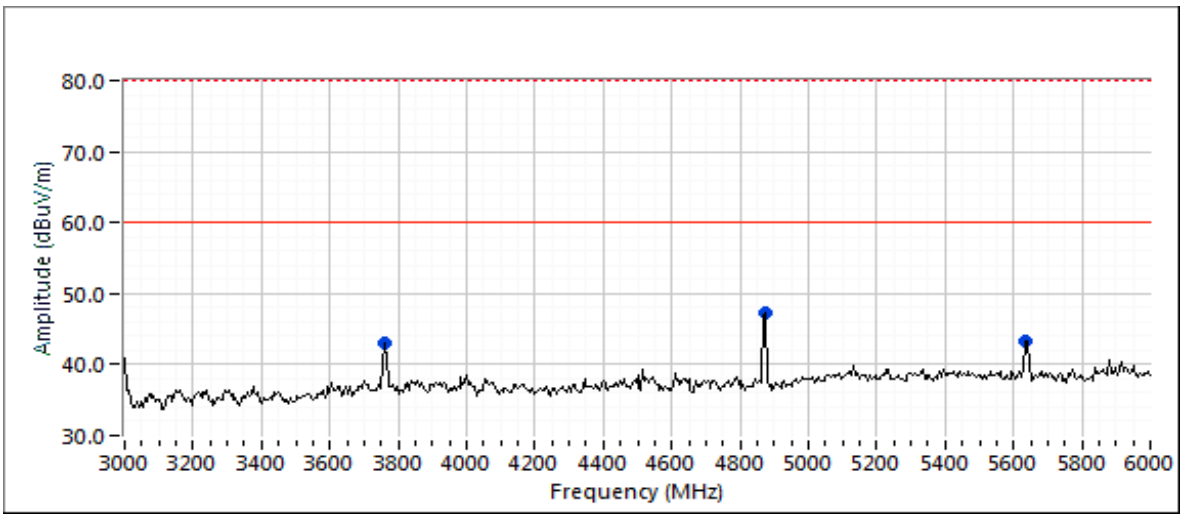
Run #3: Maximized Readings, 1000 - 26000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 26500	3	3	0.0

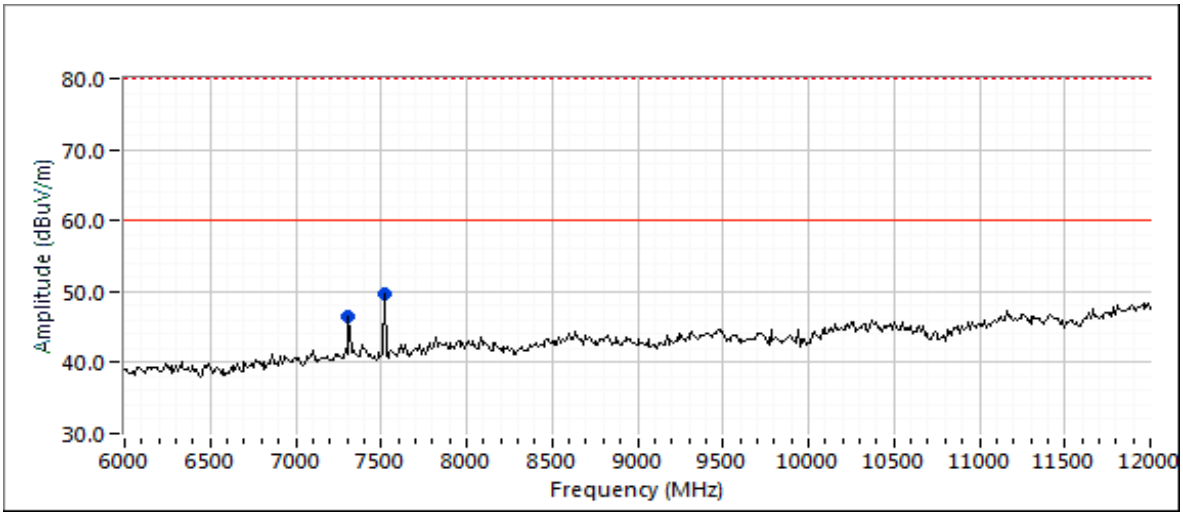
EUT and Test Configuration Details

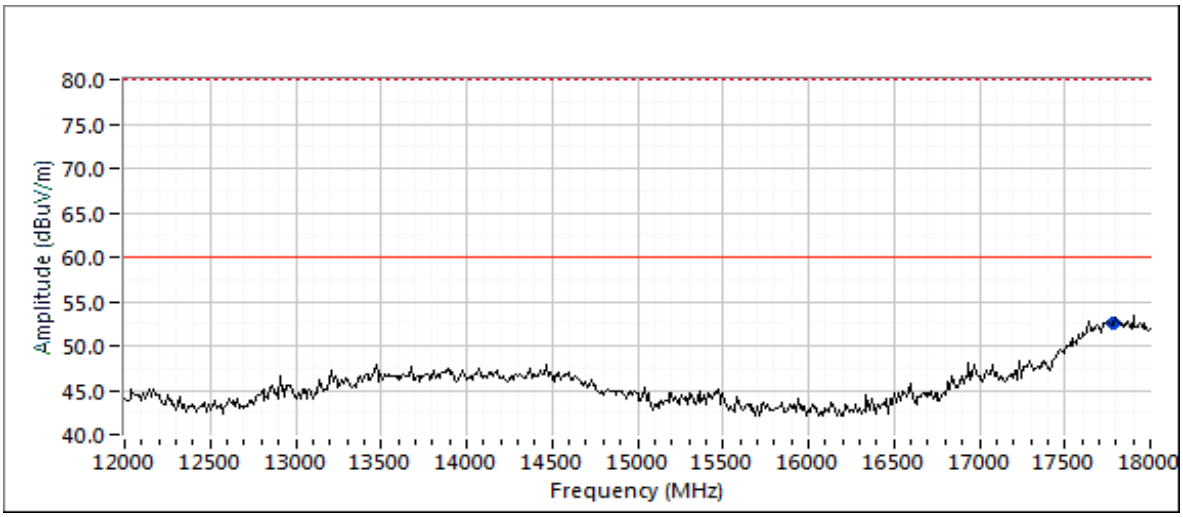
LTE modem (R202) is transmitting at 1880 MHz (Ch# 18900) with max power, 802.11b Ch#6 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



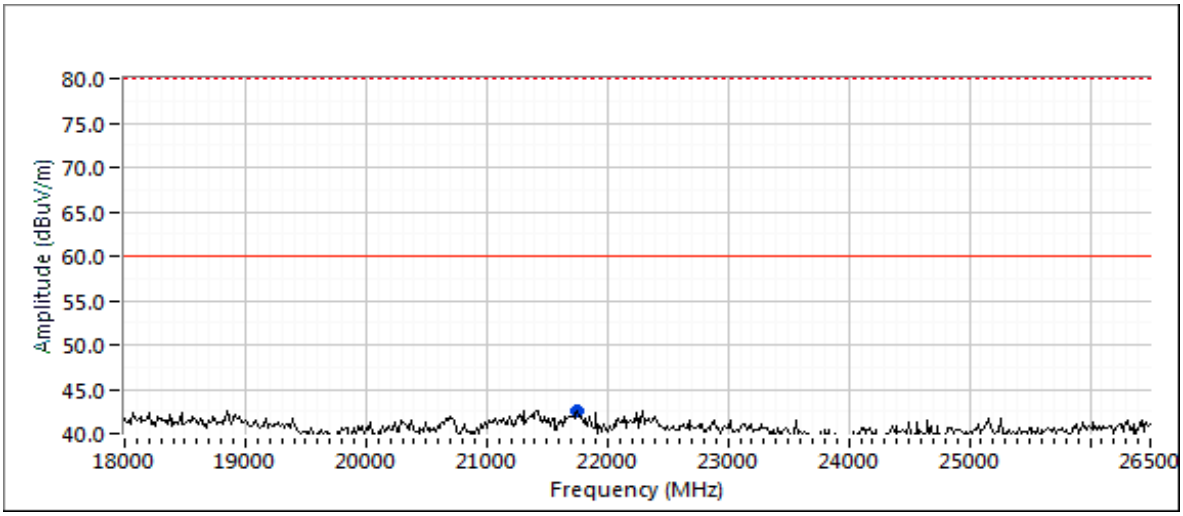


Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A



Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1218.420	*52.4*	*V*	-	-	*Peak*	*26*	*1.0*	*GPS feed*
1879.960	*119.6*	*V*	-	-	*Peak*	*57*	*1.0*	*LTE Uplink*
1960.220	*53.5*	*V*	-	-	*Peak*	*230*	*1.0*	*LTE downlink*
2436.870	*107.6*	*V*	-	-	*Peak*	*192*	*1.0*	*Wi-Fi*
3760.000	*42.9*	*V*	-	-	*Peak*	*288*	*1.3*	*LTE Uplink 2nd harmonic*
4875.000	*47.2*	*V*	-	-	*Peak*	*330*	*1.8*	*Wi-Fi 2nd harmonic*
5639.700	*43.2*	*H*	-	-	*Peak*	*95*	*1.8*	*LTE Uplink 3rd harmonic*
7310.000	*46.4*	*V*	-	-	*Peak*	*16*	*1.7*	*Wi-Fi 3rd harmonic*
7520.000	*49.6*	*V*	-	-	*Peak*	*124*	*2.0*	*LTE Uplink 4th harmonic*
17790.000	*52.6*	*H*	-	-	*Peak*	*221*	*1.8*	*Noise floor reading*
21754.170	*42.6*	*V*	-	-	*Peak*	*302*	*1.2*	*Noise floor reading*

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Final readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 24 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3760.400	40.6	V	82.2	-41.6	AVG	287	1.4	RB 1 MHz;VB 10 Hz;Peak
3760.270	51.3	V	82.2	-30.9	PK	287	1.4	RB 1 MHz;VB 3 MHz;Peak
4874.060	47.1	V	54.0	**-6.9**	AVG	329	1.1	RB 1 MHz;VB 1 kHz;Peak
4874.040	53.4	V	74.0	-20.6	PK	329	1.1	RB 1 MHz;VB 3 MHz;Peak
5638.110	41.7	H	82.2	-40.5	AVG	95	1.7	RB 1 MHz;VB 10 Hz;Peak
5638.530	53.0	H	82.2	-29.2	PK	95	1.7	RB 1 MHz;VB 3 MHz;Peak
7310.440	45.1	V	54.0	-8.9	AVG	37	2.1	RB 1 MHz;VB 1 kHz;Peak
7310.280	54.4	V	74.0	-19.6	PK	37	2.1	RB 1 MHz;VB 3 MHz;Peak
7520.030	48.1	V	82.2	-34.1	AVG	122	2.0	RB 1 MHz;VB 10 Hz;Peak
7520.150	55.4	V	82.2	-26.8	PK	122	2.0	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 24 limits apply. For intermodulation emissions, highest emission limit apply.

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/27/2020
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #4
Config. Used: 2 (Test plan #2)
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	33.5 dBµV/m @ 105.73 MHz (-6.5 dB)
3	Radiated Emissions 1 GHz - 40 GHz Maximized	FCC Class A FCC Part 27	Pass	55.9 dBµV/m @ 1415.2 MHz (-26.3 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

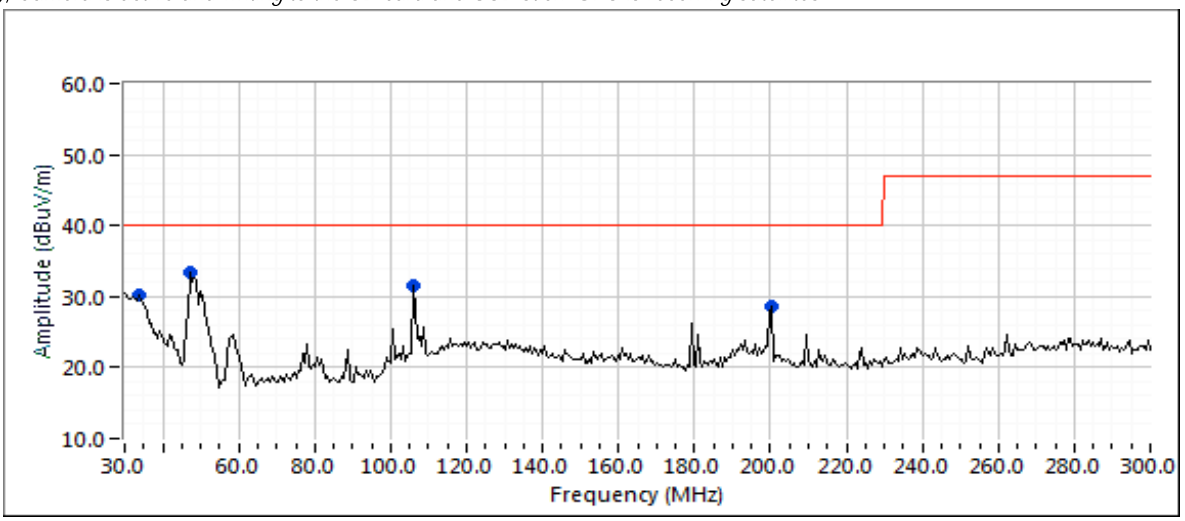
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

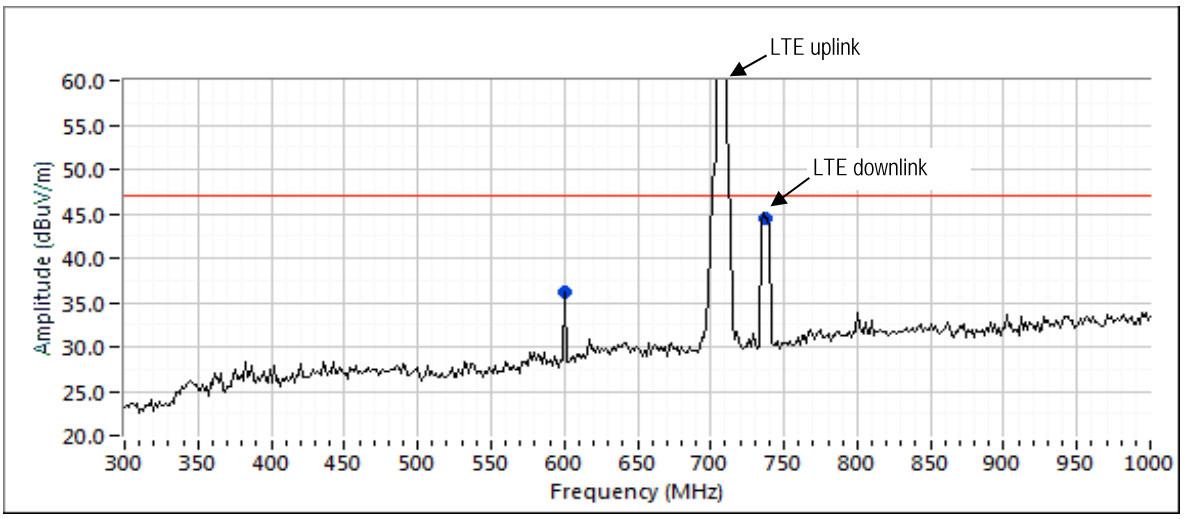
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R202) is transmitting at 707.5 MHz (Ch# 23095) with max power, 802.11n/20 Ch#36 transmitting with max RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
33.788	*30.3*	*V*	*40.0*	*-9.7*	*Peak*	*192*	*1.0*	
47.315	*33.3*	*V*	*40.0*	*-6.7*	*Peak*	*21*	*2.0*	
105.752	*31.5*	*H*	*40.0*	*-8.5*	*Peak*	*289*	*1.5*	
200.441	*28.6*	*V*	*40.0*	*-11.4*	*Peak*	*236*	*1.0*	
600.200	*36.2*	*H*	*47.0*	*-10.8*	*Peak*	*351*	*1.0*	
707.519	*112.2*	*H*	-	-	*Peak*	*129*	*2.0*	*LTE Uplink*
737.575	*44.5*	*H*	-	-	*Peak*	*103*	*2.0*	*LTE Downlink (Call box)*

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
33.593	25.8	V	40.0	-14.2	QP	166	1.0	QP (1.00s)
47.675	28.2	V	40.0	-11.8	QP	23	1.0	QP (1.00s)
105.734	32.2	H	40.0	-7.8	QP	285	2.0	QP (1.00s)
199.992	23.8	V	40.0	-16.2	QP	112	3.2	QP (1.00s)
600.001	36.7	H	47.0	-10.3	QP	350	1.0	QP (1.00s)

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
105.734	**33.5**	H	40.0	**-6.5**	QP	285	2.0	QP (1.00s)
47.675	31.2	V	40.0	-8.8	QP	23	1.0	QP (1.00s)
600.001	36.7	H	47.0	-10.3	QP	350	1.0	QP (1.00s)
33.593	28.0	V	40.0	-12.0	QP	166	1.0	QP (1.00s)
199.992	24.3	V	40.0	-15.7	QP	112	3.2	QP (1.00s)

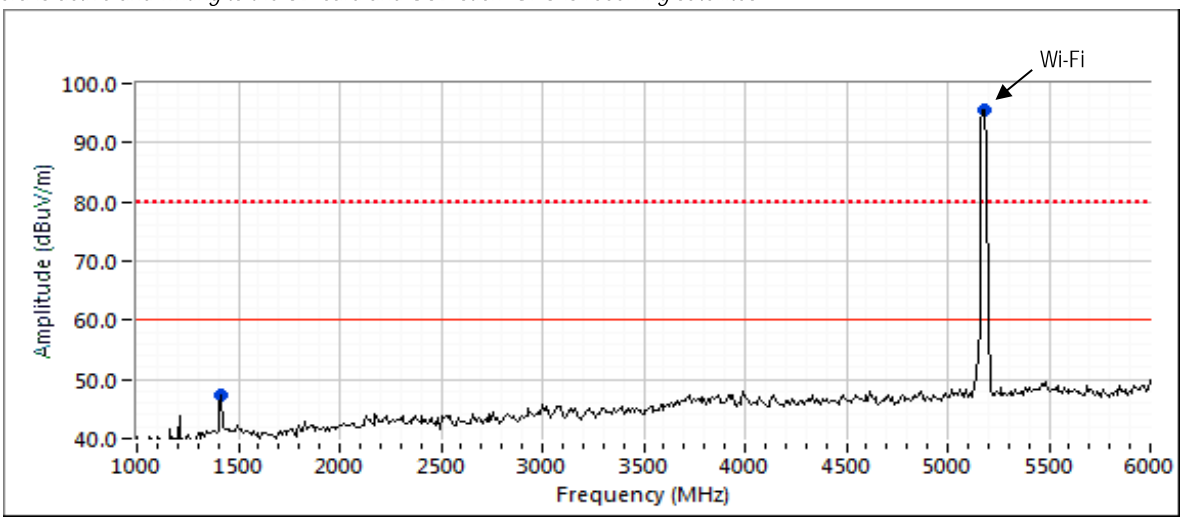
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

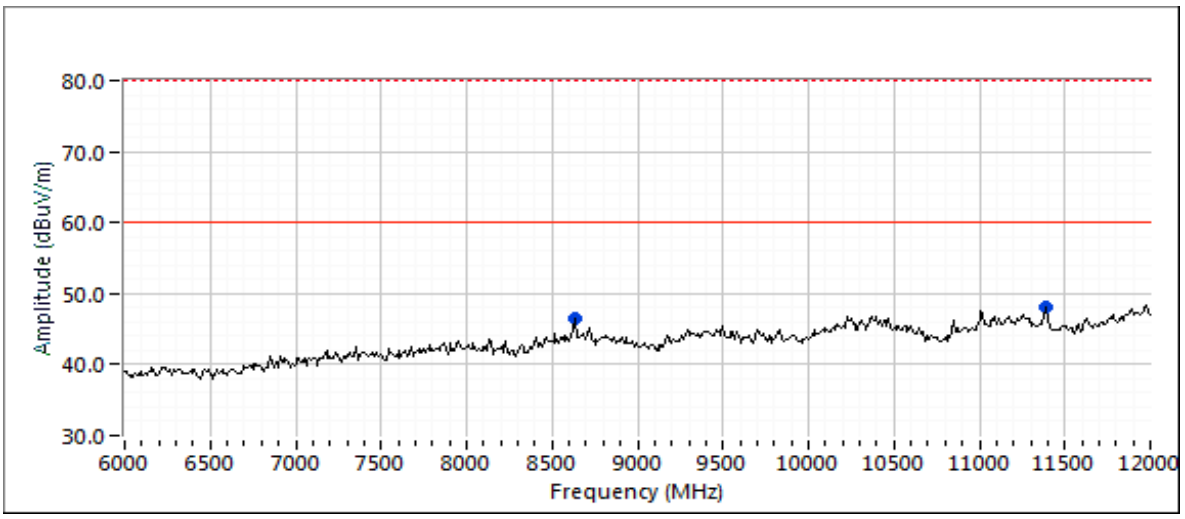
Run #3: Maximized Readings, 1000 - 40000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 40000	3	3	0.0

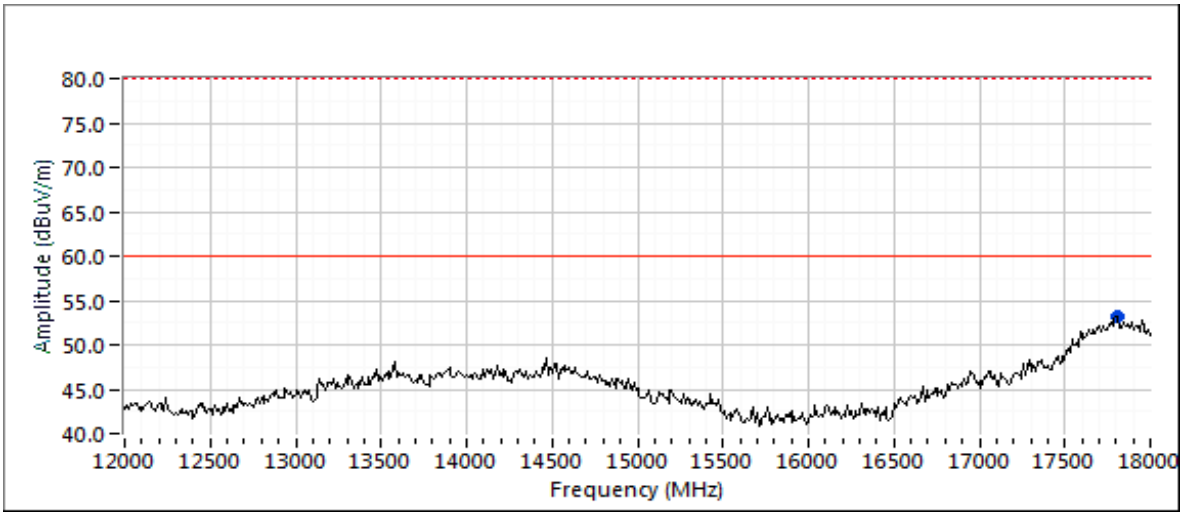
EUT and Test Configuration Details

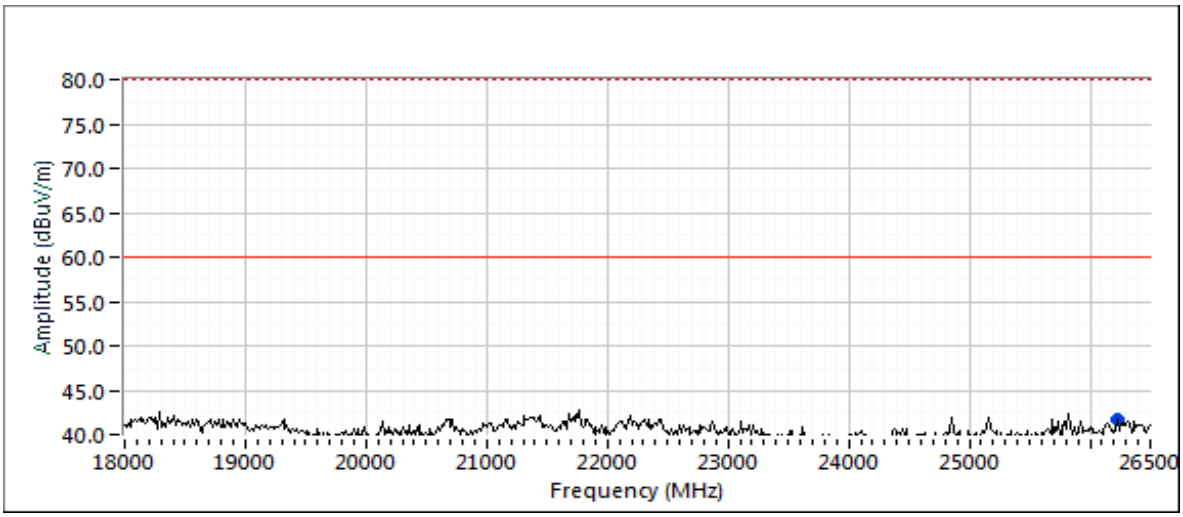
LTE modem (R202) is transmitting at 707.5 MHz (Ch# 23095) with max power, 802.11n20 Ch#36 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



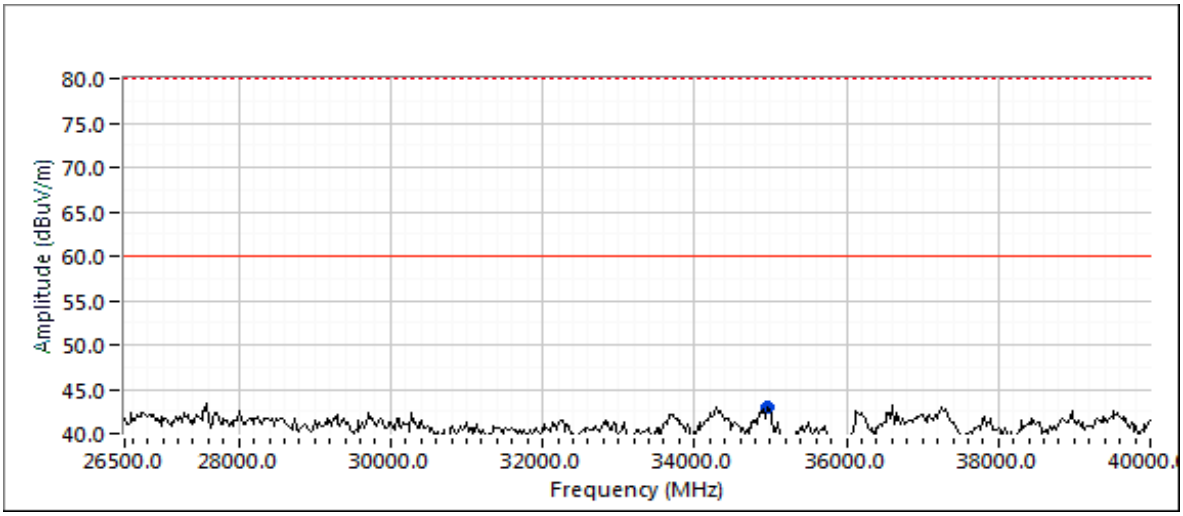


Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A



Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1416.670	*47.3*	*H*	-	-	*Peak*	*306*	*1.8*	*LTE Uplink 2nd harmonic*
5180.330	*95.4*	*H*	-	-	*Peak*	*82*	*1.5*	*Wi-Fi*
8630.000	*46.6*	*V*	-	-	*Peak*	*124*	*2.2*	*Noise floor reading*
11390.000	*48.0*	*V*	-	-	*Peak*	*307*	*2.5*	*Noise floor reading*
17810.000	*53.1*	*H*	-	-	*Peak*	*232*	*1.3*	*Noise floor reading*
26230.830	*41.6*	*H*	-	-	*Peak*	*232*	*2.5*	*Noise floor reading*
34960.000	*42.9*	*V*	-	-	*Peak*	*360*	*2.0*	*Noise floor reading*

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Final peak and average readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 24 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1415.190	**55.9**	H	82.2	**-26.3**	PK	317	1.8	RB 1 MHz;VB 3 MHz;Peak
1416.610	45.0	H	82.2	-37.2	AVG	317	1.8	RB 1 MHz;VB 10 Hz;Peak

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply. For intermodulation emissions, highest emission limit apply.

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020, 3/5/2020
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #7
Config. Used: 3 (Test plan #3)
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	36.4 dBµV/m @ 599.99 MHz (-10.6 dB)
3	Radiated Emissions 1 GHz - 40 GHz Maximized	FCC Class A FCC Part 15E, 27	Pass	48.1 dBµV/m @ 6930.1 MHz (-34.1 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

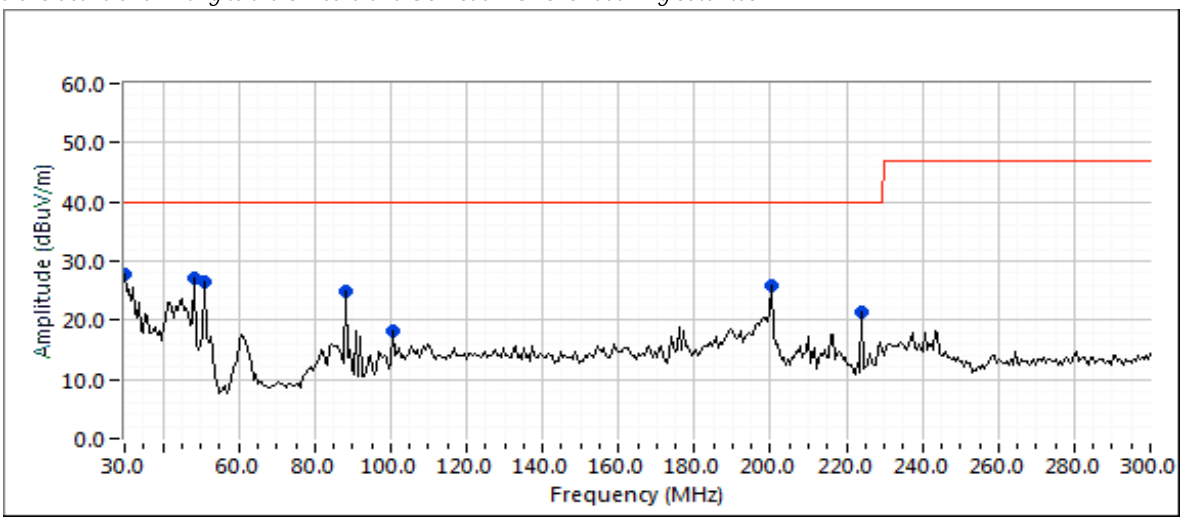
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

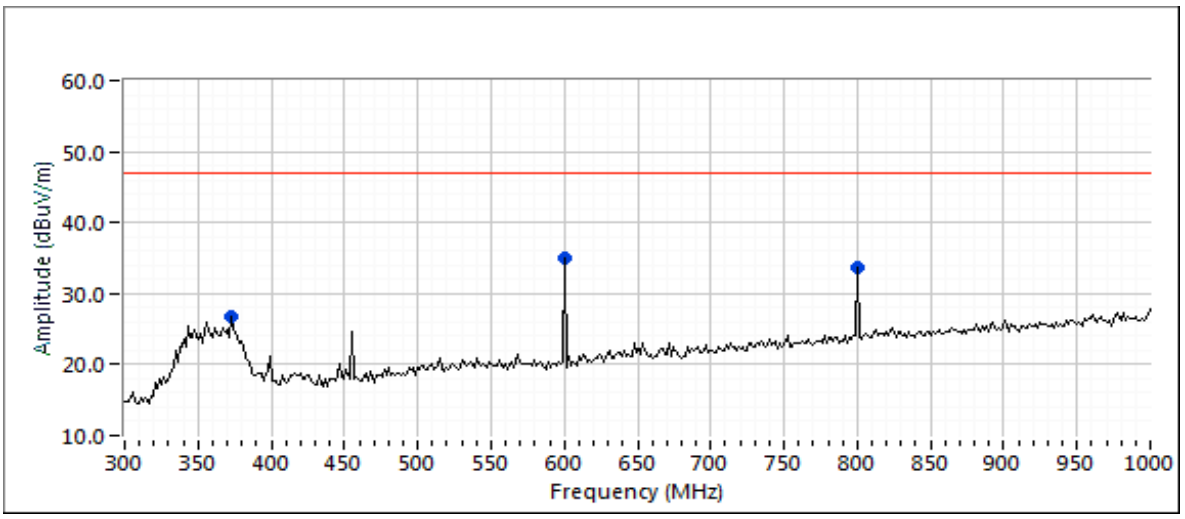
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R202) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11n20 Ch#100 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.000	*27.7*	*V*	*40.0*	*-12.3*	*Peak*	*54*	*1.5*	
48.397	*27.0*	*V*	*40.0*	*-13.0*	*Peak*	*228*	*1.5*	
51.102	*26.5*	*V*	*40.0*	*-13.5*	*Peak*	*286*	*1.0*	
88.437	*25.0*	*V*	*40.0*	*-15.0*	*Peak*	*346*	*4.0*	
100.341	*18.1*	*V*	*40.0*	*-21.9*	*Peak*	*276*	*1.0*	
200.441	*25.7*	*V*	*40.0*	*-14.3*	*Peak*	*172*	*1.0*	
224.248	*21.3*	*H*	*40.0*	*-18.7*	*Peak*	*37*	*2.0*	
371.543	*26.5*	*H*	*47.0*	*-20.5*	*Peak*	*48*	*1.0*	
600.200	*35.2*	*H*	*47.0*	*-11.8*	*Peak*	*113*	*2.5*	
800.802	*31.3*	*H*	*47.0*	*-15.7*	*Peak*	*332*	*1.5*	

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.114	26.0	V	40.0	-14.0	QP	0	1.5	QP (1.00s)
46.671	14.5	V	40.0	-25.5	QP	0	1.5	QP (1.00s)
48.846	13.2	V	40.0	-26.8	QP	360	1.0	QP (1.00s)
88.507	25.0	V	40.0	-15.0	QP	360	4.0	QP (1.00s)
100.271	19.4	V	40.0	-20.6	QP	276	1.0	QP (1.00s)
200.003	25.2	V	40.0	-14.8	QP	172	1.0	QP (1.00s)
224.005	22.4	H	40.0	-17.6	QP	43	1.9	QP (1.00s)
370.856	23.9	H	47.0	-23.1	QP	48	1.0	QP (1.00s)
599.990	36.4	H	47.0	-10.6	QP	114	2.3	QP (1.00s)
800.002	31.7	H	47.0	-15.3	QP	248	1.6	QP (1.00s)

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
599.990	**36.4**	H	47.0	**-10.6**	QP	114	2.3	QP (1.00s)
48.846	29.3	V	40.0	-10.7	QP	360	1.0	QP (1.00s)
200.003	26.4	V	40.0	-13.6	QP	172	1.0	QP (1.00s)
30.114	26.0	V	40.0	-14.0	QP	0	1.5	QP (1.00s)
88.507	25.0	V	40.0	-15.0	QP	360	4.0	QP (1.00s)
800.002	31.7	H	47.0	-15.3	QP	248	1.6	QP (1.00s)
224.005	22.4	H	40.0	-17.6	QP	43	1.9	QP (1.00s)
100.271	19.4	V	40.0	-20.6	QP	276	1.0	QP (1.00s)

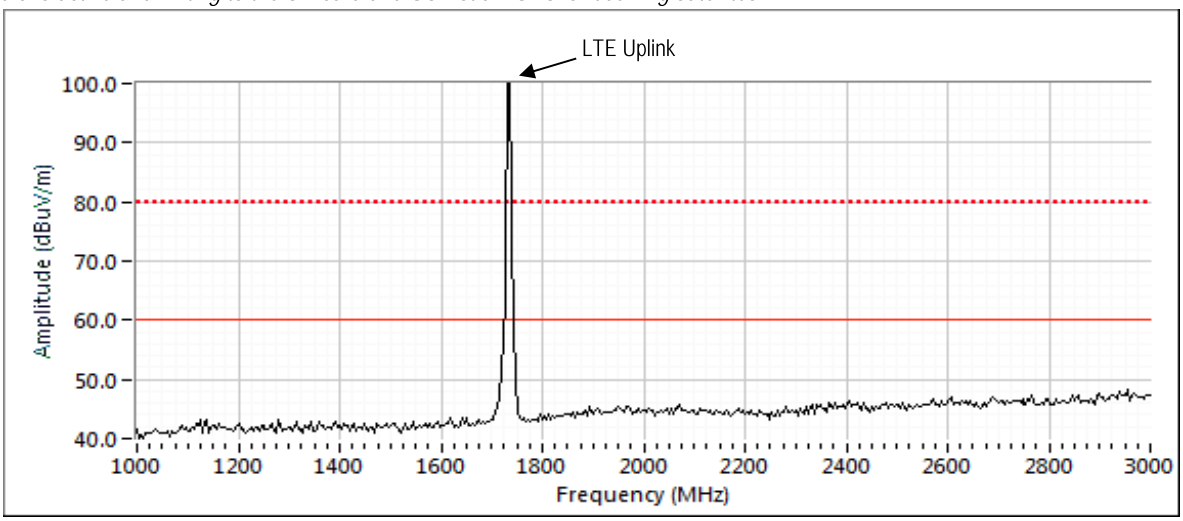
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

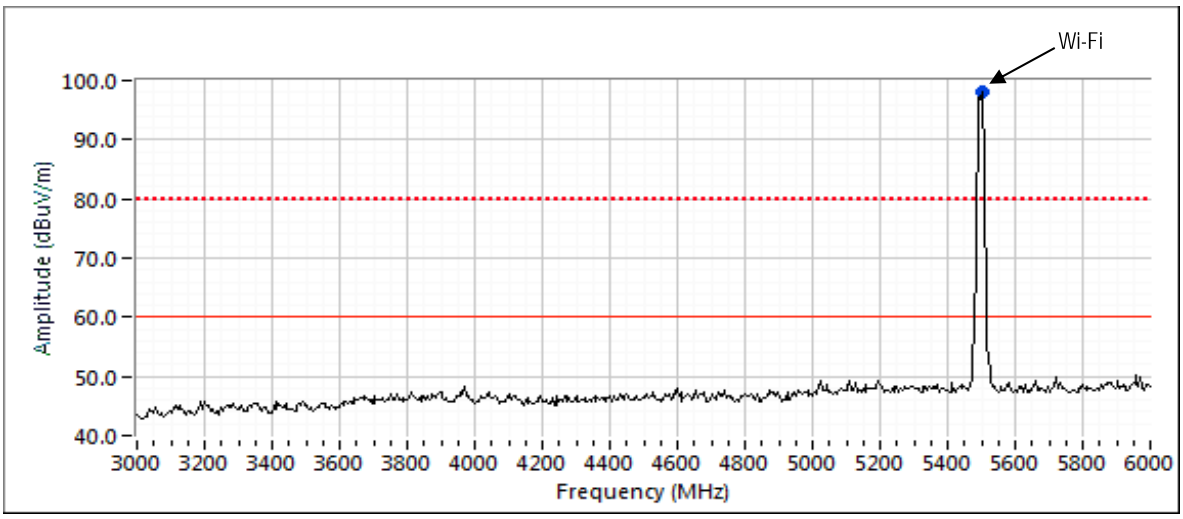
Run #3: Maximized Readings, 1000 - 40000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 40000	3	3	0.0

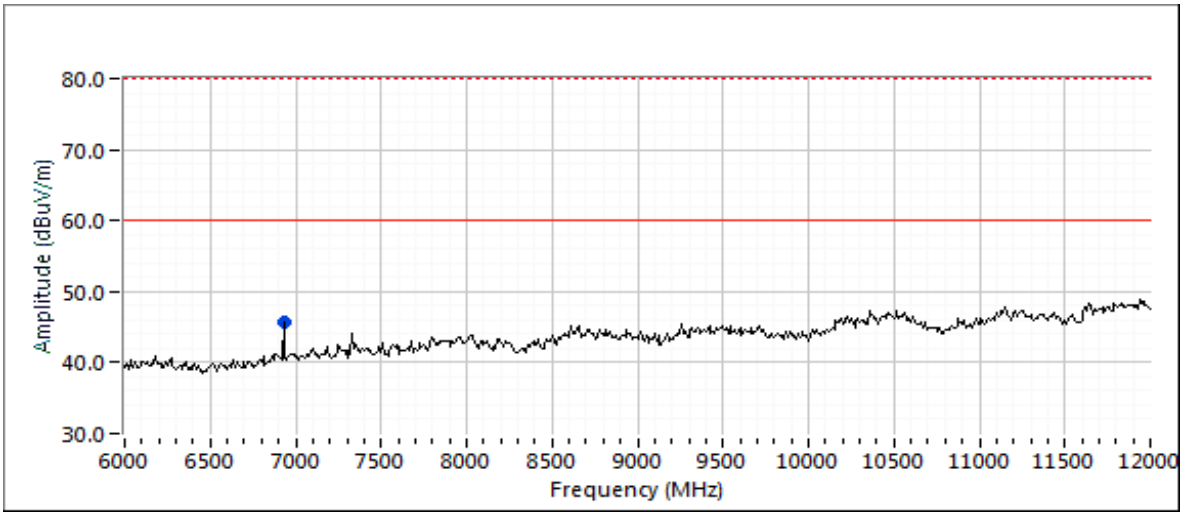
EUT and Test Configuration Details

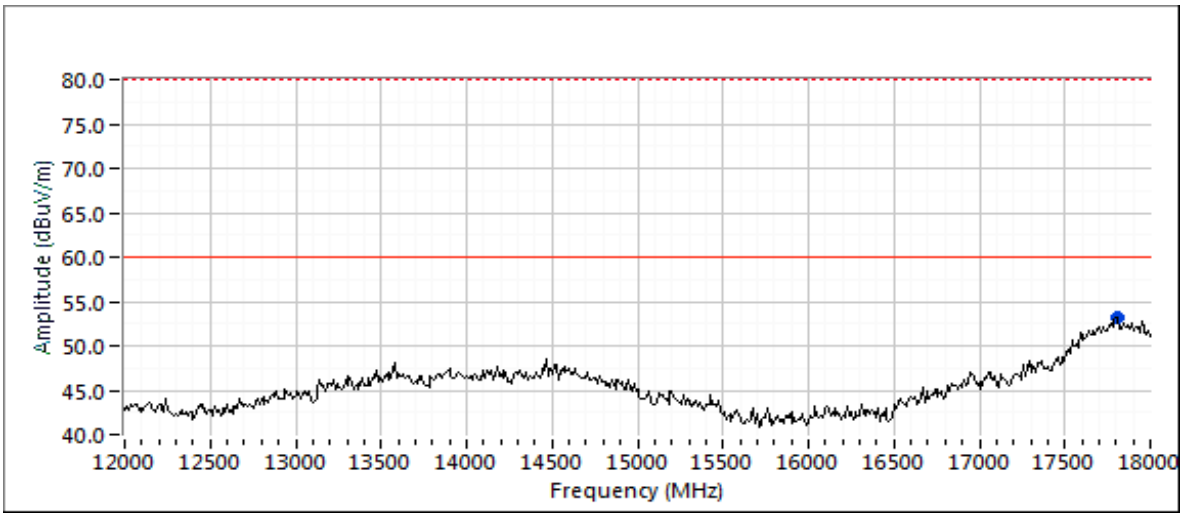
LTE modem (R202) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11n20 Ch#100 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



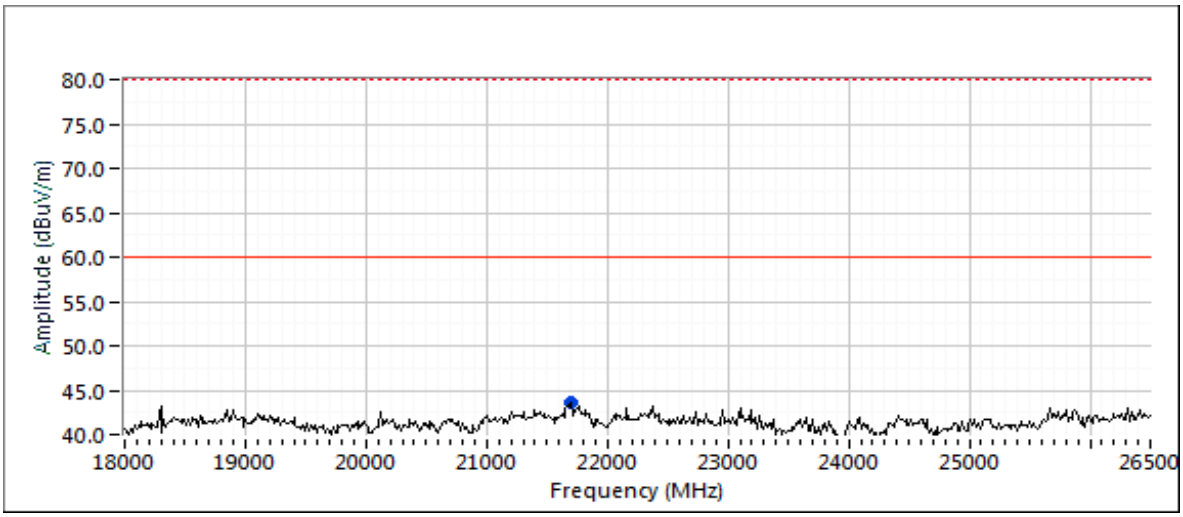


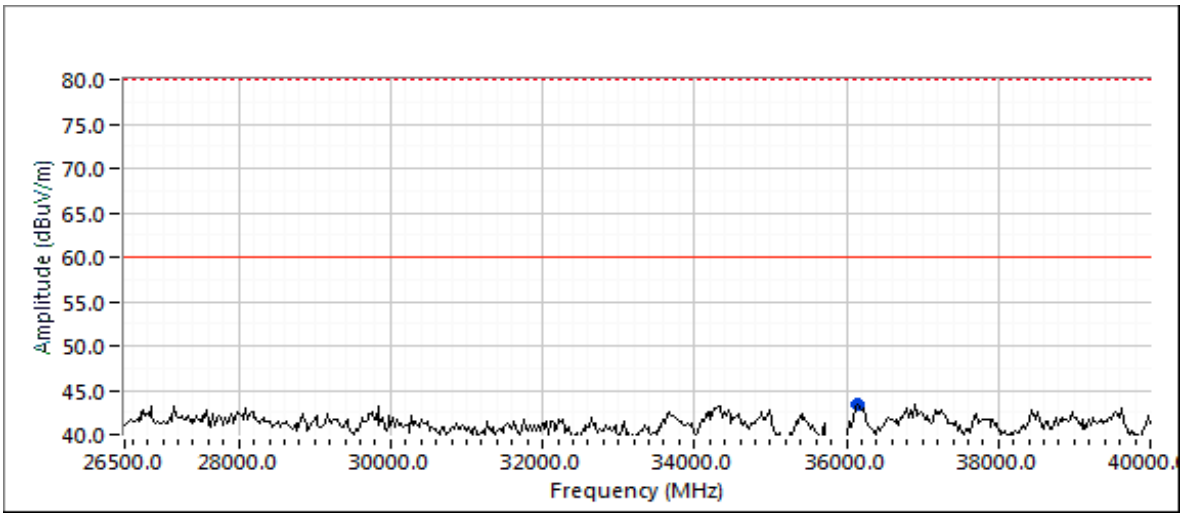
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1732.460	*107.5*	*V*	-	-	*Peak*	*154*	*1.0*	*LTE*
5500.000	*98.2*	*V*	-	-	*Peak*	*285*	*1.5*	*Wi-Fi*
6930.000	*45.8*	*V*	*60.0*	*-14.2*	*Peak*	*191*	*1.5*	*LTE 4th harmonic.*
17820.000	*48.3*	*H*	-	-	*Peak*	*215*	*1.0*	*Noise floor reading*
21697.500	*43.7*	*V*	-	-	*Peak*	*126*	*1.0*	*Noise floor reading*
36152.500	*43.4*	*V*	-	-	*Peak*	*222*	*1.3*	*Noise floor reading*

Final peak and average readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 27 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6930.070	48.1	V	82.2	-34.1	Sample	194	1.6	RB 1 MHz;VB 3 MHz;Sample

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Wi-Fi harmonics, FCC Part 15E limits apply. For LTE harmonics, FCC Part 27 limits apply. For intermodulation emissions, highest emission limit apply.

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020, 3/5/2020
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #7
Config. Used: 4 (Test plan #4)
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	36.8 dBµV/m @ 599.99 MHz (-10.2 dB)
3	Radiated Emissions 1 GHz - 40 GHz Maximized	FCC Class A FCC Part 15E, 22	Pass	62.1 dBµV/m @ 17475.4 MHz (-6.1 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

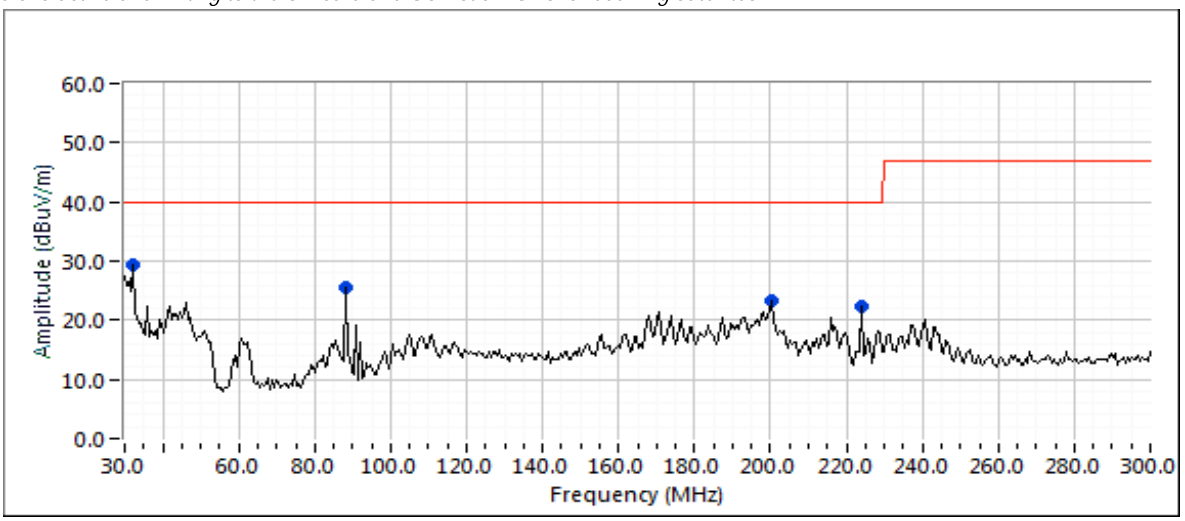
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

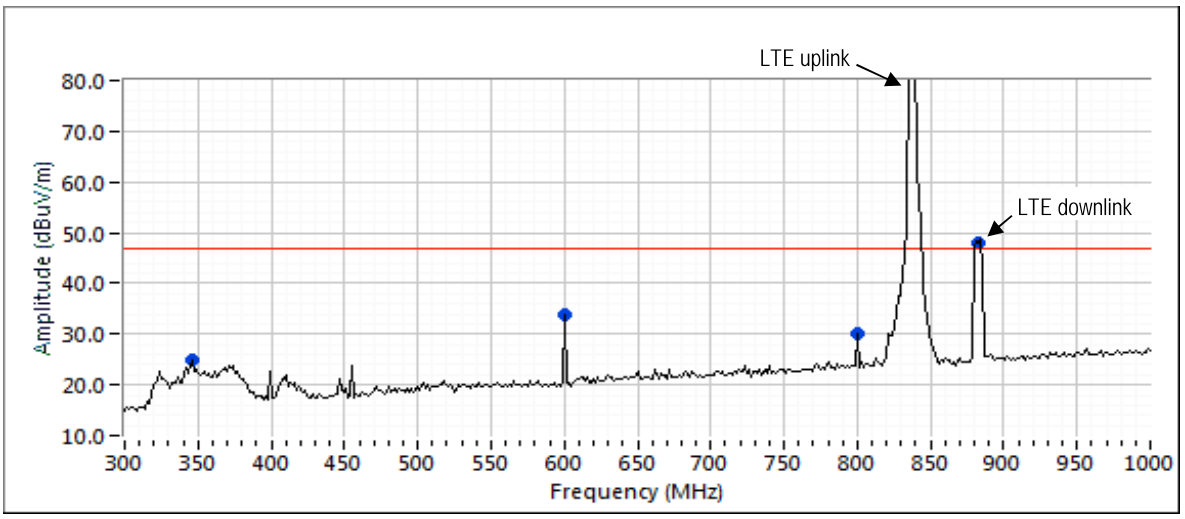
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R202) is transmitting at 836.5 MHz (Ch# 20525) with max power, 802.11n20 Ch#165 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
32.164	*29.5*	*V*	*40.0*	*-10.5*	*Peak*	*239*	*3.0*	
88.437	*25.6*	*V*	*40.0*	*-14.4*	*Peak*	*346*	*4.0*	
200.441	*23.2*	*H*	*40.0*	*-16.8*	*Peak*	*44*	*2.0*	
224.248	*22.3*	*H*	*40.0*	*-17.7*	*Peak*	*48*	*1.5*	
346.293	*24.9*	*H*	*47.0*	*-22.1*	*Peak*	*47*	*1.0*	
600.200	*33.8*	*H*	*47.0*	*-13.2*	*Peak*	*130*	*1.0*	
800.802	*30.2*	*V*	*47.0*	*-16.8*	*Peak*	*184*	*2.5*	
836.577	*87.5*	*H*	-	-	*Peak*	*184*	*3.0*	*LTE uplink*
881.502	*48.1*	*H*	-	-	*Peak*	*75*	*1.5*	*LTE downlink*

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.088	26.7	V	40.0	-13.3	QP	180	1.1	QP (1.00s)
88.507	24.3	V	40.0	-15.7	QP	360	4.0	QP (1.00s)
200.003	25.3	H	40.0	-14.7	QP	49	2.6	QP (1.00s)
224.005	23.3	H	40.0	-16.7	QP	49	2.0	QP (1.00s)
350.487	22.6	H	47.0	-24.4	QP	50	4.0	QP (1.00s)
599.990	36.7	H	47.0	-10.3	QP	130	1.0	QP (1.00s)
800.002	32.1	V	47.0	-14.9	QP	139	1.0	QP (1.00s)

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 22/32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
599.990	**36.8**	H	47.0	**-10.2**	QP	130	1.0	QP (1.00s)
30.088	26.7	V	40.0	-13.3	QP	180	1.1	QP (1.00s)
800.002	32.7	V	47.0	-14.3	QP	139	1.0	QP (1.00s)
200.003	25.3	H	40.0	-14.7	QP	49	2.6	QP (1.00s)
88.507	24.3	V	40.0	-15.7	QP	360	4.0	QP (1.00s)
224.005	23.3	H	40.0	-16.7	QP	49	2.0	QP (1.00s)
350.487	22.6	H	47.0	-24.4	QP	50	4.0	QP (1.00s)

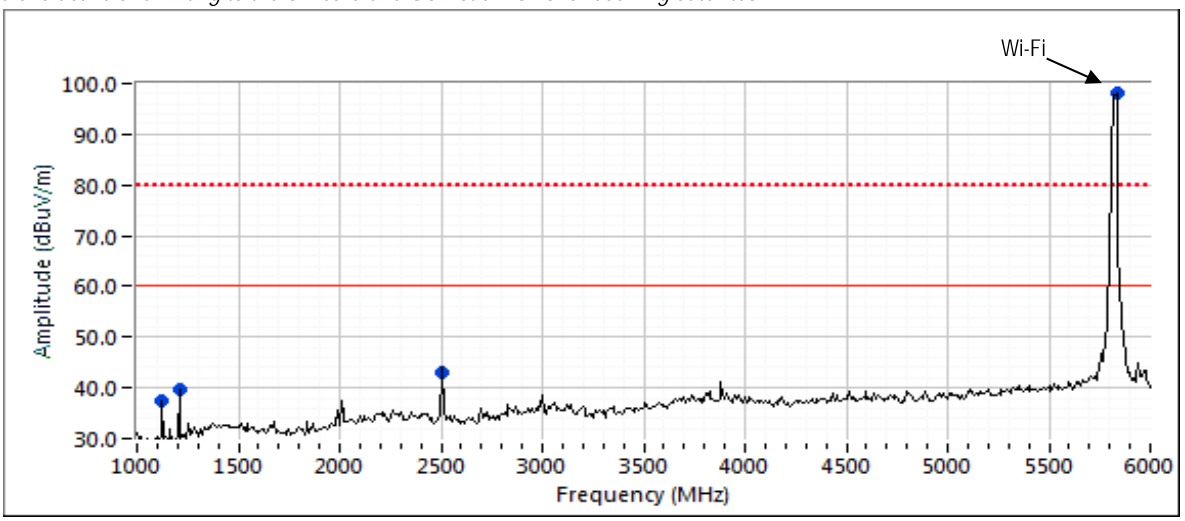
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

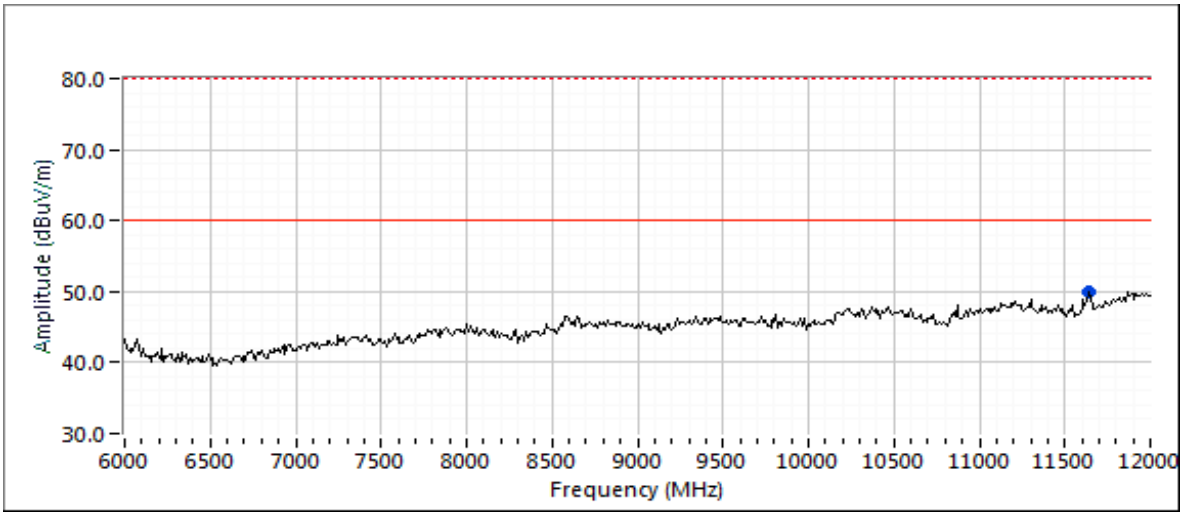
Run #3: Maximized Readings, 1000 - 40000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 40000	3	3	0.0

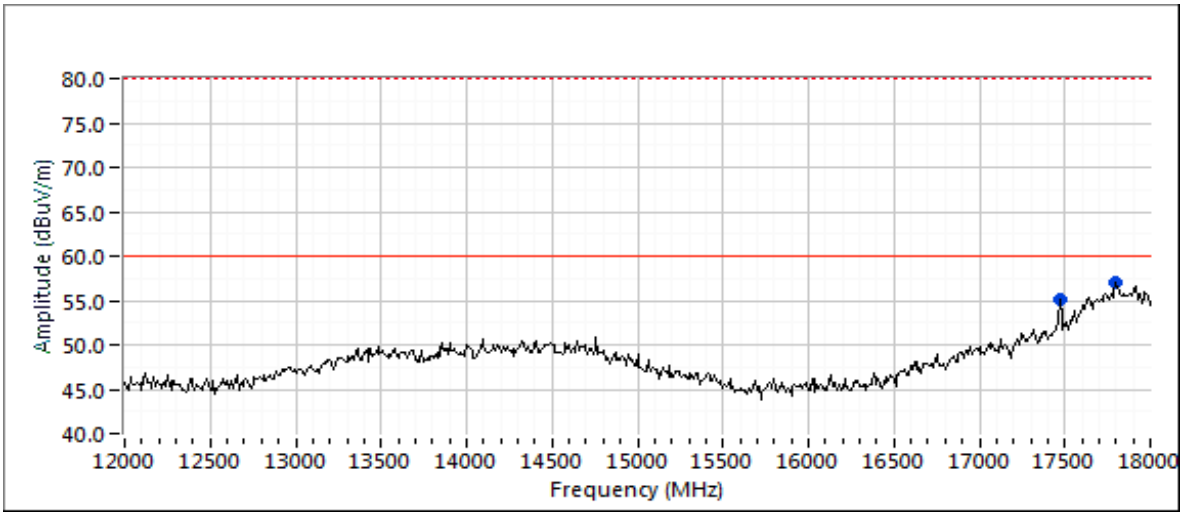
EUT and Test Configuration Details

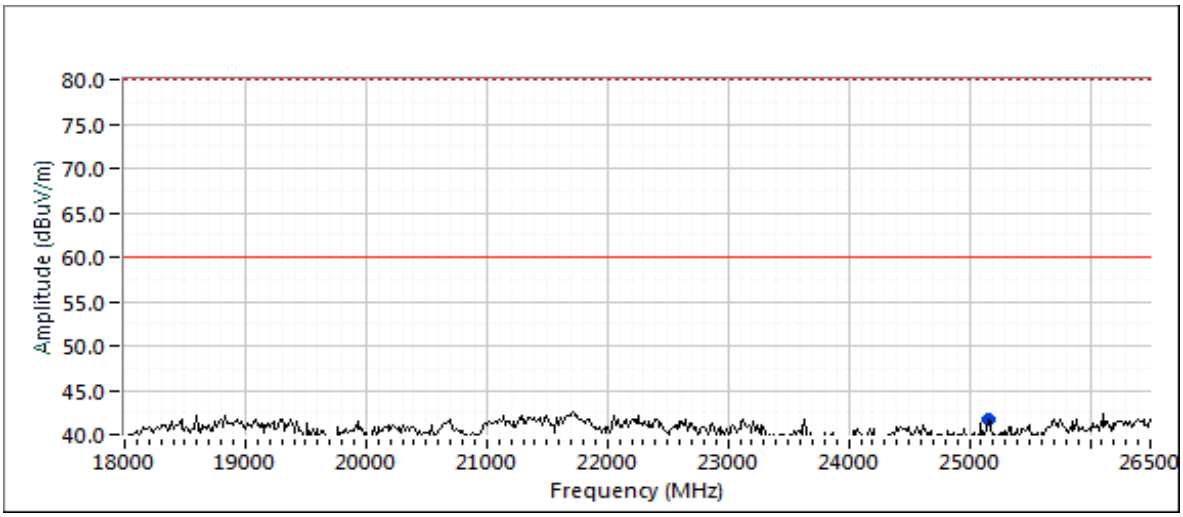
LTE modem (R202) is transmitting at 836.5 MHz (Ch# 20525) with max power, 802.11n20 Ch#165 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



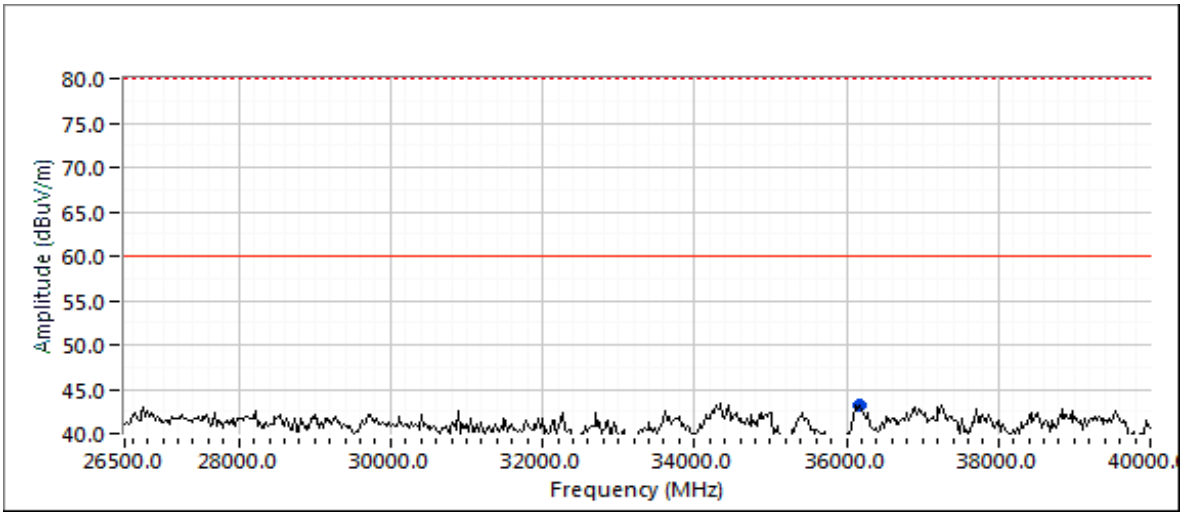


Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A



Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1125.000	*37.3*	*V*	*60.0*	*-22.7*	*Peak*	*158*	*2.5*	
1208.330	*39.7*	*V*	*60.0*	*-20.3*	*Peak*	*90*	*1.3*	
2500.000	*42.9*	*V*	*60.0*	*-17.1*	*Peak*	*36*	*1.8*	
5833.330	*98.0*	*V*	-	-	*Peak*	*72*	*1.5*	*Wi-Fi*
11666.000	49.9	H	-	-	Peak	282	1.5	Wi-Fi 2nd harmonic
17496.000	55.2	V	-	-	Peak	93	1.3	Wi-Fi 3rd harmonic
17800.000	*57.0*	*H*	-	-	*Peak*	*86*	*2.0*	*Noise floor reading*
25154.170	*41.7*	*H*	-	-	*Peak*	*121*	*2.0*	*Noise floor reading*
36175.000	*43.2*	*H*	-	-	*Peak*	*354*	*2.3*	*Noise floor reading*

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Final peak and average readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 22 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
17475.380	**62.1**	V	68.2	**-6.1**	PK	114	1.6	RB 1 MHz;VB 3 MHz;Peak
11655.200	55.6	H	68.2	-12.6	PK	282	1.5	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Wi-Fi harmonics, FCC Part 15E limits apply. For LTE harmonics, FCC Part 22 limits apply. For intermodulation emissions, highest emission limit apply.

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/2/2020, 3/6/2020
Test Engineer: John Caizzi
Test Location: Fremont Chamber #4
Config. Used: 5 (Test plan #5)
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	38.9 dBµV/m @ 599.99 MHz (-8.1 dB)
3	Radiated Emissions 1 GHz - 25 GHz Maximized	FCC Class A FCC Part 27, 15.247	Pass	46.6 dBµV/m @ 4824.0 MHz (-7.4 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

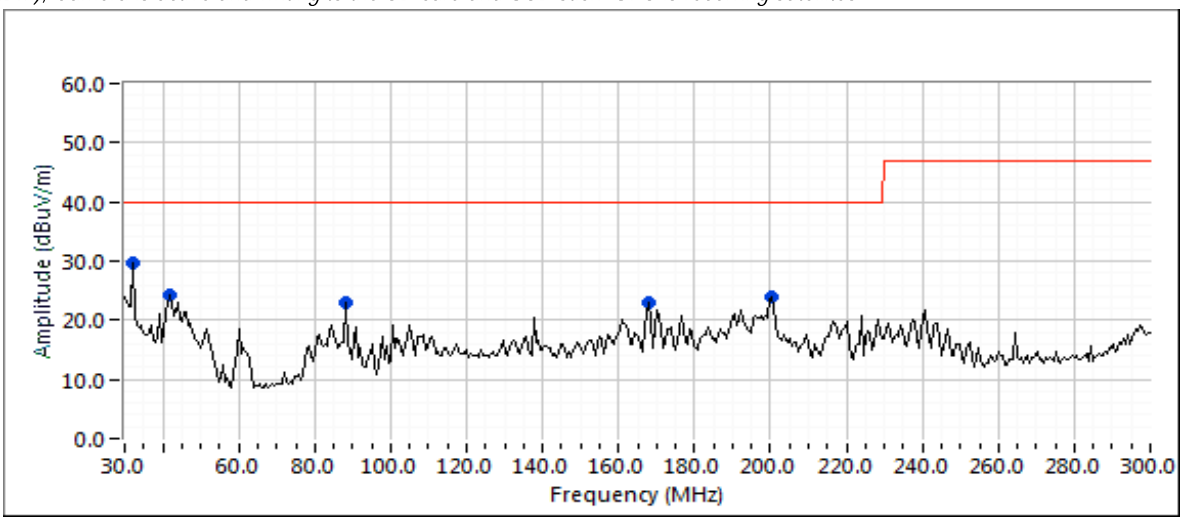
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

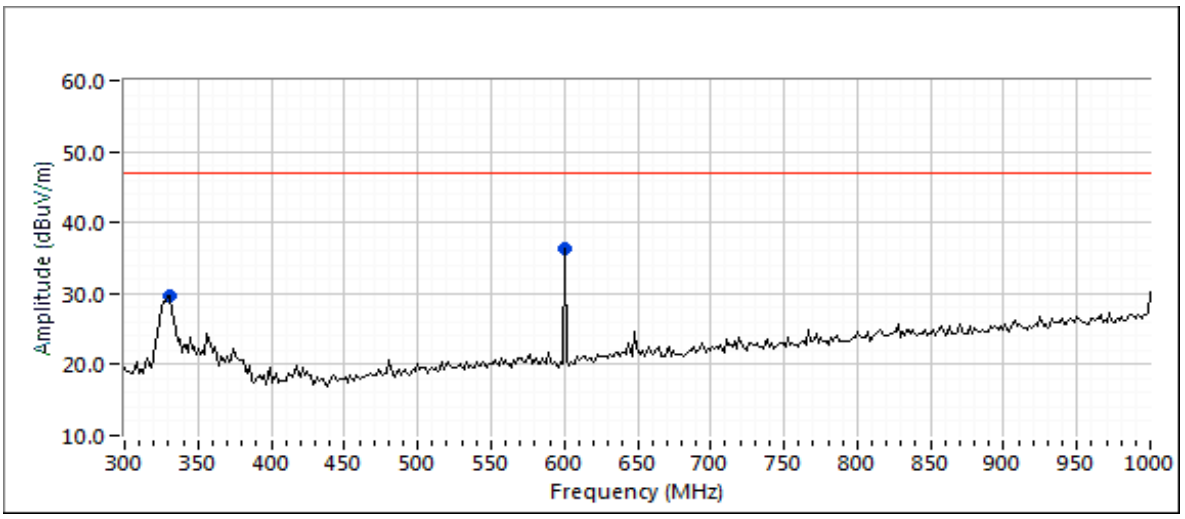
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R204) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11b Ch#1 transmitting with max rated RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
32.164	*29.6*	*V*	*40.0*	*-10.4*	*Peak*	*64*	*2.5*	
41.904	*24.4*	*V*	*40.0*	*-15.6*	*Peak*	*74*	*1.0*	
88.437	*23.0*	*V*	*40.0*	*-17.0*	*Peak*	*332*	*4.0*	
167.976	*23.0*	*V*	*40.0*	*-17.0*	*Peak*	*226*	*1.0*	
200.441	*23.9*	*V*	*40.0*	*-16.1*	*Peak*	*174*	*1.0*	
330.862	*29.8*	*H*	*47.0*	*-17.2*	*Peak*	*52*	*1.5*	
600.200	*36.2*	*H*	*47.0*	*-10.8*	*Peak*	*5*	*3.0*	

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.604	25.8	V	40.0	-14.2	QP	0	1.0	QP (1.00s)
41.520	21.1	V	40.0	-18.9	QP	0	1.0	QP (1.00s)
88.507	22.6	V	40.0	-17.4	QP	332	4.0	QP (1.00s)
167.992	21.6	V	40.0	-18.4	QP	212	1.0	QP (1.00s)
200.022	24.6	V	40.0	-15.4	QP	180	1.0	QP (1.00s)
329.389	27.3	H	47.0	-19.7	QP	52	1.5	QP (1.00s)
599.994	38.9	H	47.0	-8.1	QP	6	3.0	QP (1.00s)

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.604	25.8	V	40.0	-14.2	QP	0	1.0	QP (1.00s)
41.520	21.1	V	40.0	-18.9	QP	0	1.0	QP (1.00s)
88.507	22.6	V	40.0	-17.4	QP	332	4.0	QP (1.00s)
167.992	21.6	V	40.0	-18.4	QP	212	1.0	QP (1.00s)
200.022	24.6	V	40.0	-15.4	QP	180	1.0	QP (1.00s)
329.389	27.3	H	47.0	-19.7	QP	52	1.5	QP (1.00s)
599.994	38.9	H	47.0	**-8.1**	QP	6	3.0	QP (1.00s)

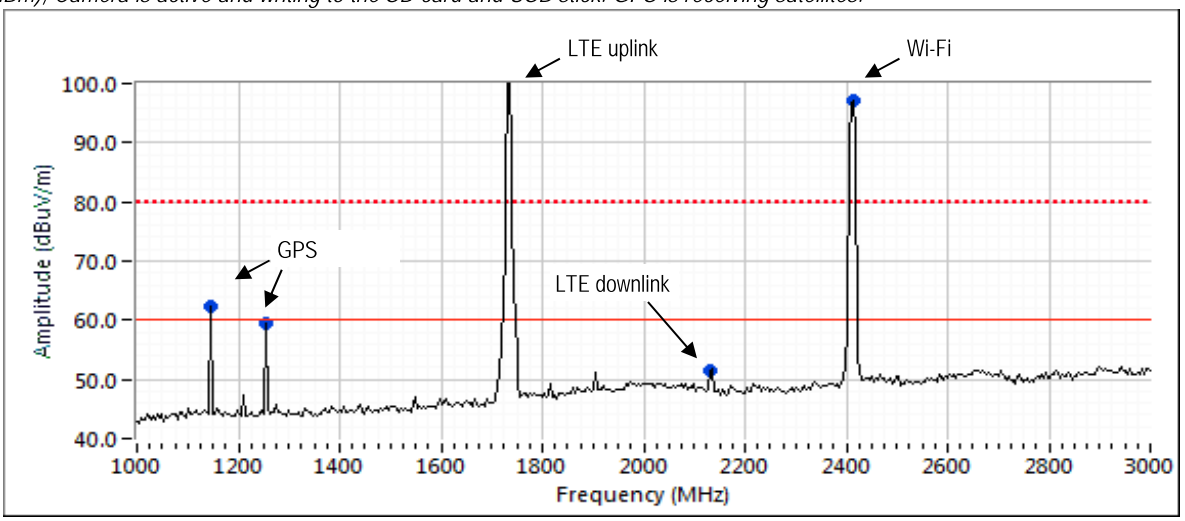
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

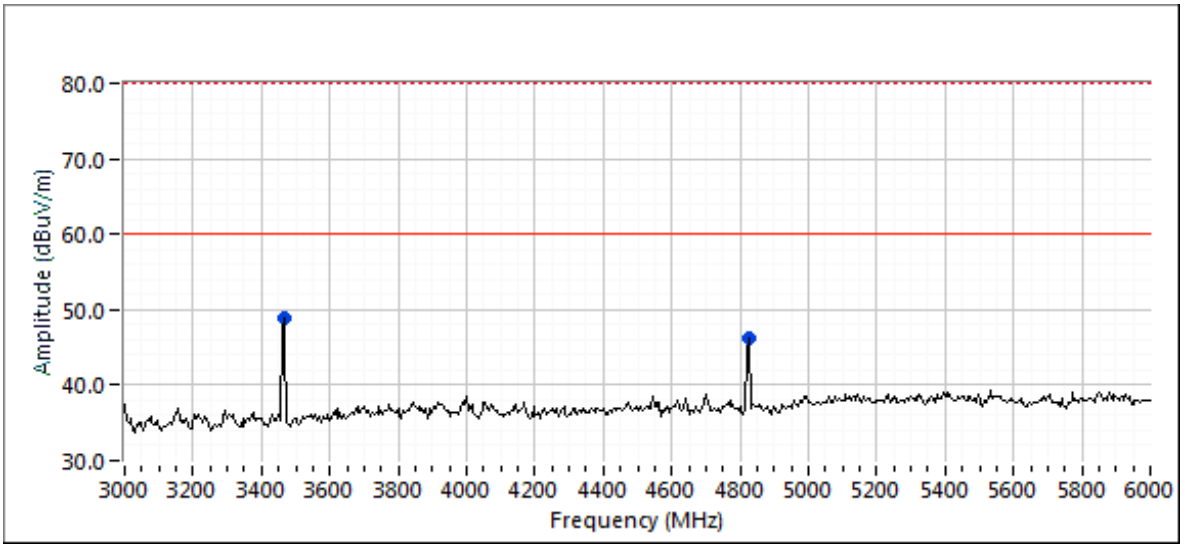
Run #3: Maximized Readings, 1000 - 25000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 25000	3	3	0.0

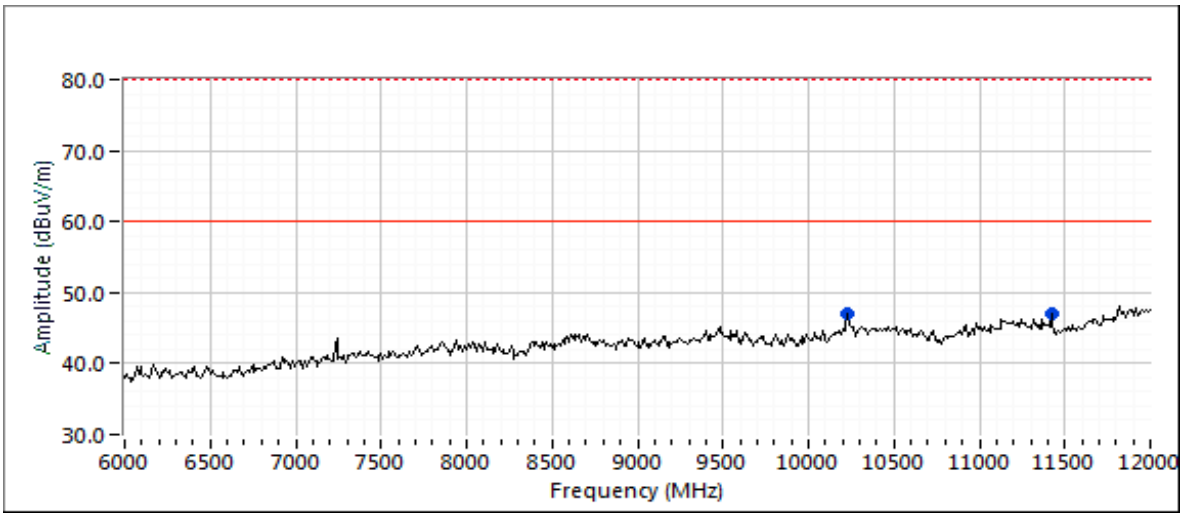
EUT and Test Configuration Details

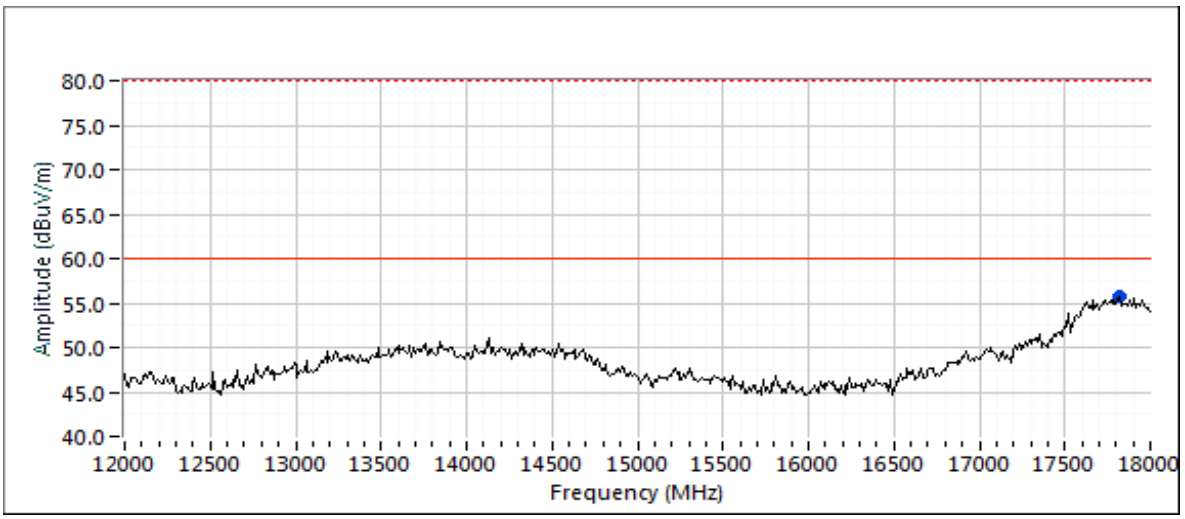
LTE modem (R204) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11b Ch#1 transmitting with max rated RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



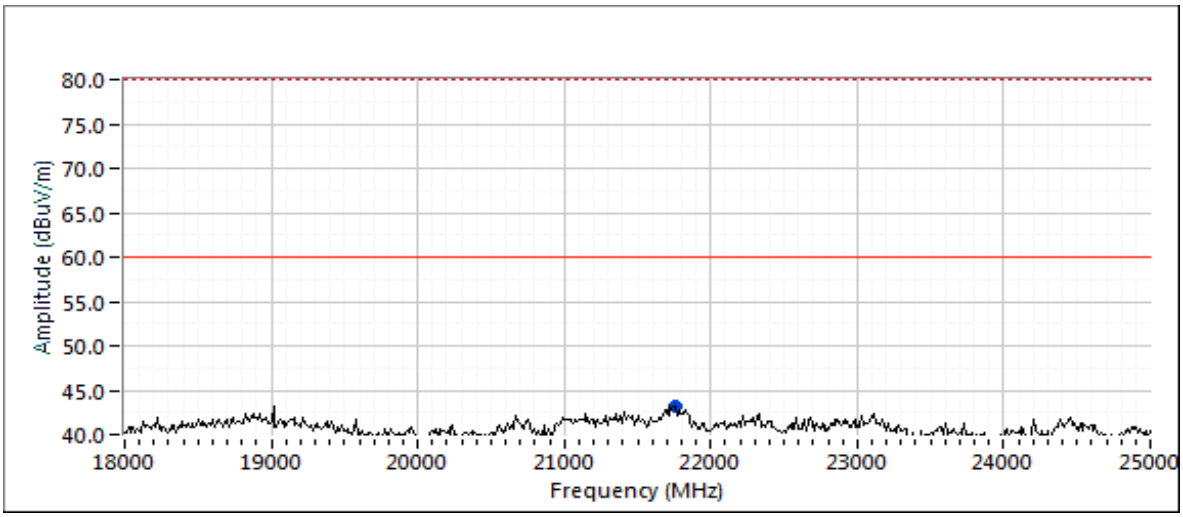


Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A



Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1144.290	*62.3*	*V*	-	-	*Peak*	*24*	*1.5*	*GPS- intermittent*
1256.510	*59.5*	*V*	-	-	*Peak*	*180*	*2.0*	*GPS*
1732.470	*112.1*	*H*	-	-	*Peak*	*293*	*1.3*	*LTE uplink*
2412.750	*97.1*	*H*	-	-	*Peak*	*100*	*2.3*	*Wi-Fi*
2132.450	*51.5*	*H*	-	-	*Peak*	*64*	*1.5*	*LTE downlink*
3465.000	48.8	H	82.2	-33.4	Peak	312	1.8	LTE uplink 2nd harmonic
4824.000	46.1	V	54.0	-7.9	Peak	232	1.5	Wi-Fi 2nd harmonic
10230.000	*46.9*	*V*	-	-	*Peak*	*321*	*1.3*	*Noise floor reading*
11420.000	*47.1*	*V*	-	-	*Peak*	*345*	*1.0*	*Noise floor reading*
17820.000	*55.7*	*H*	-	-	*Peak*	*296*	*2.0*	*Noise floor reading*
21756.670	*43.2*	*H*	-	-	*Peak*	*103*	*1.0*	*Noise floor reading*

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Final peak and average readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 27 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4824.000	46.6	V	54.0	-7.4	AVG	229	1.3	RB 1 MHz;VB 1 kHz;Peak
4824.120	52.0	V	74.0	-22.0	PK	229	1.3	RB 1 MHz;VB 3 MHz;Peak
3465.200	56.7	H	82.2	-25.5	PK	313	1.9	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply. For intermodulation emissions, highest emission limit apply.

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020
Test Engineer: Deniz Demirci, John Caizzi
Test Location: Fremont Chamber #7
Config. Used: 6 (Test plan #6)
Config Change: None
EUT Voltage: 12 V battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 35-37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class A	Eval	Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class A	Pass	39.5 dBµV/m @ 600.00 MHz (-7.5 dB)
3	Radiated Emissions 1 GHz - 25 GHz Maximized	FCC Class A FCC Part 27, 15.247	Pass	52.3 dBµV/m @ 7205.9 MHz (-1.7 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

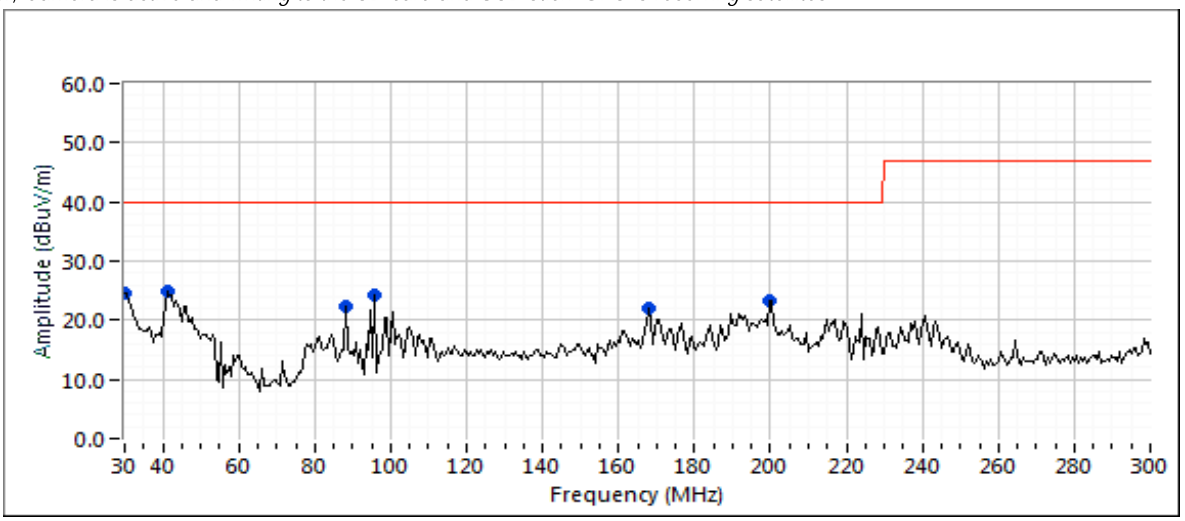
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

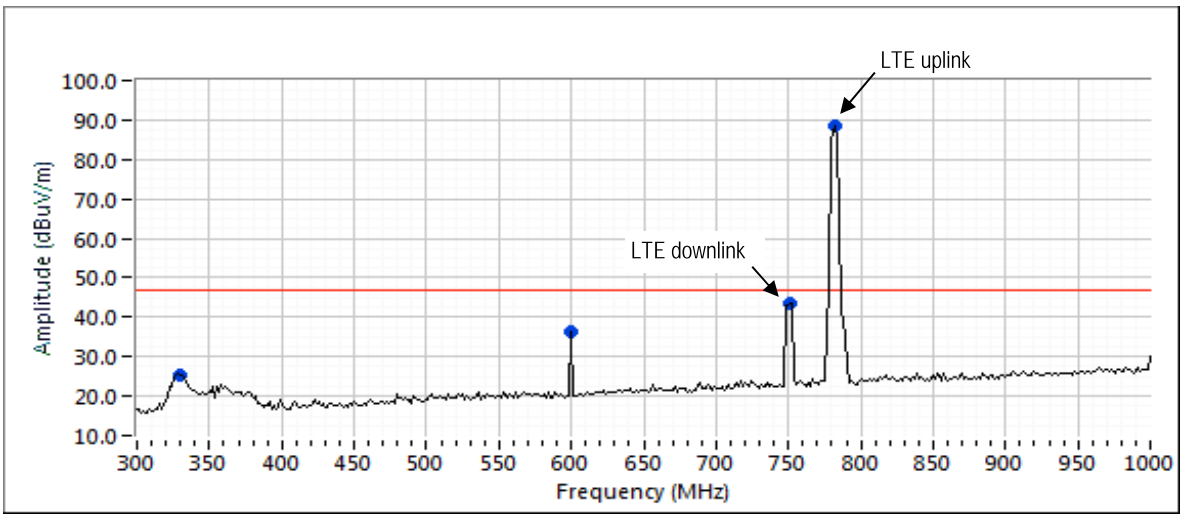
Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

EUT and Test Configuration Details

LTE modem (R204) is transmitting at 782 MHz (Ch# 23230) with max power, Bluetooth EDR Ch#0 transmitting with max rated RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.000	*24.7*	*V*	*40.0*	*-15.3*	*Peak*	*239*	*2.5*	
41.363	*24.9*	*V*	*40.0*	*-15.1*	*Peak*	*24*	*1.0*	
88.437	*22.3*	*V*	*40.0*	*-17.7*	*Peak*	*329*	*3.0*	
96.012	*24.2*	*V*	*40.0*	*-15.8*	*Peak*	*192*	*1.5*	
167.976	*22.0*	*H*	*40.0*	*-18.0*	*Peak*	*34*	*2.5*	
199.900	*23.4*	*V*	*40.0*	*-16.6*	*Peak*	*185*	*1.0*	
329.459	*25.4*	*H*	*47.0*	*-21.6*	*Peak*	*58*	*1.5*	
600.200	*36.5*	*H*	*47.0*	*-10.5*	*Peak*	*2*	*2.5*	
751.003	*43.4*	*H*	-	-	*Peak*	*60*	*3.5*	*LTE downlink*
782.005	*88.3*	*V*	-	-	*Peak*	*212*	*1.0*	*LTE uplink*

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.022	26.4	V	40.0	-13.6	QP	209	1.0	QP (1.00s)
42.391	18.2	V	40.0	-21.8	QP	64	1.0	QP (1.00s)
88.518	19.0	V	40.0	-21.0	QP	200	4.0	QP (1.00s)
94.140	17.5	V	40.0	-22.5	QP	166	1.2	QP (1.00s)
200.007	26.2	V	40.0	-13.8	QP	182	1.0	QP (1.00s)
600.004	39.5	H	47.0	-7.5	QP	354	2.6	QP (1.00s)

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	CISPR 32 Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.022	26.4	V	40.0	-13.6	QP	209	1.0	QP (1.00s)
42.391	18.2	V	40.0	-21.8	QP	64	1.0	QP (1.00s)
88.518	19.0	V	40.0	-21.0	QP	200	4.0	QP (1.00s)
94.140	17.5	V	40.0	-22.5	QP	166	1.2	QP (1.00s)
200.007	26.2	V	40.0	-13.8	QP	182	1.0	QP (1.00s)
600.004	39.5	H	47.0	**-7.5**	QP	354	2.6	QP (1.00s)

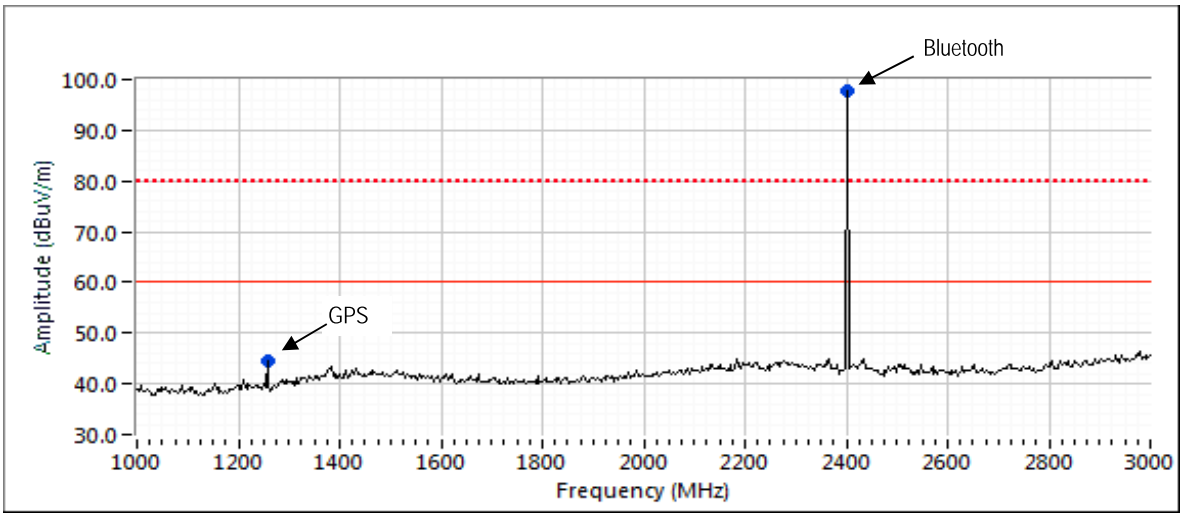
Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

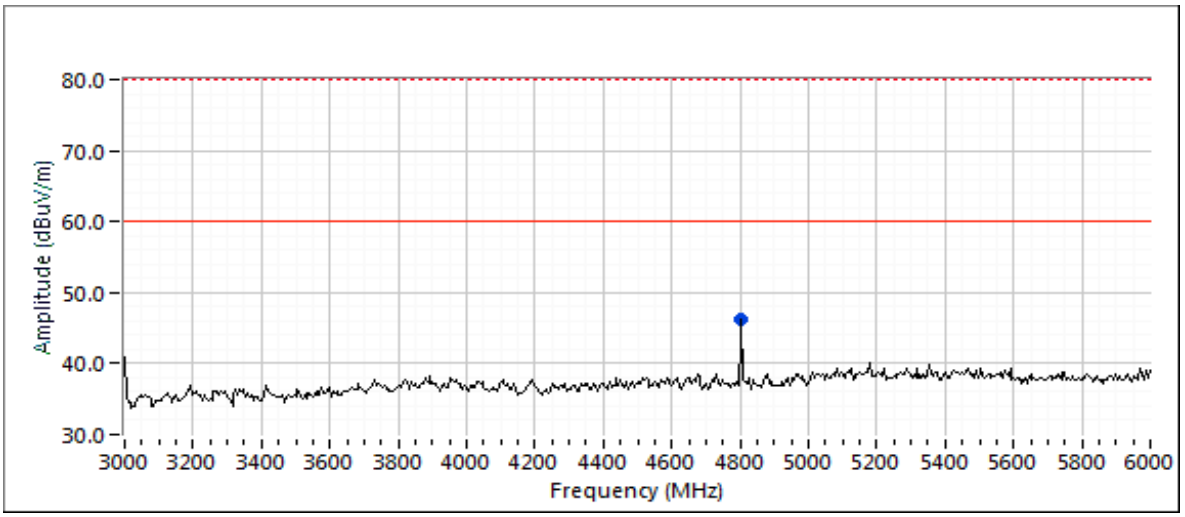
Run #3: Maximized Readings, 1000 - 25000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
1000 - 25000	3	3	0.0

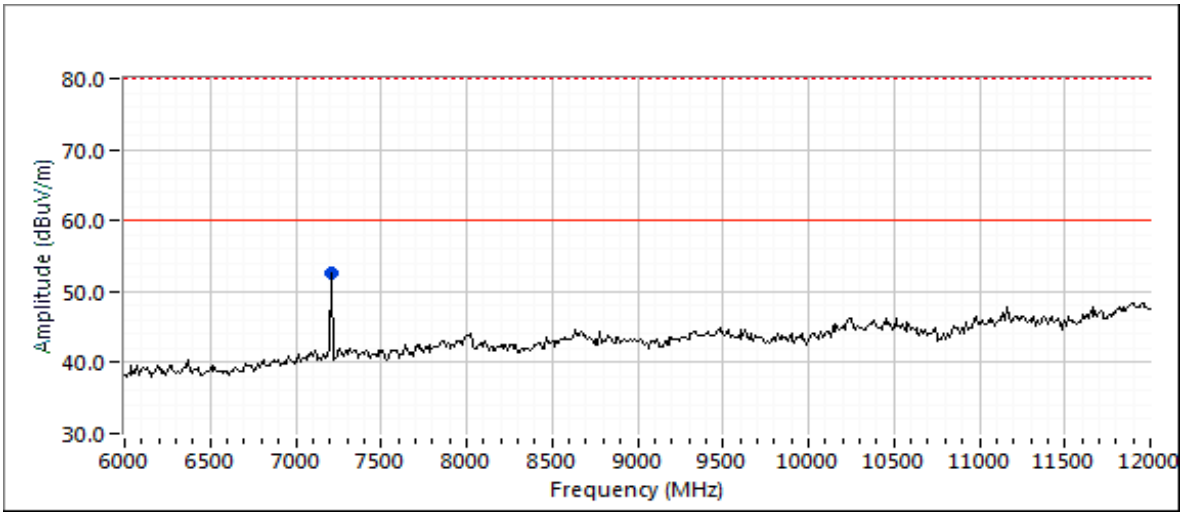
EUT and Test Configuration Details

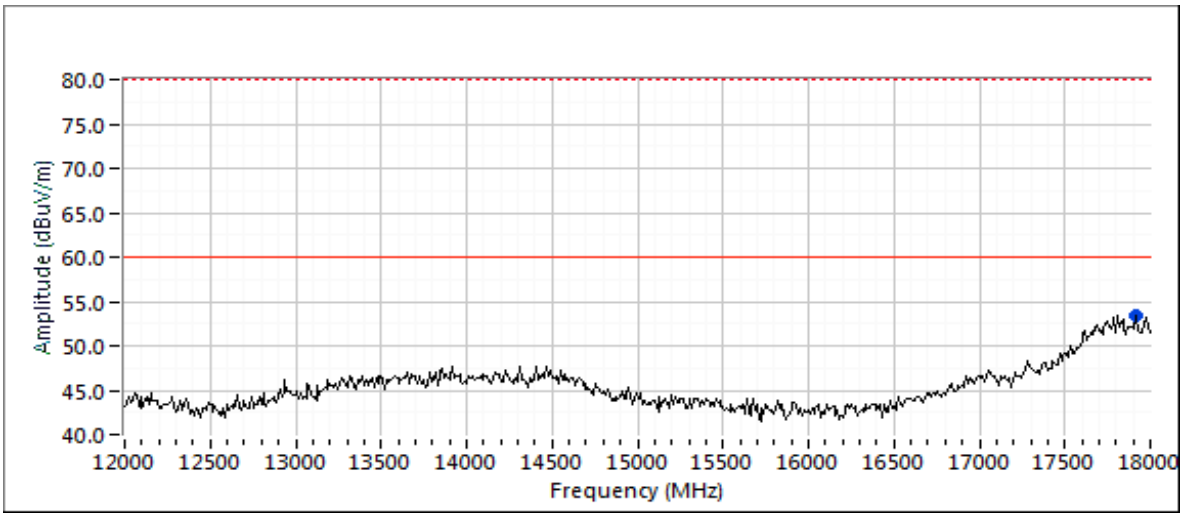
LTE modem (R204) is transmitting at 782 MHz (Ch# 23230) with max power, Bluetooth EDR Ch#0 transmitting with max rated RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A





Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
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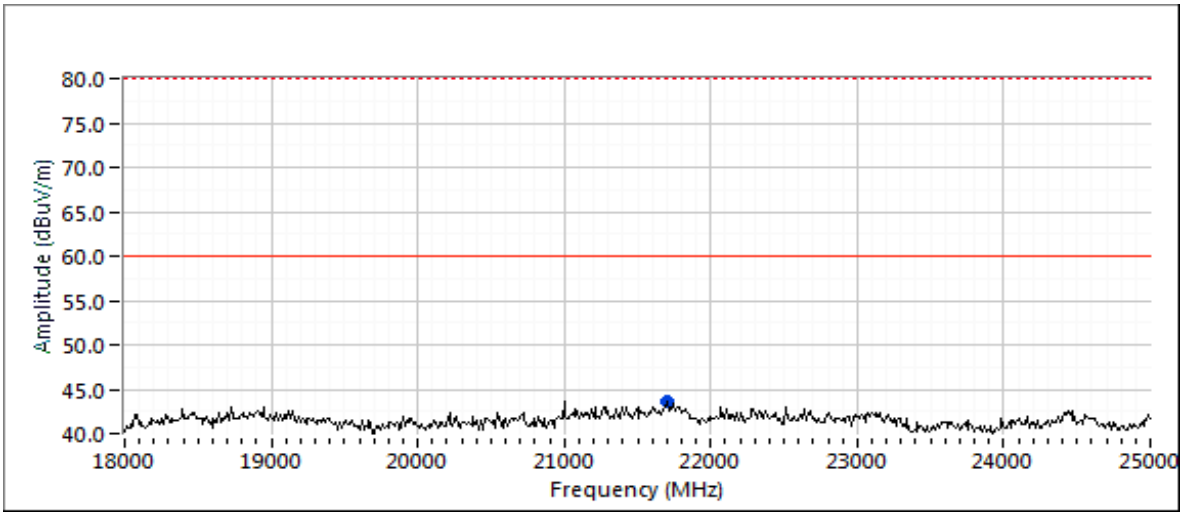

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC 15 B Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1256.670	*44.7*	*V*	-	-	*Peak*	*185*	*1.8*	*GPS*
2402.030	*97.7*	*H*	-	-	*Peak*	*108*	*1.8*	*Bluetooth*
4804.000	*46.3*	*V*	-	-	*Peak*	*229*	*1.3*	*Bluetooth 2nd harmonic.*
7206.000	*52.7*	*V*	-	-	*Peak*	*322*	*1.8*	*Bluetooth 3rd harmonic.*
17920.000	*53.4*	*V*	-	-	*Peak*	*210*	*1.3*	*Noise floor reading*
21698.330	*43.6*	*V*	-	-	*Peak*	*154*	*1.0*	*Noise floor reading*

Client:	Hexagon Mining	PR Number:	PR113292
Model:	HxGN MineProtect OAS-LV 202 and 204	T-Log Number:	TL113292
		Project Manager:	Christine Krebill
Contact:	Marco Carvalho	Project Engineer:	Deniz Demirci
Standard:	FCC 15B, CISPR 32, EN 301 489	Class:	A

Final peak and average readings

Frequency	Level	Pol	FCC 15 B Class A FCC Part 27 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4803.950	45.7	V	54.0	-8.3	AV	228	1.4	RB 1 MHz;VB 3 kHz;Peak
4804.070	51.6	V	74.0	-22.4	PK	228	1.4	RB 1 MHz;VB 3 MHz;Peak
7205.870	52.3	V	54.0	-1.7	AV	313	1.9	RB 1 MHz;VB 3 kHz;Peak
7206.410	57.7	V	74.0	-16.3	PK	313	1.9	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.
Note 2:	For Bluetooth harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply. For intermodulation emissions, highest emission limit apply.

Appendix C Product Labeling Requirements

The following information has been provided to clarify notification, equipment labeling requirements and information that must be included in the operator's manual. These requirements may be found in the standards/regulations listed in the scope of this report.

Label Location

The required label(s) must be in a *conspicuous location* on the product, which is defined as any location readily visible to the user of the device without the use of tools.

Label Attachment

The label(s) must be *permanently attached* to the product, which is defined as attached such that it can normally be expected to remain fastened to the equipment during the equipment's expected useful life. A paper gum label will generally not meet this condition.

United States Class A Label

> This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

If the device is too small or for such use that it is not practicable to place the US label statement on it, the statement shall be placed in a prominent location in the instruction manual or pamphlet supplied in paper form with the product. If not it shall be placed on the container in which the device is marketed or on a paper insert or removable tag on the product.

For FCC, a unique identifier shall appear on the product label. The importer or manufacturer shall maintain adequate identification records to facilitate positive identification of each product sold.

United States Supplier's Declaration of Conformity Label

In addition to the two-part statement detailed above, the labeling on the device may include the FCC logo.
An example of the FCC logo is shown below:

Industry Canada

For ICES-003 Issue 6, the product must be labeled with the following Innovation, Science and Economic Development Canada ICES-003 Compliance Label:

CAN ICES-3 (*)/NMB-3(*)

*Insert either “A” or “B” but not both to identify the applicable Class of ITE.

If the product is too small then the text may be placed in the manual with the approval of ISED Canada.

Appendix D User Manual Regulatory Statements

Where special accessories, such as shielded cables, are required in order to meet the emission limits, appropriate instructions regarding the need to use such accessories must be contained on the first page of text concerned with the installation of the device in the operator's manual.

A requirement by FCC regulations, and recommended for all regulatory markets, is a cautionary statement to the end user that changes or modifications to the device not expressly approved by you, the manufacturer, could void their right to operate the equipment.

United States Class A Manual Statement

> **NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note: Additional information about corrective measures may also be provided to the user at the company's option.

The FCC has indicated that the radio interference statement be bound in the same manner as the operator's manual. Thus, a loose-leaf insert page in a bound or center-spine and stapled manual would not meet this condition.

United States Supplier's Declaration of Conformity Manual Requirements

In addition to the manual statement(s) previously described, the following declaration shall be included in the user manual or in the documentation provided with the product:

> (*company 's legal name*),
> (*street*)
> (*city, state, Zip & countr*[1]*y*)
> (*telephone # or internet address*)
>
> declare under our sole responsibility that the product(s)
>
> (*trade name(s) and model(s)*)
> complies(y) with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

[1] Must be a US address

Appendix E Basic and Reference Standards

Subpart B of Part 15 of FCC Rules for digital devices.

FCC Part 15 Subpart B references the use of ANSI C63.4–2014: "*Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*" for the purposes of evaluating the radiated and conducted emissions from digital devices.

Industry Canada Interference Causing Equipment Standard ICES-003 Issue 6, January 2016

ICES 003 refers to ANSI C63.4-2014 and Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22: 10, "*Information technology equipment - Radio disturbance characteristics - Limits and Methods of Measurement.*" This standard is an adoption of IEC CISPR 22:2008-09, sixth edition, with Canadian deviations.

End of Report

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