



**F2 Labs**  
**16740 Peters Road**  
**Middlefield, Ohio 44062**  
**United States of America**  
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## **CERTIFICATION TEST REPORT**

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**Manufacturer:** CSE Corporation  
800 Seco Road  
Monroeville, Pennsylvania 15146  
United States of America

**Applicant:** Same As Above

**Product:** Mine Safety Tag

**Model:** SR2000

**FCC ID:** 2ADSZ-12122014

**Testing Commenced:** Dec. 10, 2014

**Testing Ended:** Dec. 10, 2014

**Summary of Test Results:** Page 5

### **Standards:**

- ❖ FCC Part 15 Subpart C, Section 15.249
- ❖ FCC Part 15 Subpart C, Section 15.215(c) – Additional provisions to the general radiated emission limitations
- ❖ FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards



Order Number: F2LQ6381

Client: CSE International

Model: SR2000

**Evaluation Conducted by:**

Joe Knepper, EMC Proj. Eng.

**Report Reviewed by:**

Ken Littell, EMC Tech. Mgr.

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## 1 ADMINISTRATIVE INFORMATION

### 1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

### 1.2 Measurement Procedure:

All measurements were performed according to the 2009 version of ANSI C63.4 and recommended FCC procedure of measurement of DTS operating under Section 15.249. A list of the measurement equipment can be found in Section 6.

### 1.3 Uncertainty Budget:

Radiated Emission

- Combined Uncertainty (+ or -) 2.67 dB
- Expanded Uncertainty (+ or -) 5.35 dB

Conducted Emissions

- Combined Uncertainty (+ or -) 1.88 dB
- Expanded Uncertainty (+ or -) 3.75 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

### 1.4 Document History:

| Document Number     | Description                        | Issue Date    | Approved By |
|---------------------|------------------------------------|---------------|-------------|
| F2LQ6381-01E        | First Issue                        | Dec. 22, 2014 | K. Littell  |
| F2LQ6381-01E Rev. 1 | Modification of Correction Factors | Apr. 20, 2015 | K. Littell  |
|                     |                                    |               |             |
|                     |                                    |               |             |



## 2 SUMMARY OF TEST RESULTS

| Test Name                   | Standard(s)              | Results  |
|-----------------------------|--------------------------|----------|
| -20dB Occupied Bandwidth    | CFR 47 Part 15.215(c)    | Complies |
| Field Strength of Emissions | CFR 47 Part 15.249(a)(d) | Complies |

| Modifications Made to the Equipment |
|-------------------------------------|
| None                                |



### 3 TABLE OF MEASURED RESULTS

| Test                                           | High Channel<br>926 MHz | Mid Channel<br>914 MHz | Low Channel<br>904 MHz |
|------------------------------------------------|-------------------------|------------------------|------------------------|
| Quasi-Peak Field<br>Strength of<br>Fundamental | 92.5 dB $\mu$ V/m       | 90.5 dB $\mu$ V/m      | 91.5 dB $\mu$ V/m      |
| Quasi-Peak Limit for<br>Fundamental            | (94dBuV/m)              | (94dBuV/m)             | (94dBuV/m)             |
| -20dB Occupied<br>Bandwidth                    | 512.9                   | 510.95                 | 519.448                |

The 20 dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.



#### **4 ENGINEERING STATEMENT**

This report has been prepared on behalf of CSE International to provide documentation for the testing described herein. This equipment has been tested and found to comply with part 15.249 of the FCC Rules using ANSI C63.4 2009 standard. The test results found in this test report relate only to the items tested.



## **5 EUT INFORMATION AND DATA**

### **5.1 Equipment Under Test:**

Product: Safety Mine Tag

Model: SR2000

Serial No.: None Specified

FCC ID: 2ADSZ-12122014

### **5.2 Trade Name:**

CSE International

### **5.3 Power Supply:**

Battery-operated

### **5.4 Applicable Rules:**

CFR 47, Part 15.249

### **5.5 Equipment Category:**

Radio Transmitter-DTS

### **5.6 Antenna:**

Integral Antenna

### **5.7 Accessories:**

N/A

### **5.8 Test Item Condition:**

The equipment to be tested was received in good condition.

### **5.9 Testing Algorithm:**

EUT was set up in a normal testing manner, powered by a new battery. EUT transmitted at high, mid and low frequencies.

**6 LIST OF MEASUREMENT INSTRUMENTATION**

| Equipment Type             | Asset Number           | Manufacturer         | Model                            | Serial Number | Calibration Due Date |
|----------------------------|------------------------|----------------------|----------------------------------|---------------|----------------------|
| Shield Room                | 0175                   | Ray Proof            | N/A                              | 11645         | Verified             |
| Temp/Hum. Recorder         | CL137                  | Extech               | RH520                            | CH16992       | May 5, 2015          |
| OATS-3m                    | CL017                  | Compliance Labs      | N/A                              | 001           | Dec. 13, 2014        |
| Spectrum Analyzer          | CL138                  | Agilent Technologies | E4407B                           | US41192779    | Nov. 17, 2015        |
| Receiver                   | CL151                  | Rohde & Schwarz      | ESU40                            | 100319        | Nov. 12, 2015        |
| Antenna 1-Chamber          | 0142                   | ETS/EMCO             | 3142B                            | 9811-1330     | Verified             |
| Antenna 2-OATS             | 0105                   | Sunol Sciences       | JB1                              | A101101       | May 7, 2015          |
| Pre-Amplifier              | CL045                  | Hewlett-Packard      | 8447D                            | 2944A08445    | Nov. 15, 2015        |
| Horn Antenna               | CL098                  | Emco                 | 3115                             | 9809-5580     | Dec. 3, 2015         |
| Pre-Amplifier              | CL045                  | Hewlett-Packard      | 8447D                            | 2944A08445    | Nov. 15, 2015        |
| Pre-Amplifier              | CL153                  | Agilent              | 83006-69007                      | MY39500900    | Jan. 9, 2015         |
| Amp. w/Monopole & 18" Loop | CL163                  | A.H. Systems, Inc.   | EHA-52B                          | 100           | Apr. 24, 2015        |
| Software:                  | Tile Version 1.0       |                      | Software Verified: Dec. 10, 2014 |               |                      |
| Software:                  | EMC 32, Version 5.20.2 |                      | Software Verified: Dec. 10, 2014 |               |                      |



## **7 FCC PART 15.215(e) – OCCUPIED BANDWIDTH**

### **7.1 Requirements:**

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

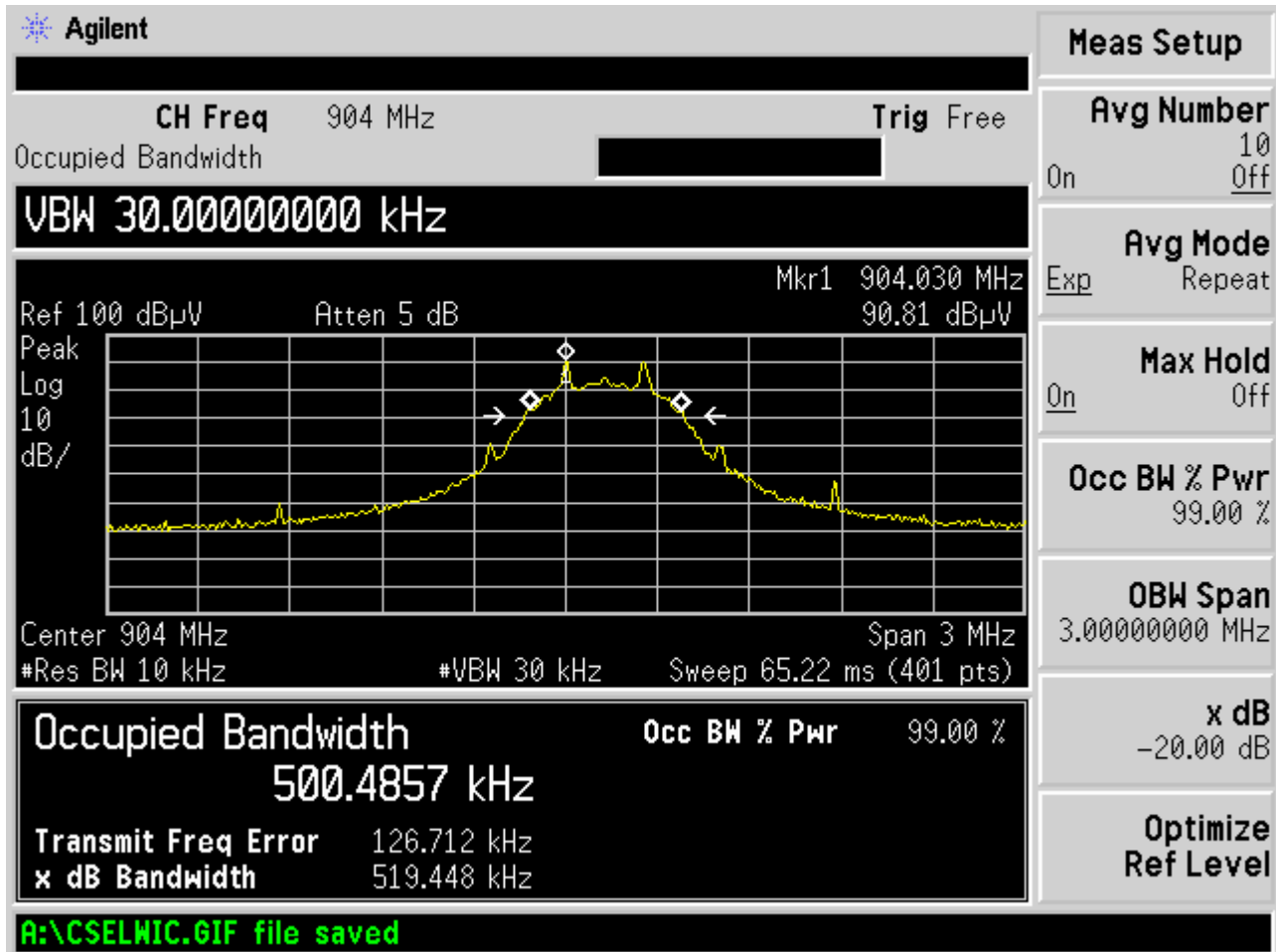
Bandwidth measurements were made at the low (904 MHz), mid (914 MHz) and upper (926 MHz) frequencies. The bandwidth was measured using the analyzer's marker function.



## 7.2 Occupied Bandwidth Test Data

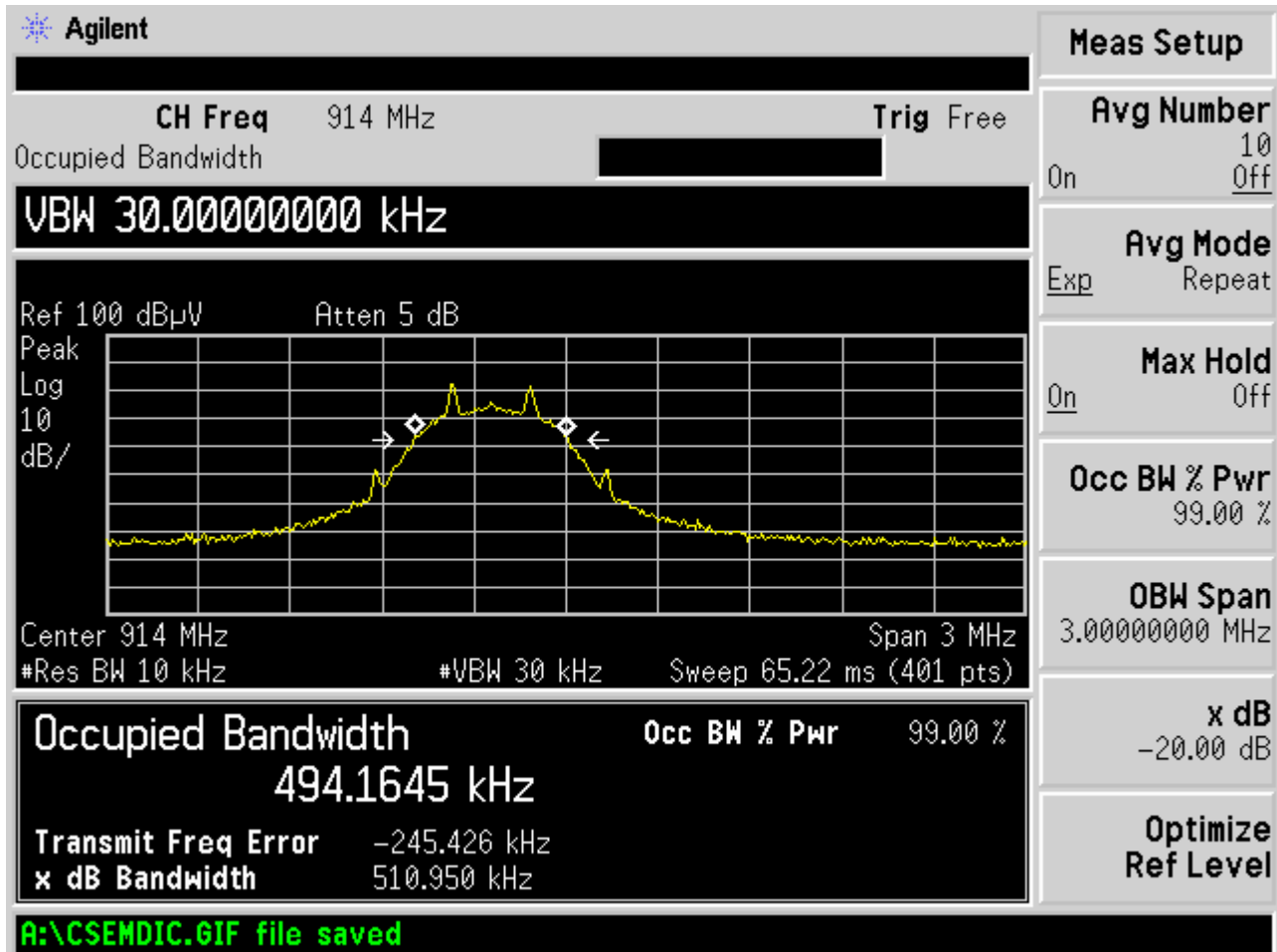
|            |                       |                    |            |
|------------|-----------------------|--------------------|------------|
| Test Date: | Dec. 10, 2014         | Test Engineer(s):  | J. Knepper |
| Standards: | CFR 47 Part 15.215(c) | Air Temperature:   | 20.8°C     |
|            |                       | Relative Humidity: | 43%        |

## Low Channel



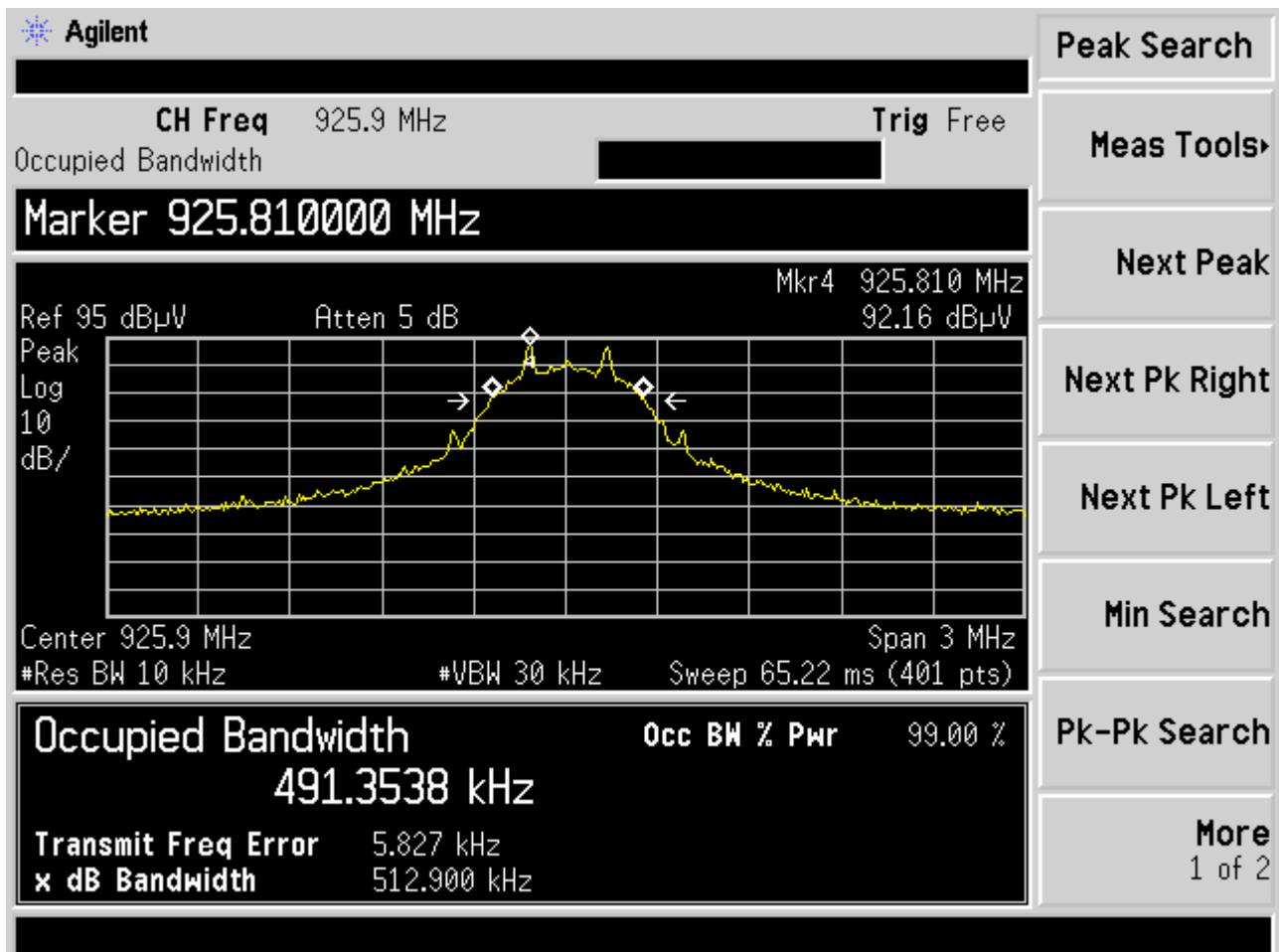


## Mid Channel





## High Channel



**8 FCC PART 15.249(a)(d) – FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS**

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| <b>Fundamental frequency</b> | <b>Field strength of fundamental (millivolts/meter)</b> | <b>Field strength of harmonics (microvolts/meter)</b> |
|------------------------------|---------------------------------------------------------|-------------------------------------------------------|
| 902-928 MHz                  | 50                                                      | 500                                                   |
| 2400-2483.5 MHz              | 50                                                      | 500                                                   |
| 5725-5875 MHz                | 50                                                      | 500                                                   |
| 24.0-24.25 GHz               | 250                                                     | 2500                                                  |

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

NOTE: During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.

**8.1 Test Data - Field Strength of Emissions from Intentional Radiators**

|                   |                                     |                           |            |
|-------------------|-------------------------------------|---------------------------|------------|
| <b>Test Date:</b> | Dec. 10, 2014                       | <b>Test Engineer(s):</b>  | J. Knepper |
| <b>Standards:</b> | CFR 47 Part 15.249(d) / Part 15.209 | <b>Air Temperature:</b>   | 10.7°C     |
|                   |                                     | <b>Relative Humidity:</b> | 43%        |

**Low Channel**

| Frequency (MHz) | Polarity | Corr. (dB) | QuasiPeak (dB $\mu$ V/m) | QuasiPeak (dB $\mu$ V/m) Limit | QuasiPeak Margin | Bandwidth (kHz) |
|-----------------|----------|------------|--------------------------|--------------------------------|------------------|-----------------|
| 904.000000      | V        | 28.40      | 81.1                     | 94                             | -12.9            | 120.000         |
| 904.290000      | H        | 28.40      | 91.5                     | 94                             | -2.5             | 120.000         |

**Mid Channel**

| Frequency (MHz) | Polarity | Corr. (dB) | QuasiPeak (dB $\mu$ V/m) | QuasiPeak (dB $\mu$ V/m) Limit | QuasiPeak Margin | Bandwidth (kHz) |
|-----------------|----------|------------|--------------------------|--------------------------------|------------------|-----------------|
| 913.880000      | V        | 28.2       | 80.8                     | 94                             | -13.2            | 120.000         |
| 913.880000      | H        | 28.2       | 90.5                     | 94                             | -3.5             | 120.000         |

**High Channel**

| Frequency (MHz) | Polarity | Corr. (dB) | QuasiPeak (dB $\mu$ V/m) | QuasiPeak (dB $\mu$ V/m) Limit | QuasiPeak Margin | Bandwidth (kHz) |
|-----------------|----------|------------|--------------------------|--------------------------------|------------------|-----------------|
| 925.810000      | V        | 28.2       | 80                       | 94                             | -14.0            | 120.000         |
| 925.810000      | H        | 28.2       | 92.6                     | 94                             | -1.4             | 120.000         |



## 8.2 Test Data – Spurious Emissions

Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. At some frequencies, no emissions from the EUT were measurable over the ambient noise floor. The readings did not change with EUT on and EUT off.

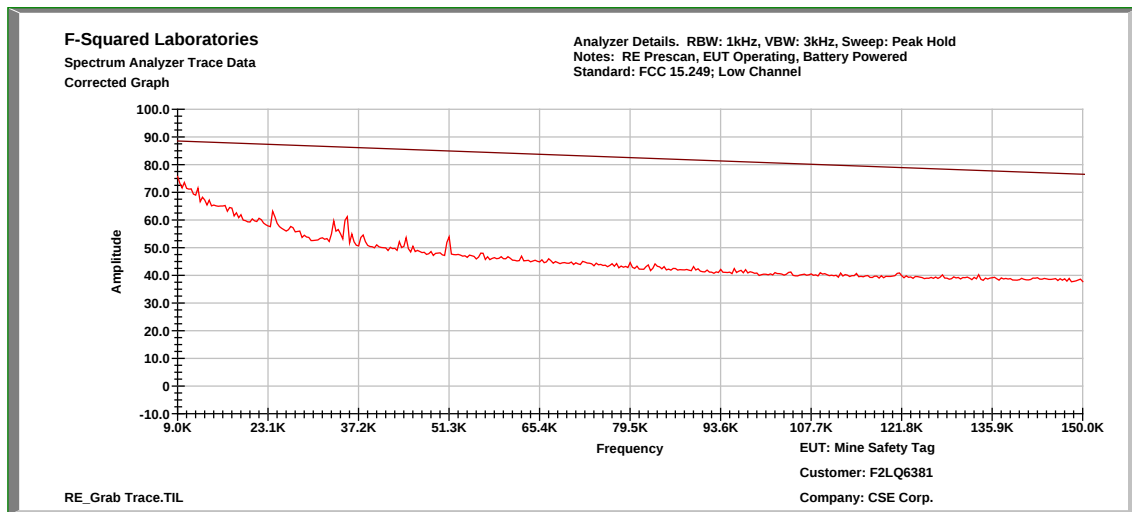
At least 6 of the highest frequencies were measured per ANSI 63.4 on the Open Area Test Site. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables below.

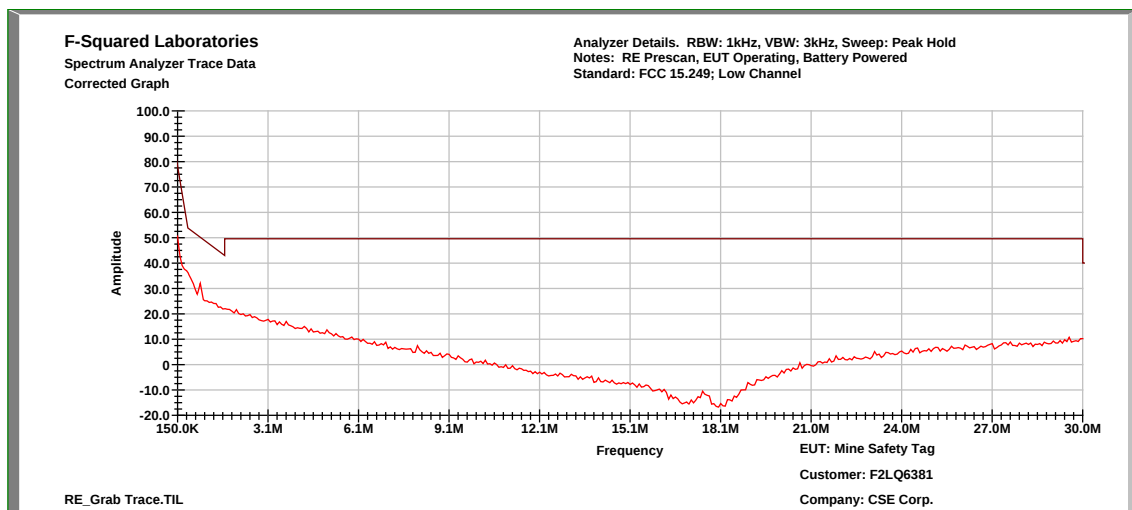


|            |                                     |                    |            |
|------------|-------------------------------------|--------------------|------------|
| Test Date: | Dec. 10, 2014                       | Test Engineer(s):  | J. Knepper |
| Standards: | CFR 47 Part 15.249(d) / Part 15.209 | Air Temperature:   | 10.7°C     |
|            |                                     | Relative Humidity: | 43%        |

## Low Channel, .009 to 0.15 MHz

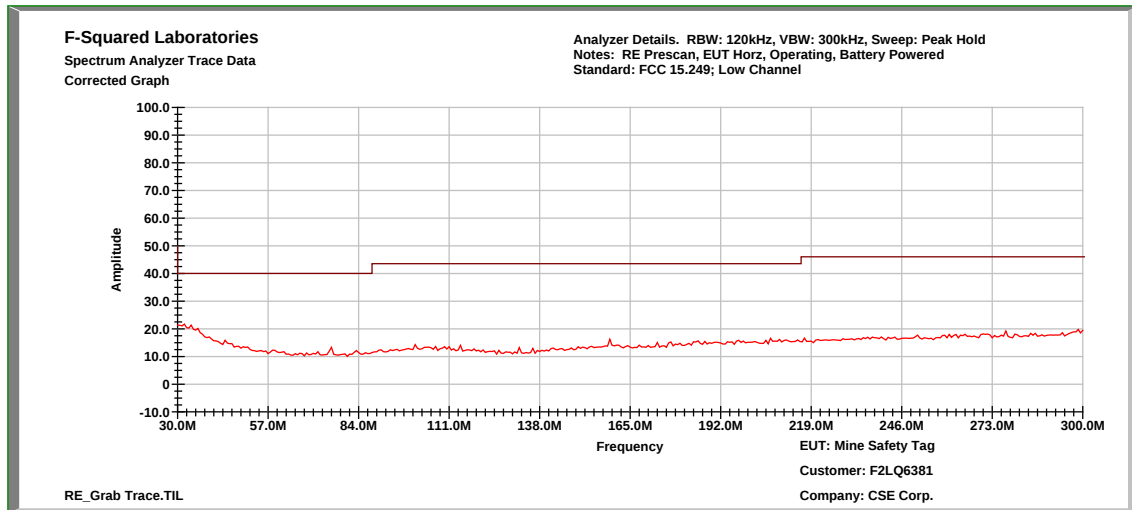


## Low Channel, 0.15 MHz to 30 MHz

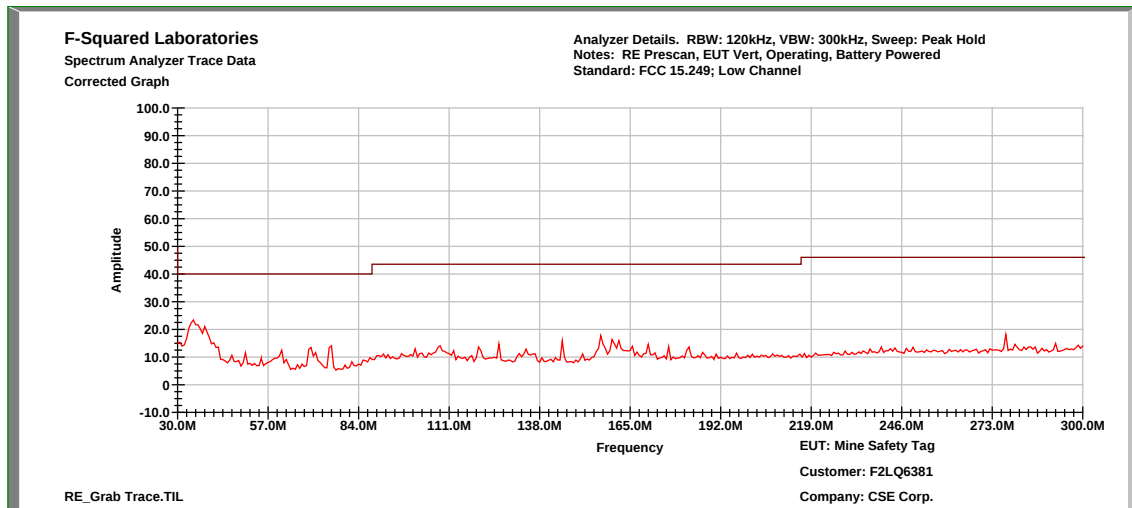




### Low Channel, 30 MHz to 300 MHz, Horizontal

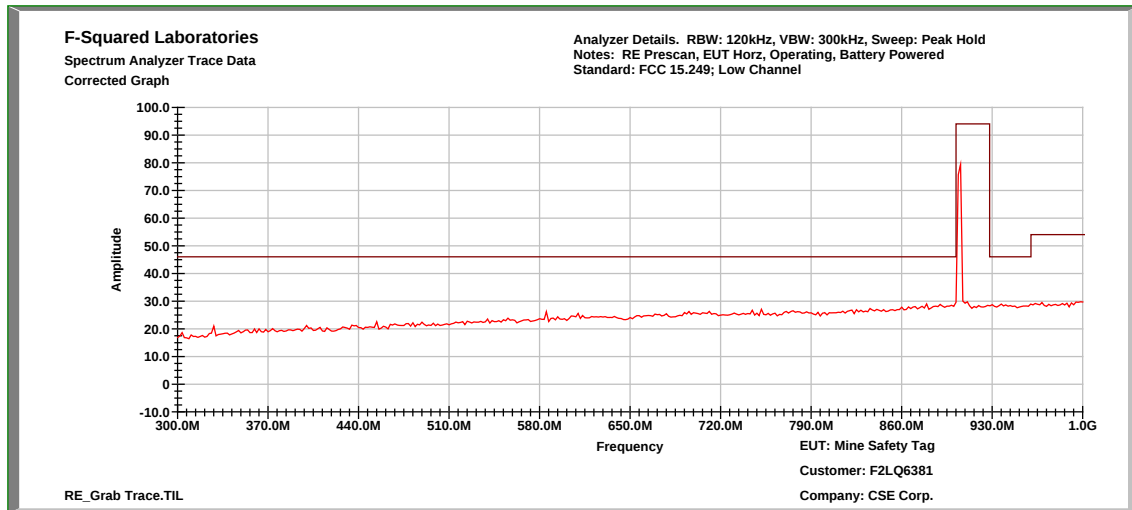


### Low Channel, 30 MHz to 300 MHz, Vertical

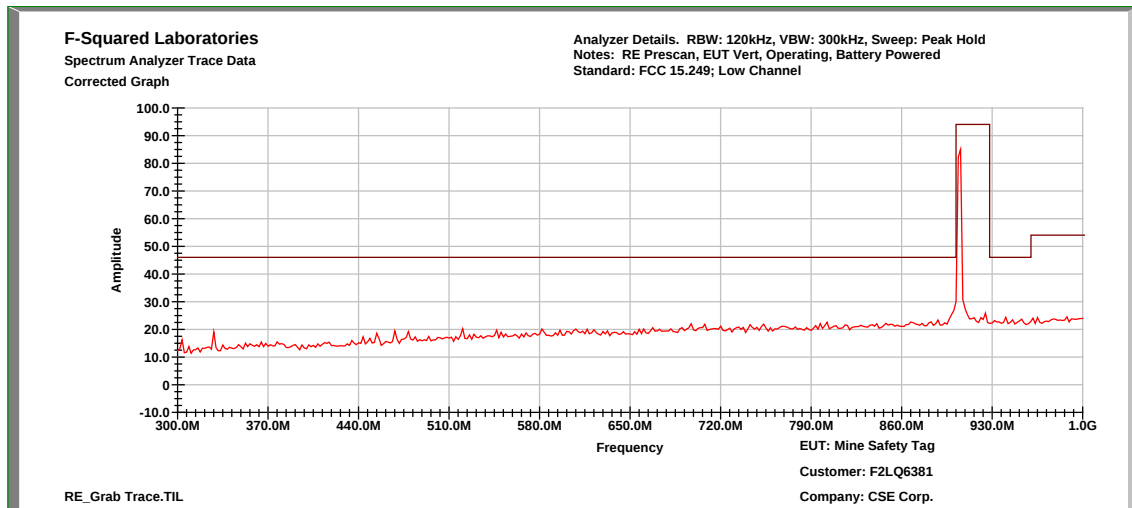




### Low Channel, 300 MHz to 1 GHz, Horizontal

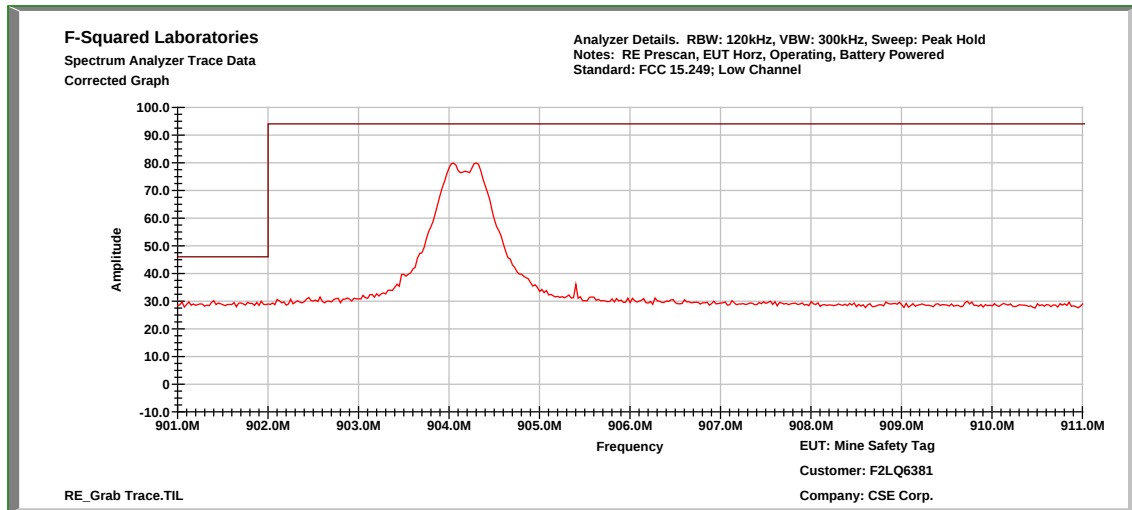


### Low Channel, 300 MHz to 1 GHz, Vertical

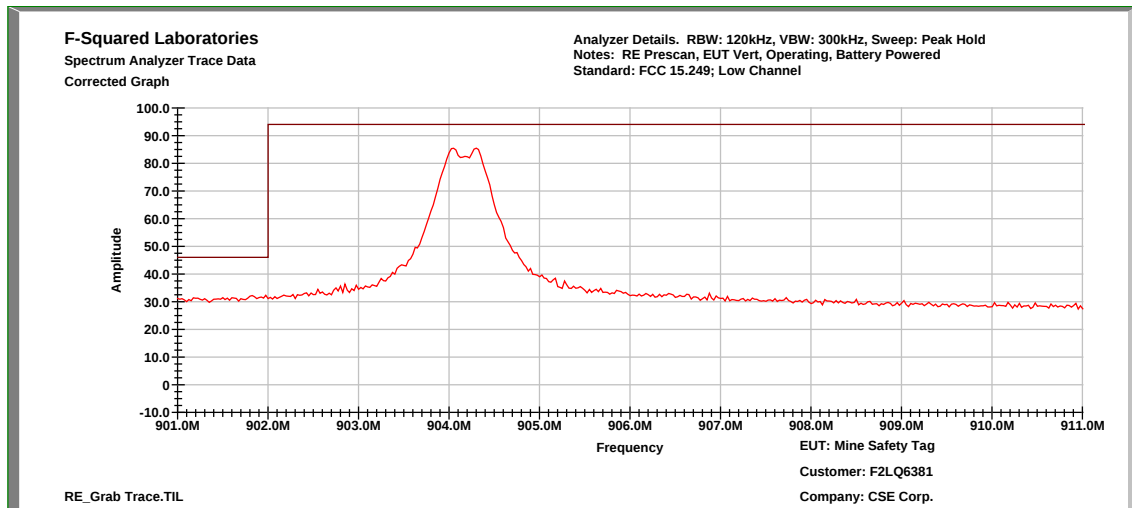




### Low Channel, Fundamental, Horizontal

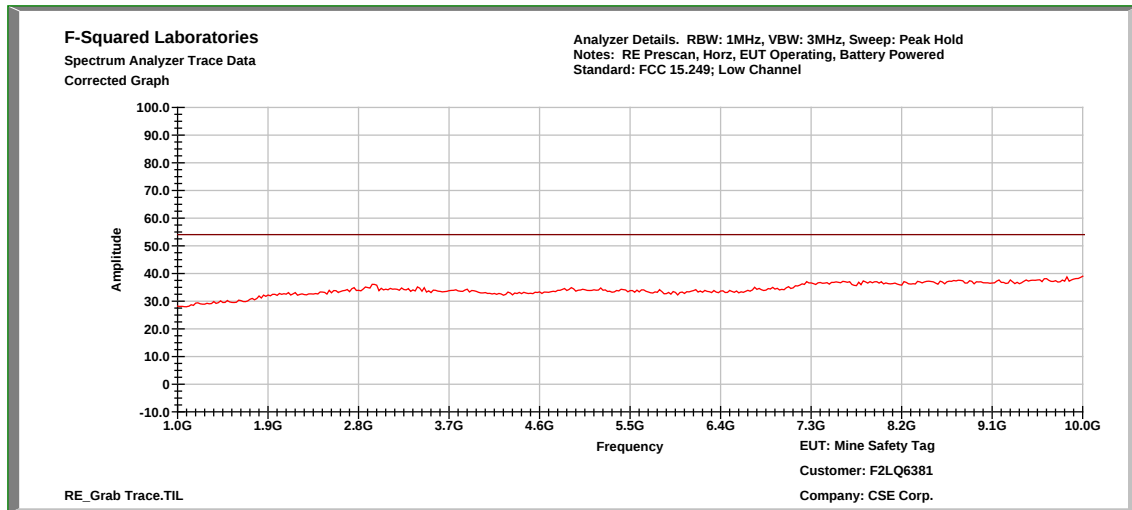


### Low Channel, Fundamental, Vertical

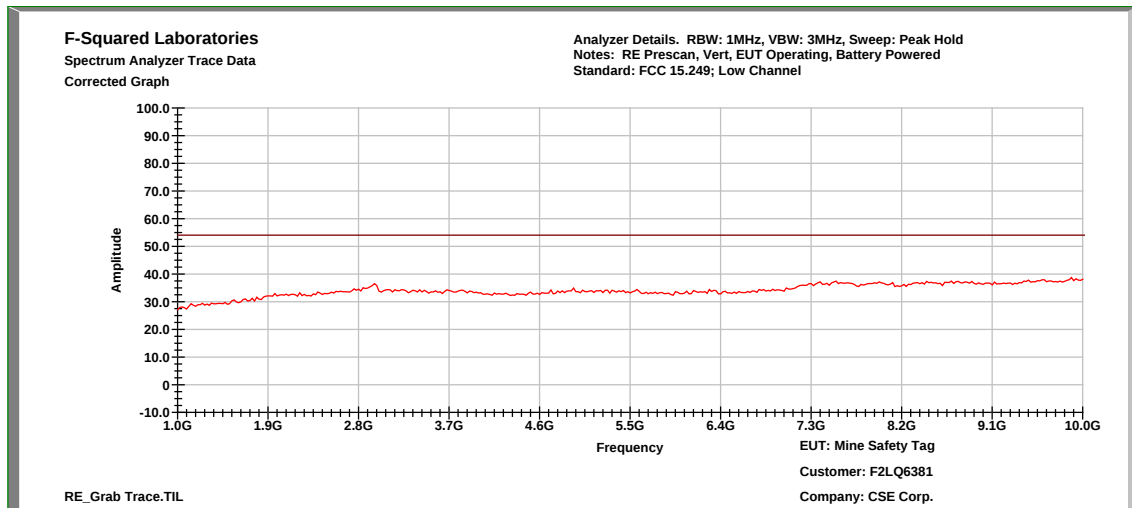




### Low Channel, 1 GHz to 10 GHz, Horizontal

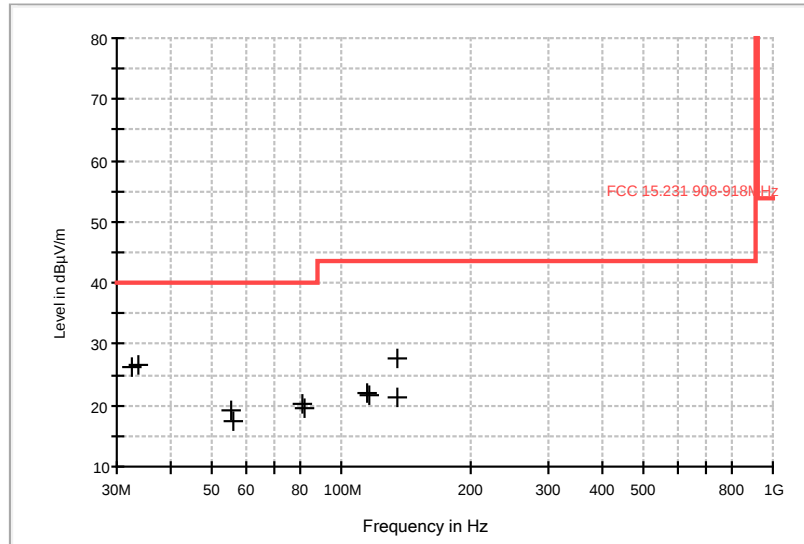


### Low Channel, 1 GHz to 10 GHz, Vertical





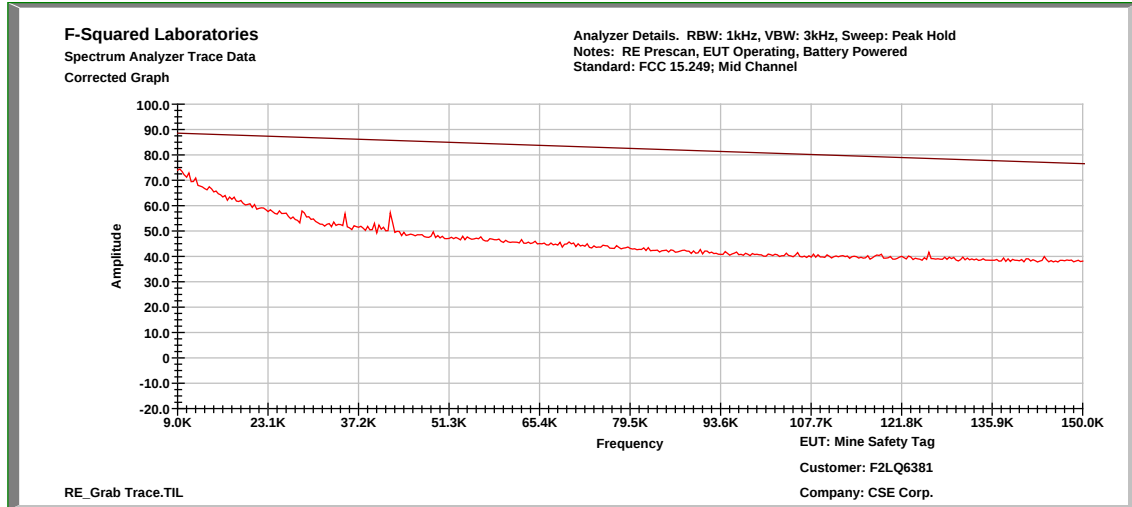
## Low Channel



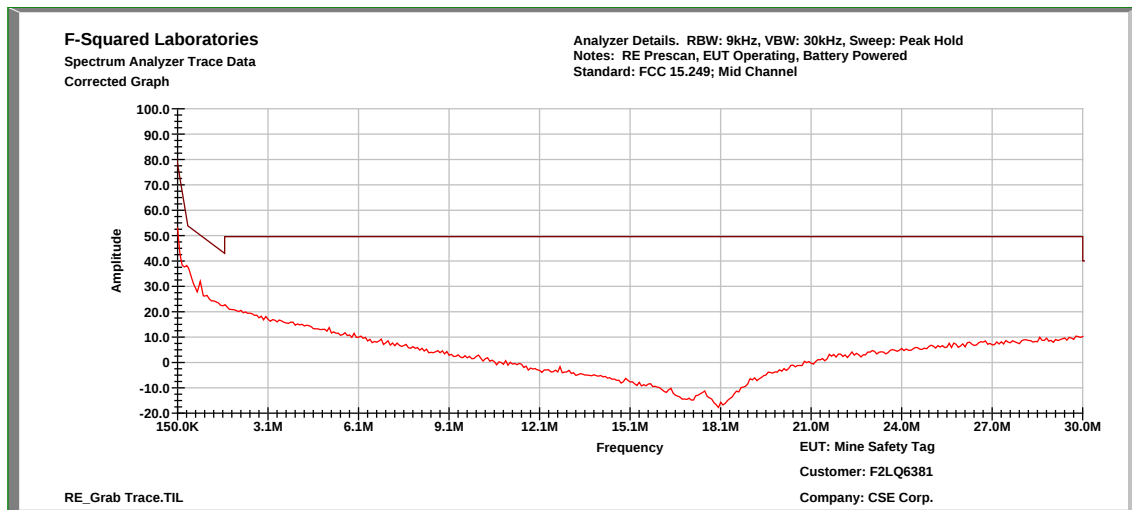
| Frequency (MHz) | Antenna Polarization | Bandwidth (kHz) | Reading (dBµV) | Cable Loss & Antenna Factor (dB) | Emission (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|-----------------|----------------------|-----------------|----------------|----------------------------------|-------------------|----------------|-------------|
| 32.590000       | H                    | 120.000         | 8.4            | 18.0                             | 26.4              | 40.0           | -13.6       |
| 33.740000       | V                    | 120.000         | 8.7            | 18.0                             | 26.7              | 40.0           | -13.3       |
| 55.150000       | V                    | 120.000         | 10.3           | 8.9                              | 19.2              | 40.0           | -20.8       |
| 56.090000       | H                    | 120.000         | 8.5            | 8.9                              | 17.4              | 40.0           | -22.6       |
| 81.280000       | V                    | 120.000         | 11.1           | 9.1                              | 20.2              | 40.0           | -19.8       |
| 81.440000       | H                    | 120.000         | 10.6           | 9.1                              | 19.7              | 40.0           | -20.3       |
| 114.770000      | V                    | 120.000         | 6.7            | 15.4                             | 22.1              | 43.5           | -21.4       |
| 115.320000      | H                    | 120.000         | 6.3            | 15.4                             | 21.7              | 43.5           | -21.8       |
| 134.450000      | V                    | 120.000         | 12.2           | 15.4                             | 27.6              | 43.5           | -15.9       |
| 134.720000      | H                    | 120.000         | 6.1            | 15.4                             | 21.5              | 43.5           | -22.0       |



### Mid Channel, .009 to 0.15 MHz

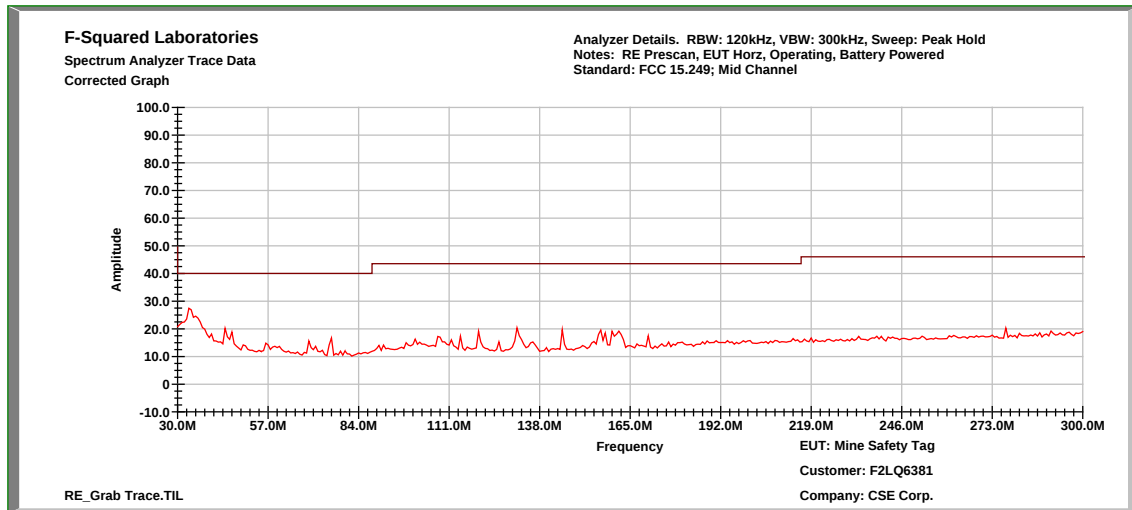


### Mid Channel, 0.15 MHz to 30 MHz

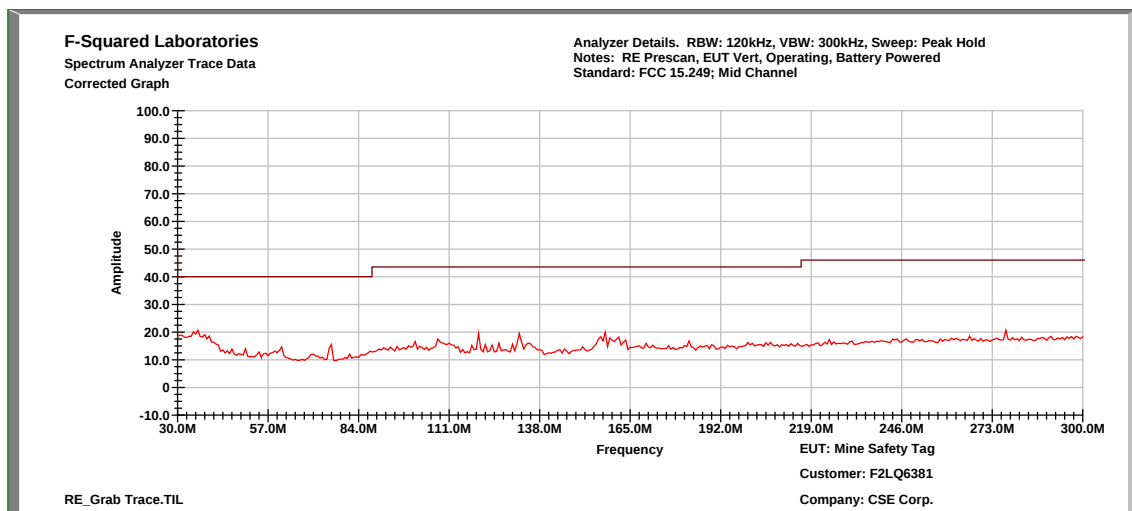




### Mid Channel, 30 MHz to 300 MHz, Horizontal

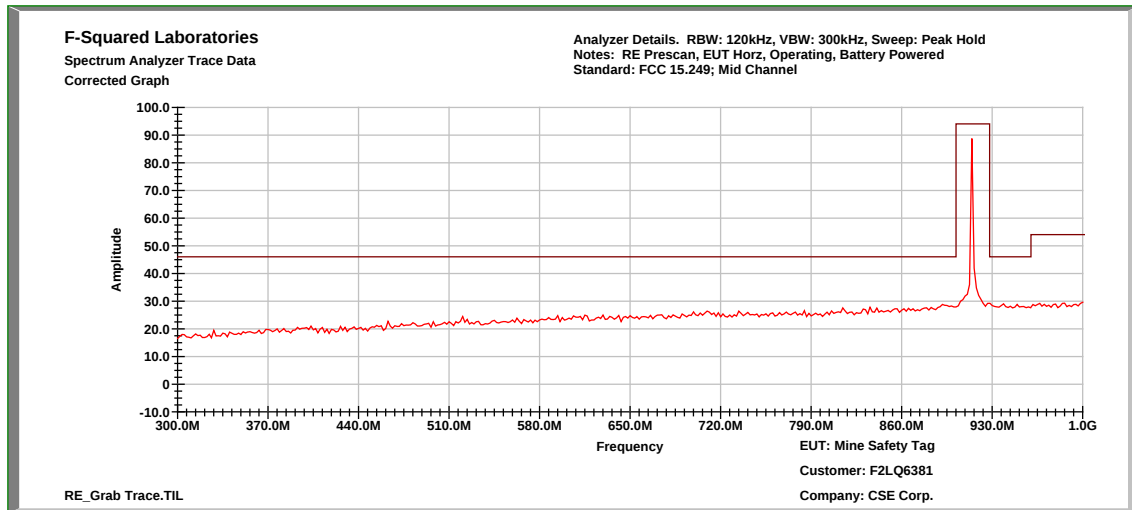


### Mid Channel, 30 MHz to 300 MHz, Vertical

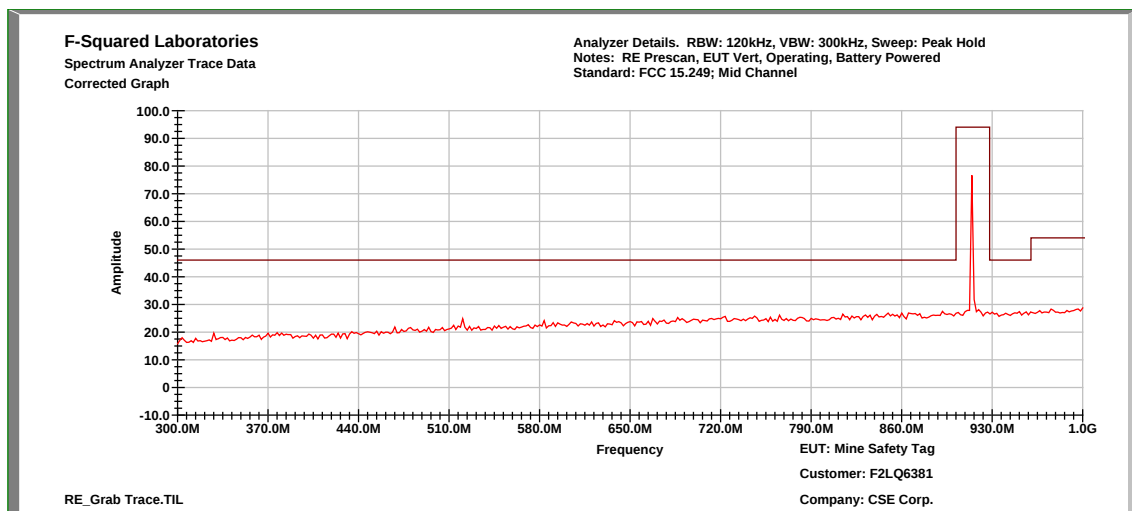




Mid Channel, 300 MHz to 1 GHz, Horizontal

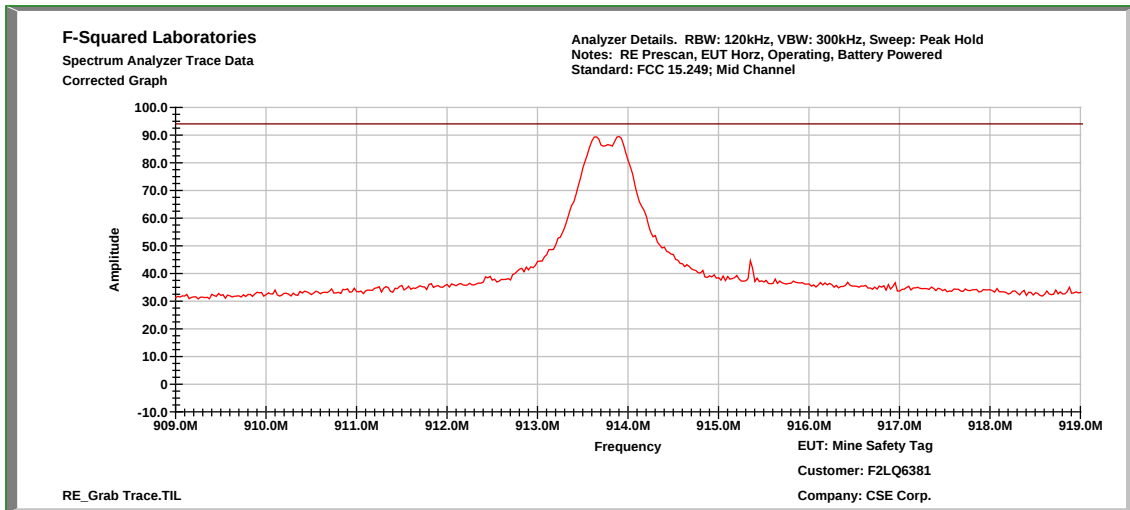


Mid Channel, 300 MHz to 1 GHz, Vertical

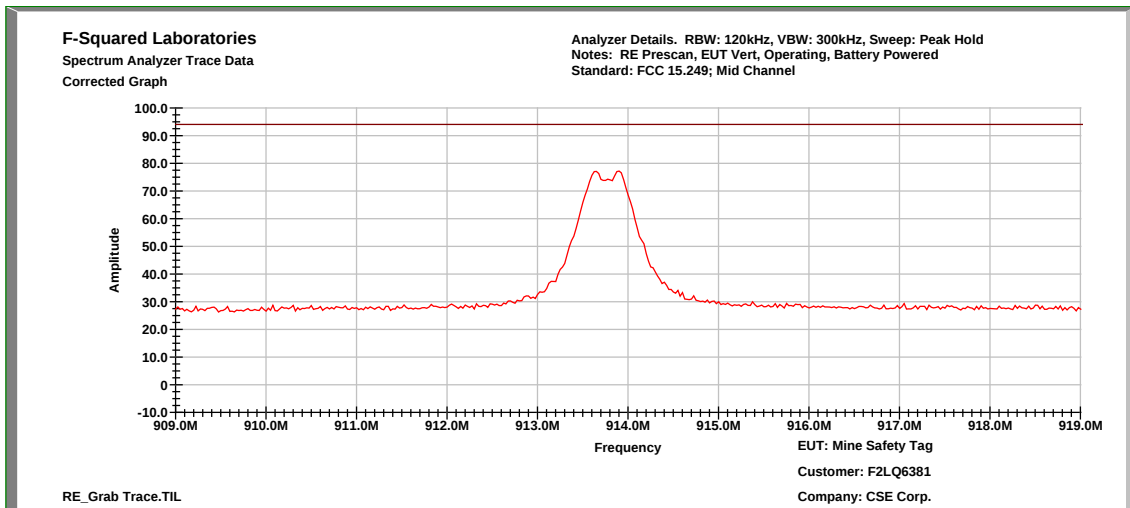




### Mid Channel, Fundamental, Horizontal

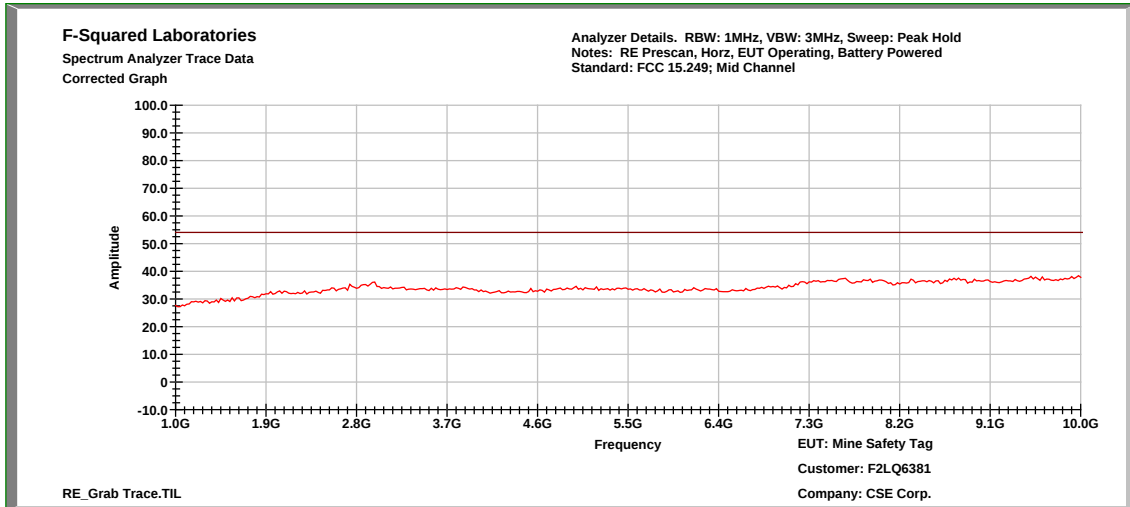


### Mid Channel, Fundamental, Vertical

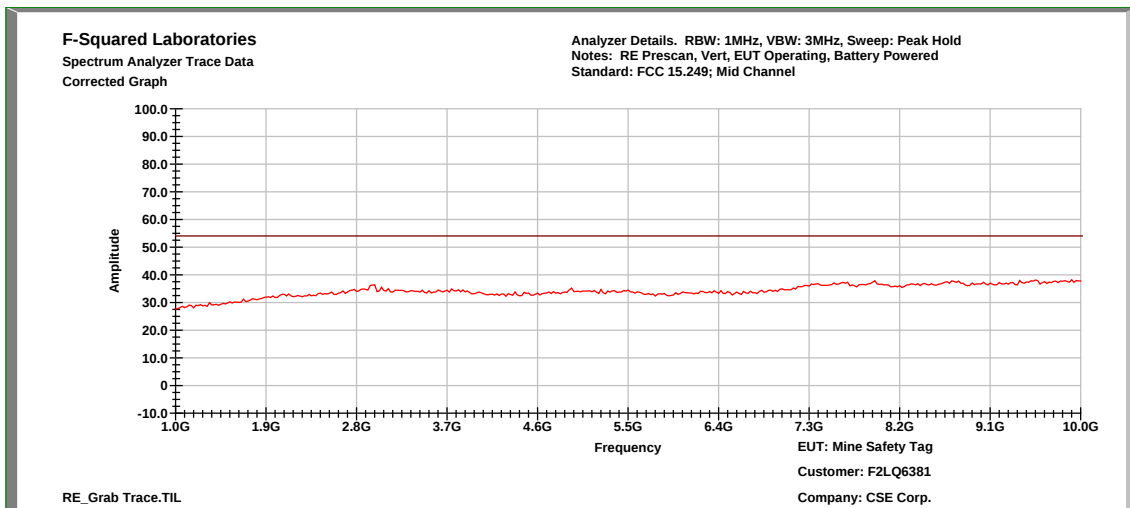




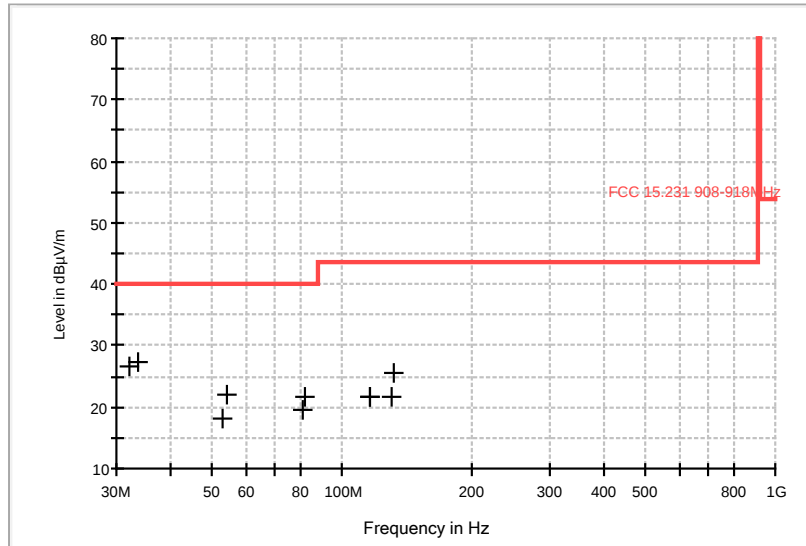
### Mid Channel, 1 GHz to 10 GHz, Horizontal



### Mid Channel, 1 GHz to 10 GHz, Vertical



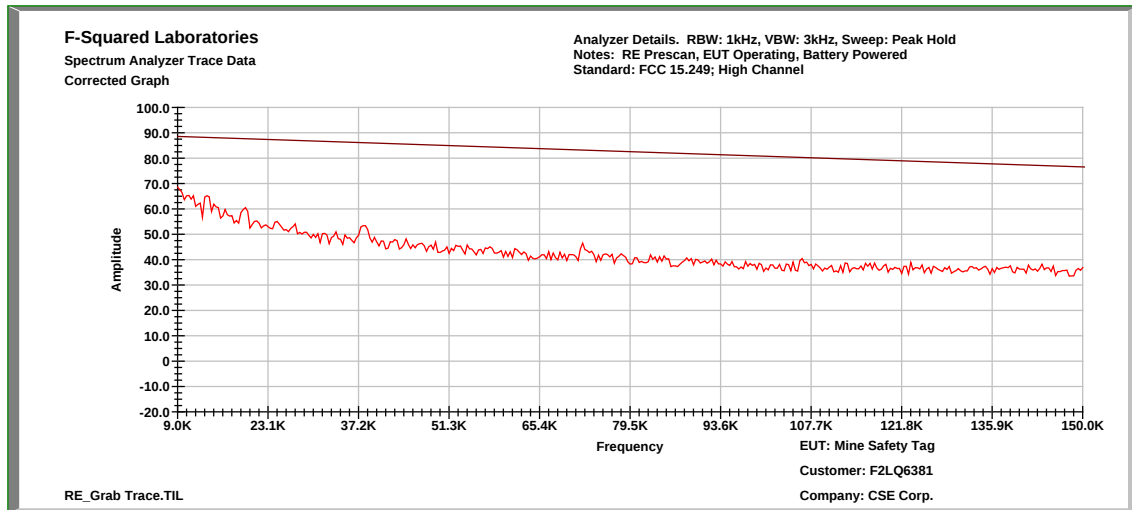
### Mid Channel



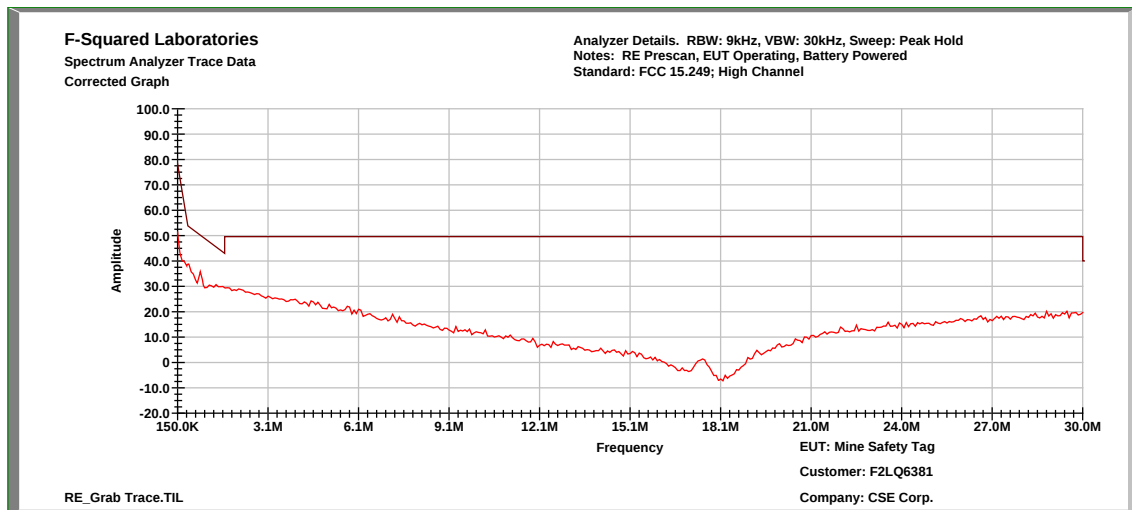
| Frequency (MHz) | Antenna Polarization | Bandwidth (kHz) | Reading (dBμV) | Cable Loss & Antenna Factor (dB) | Emission (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|----------------------|-----------------|----------------|----------------------------------|-------------------|----------------|-------------|
| 32.070000       | H                    | 120.000         | 6.2            | 20.3                             | 26.5              | 40.0           | -13.5       |
| 33.590000       | V                    | 120.000         | 7.1            | 20.3                             | 27.4              | 40.0           | -12.6       |
| 52.620000       | H                    | 120.000         | 9.5            | 8.7                              | 18.2              | 40.0           | -21.8       |
| 53.900000       | V                    | 120.000         | 13.3           | 8.7                              | 22.0              | 40.0           | -18.0       |
| 80.590000       | H                    | 120.000         | 10.4           | 9.1                              | 19.5              | 40.0           | -20.5       |
| 81.470000       | V                    | 120.000         | 12.6           | 9.1                              | 21.7              | 40.0           | -18.3       |
| 115.150000      | V                    | 120.000         | 6.2            | 15.4                             | 21.6              | 43.5           | -21.9       |
| 115.160000      | H                    | 120.000         | 6.4            | 15.4                             | 21.8              | 43.5           | -21.7       |
| 130.250000      | H                    | 120.000         | 6.1            | 15.6                             | 21.7              | 43.5           | -21.8       |
| 130.680000      | V                    | 120.000         | 9.9            | 15.6                             | 25.5              | 43.5           | -18.0       |



### High Channel, .009 to 0.15 MHz

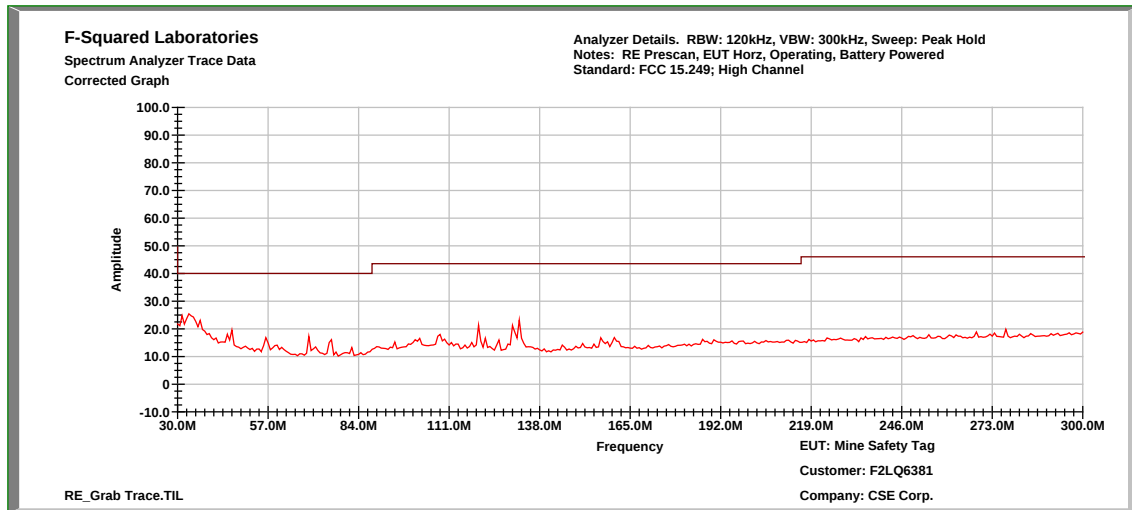


### High Channel, 0.15 MHz to 30 MHz

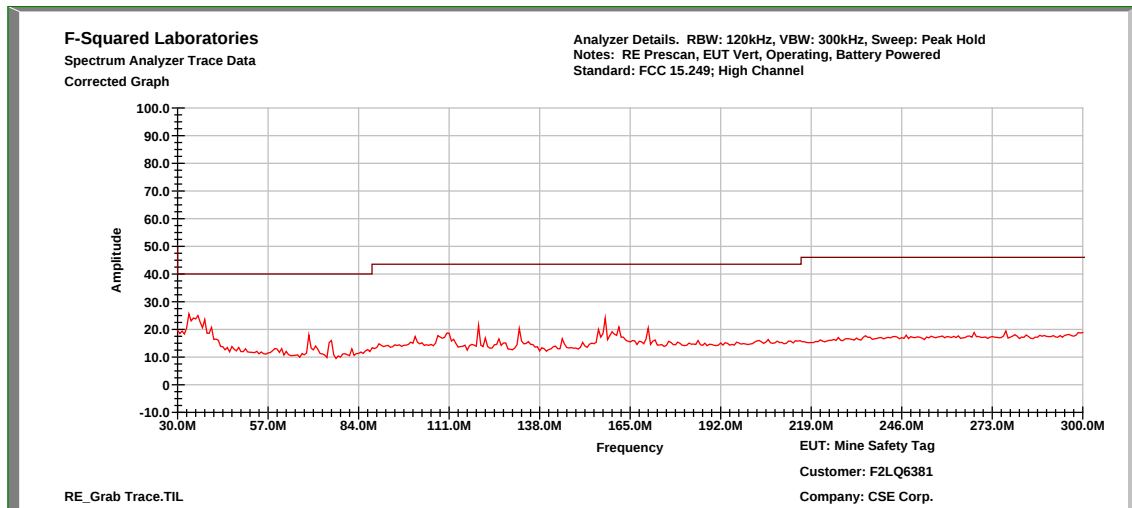




### High Channel, 30 MHz to 300 MHz, Horizontal

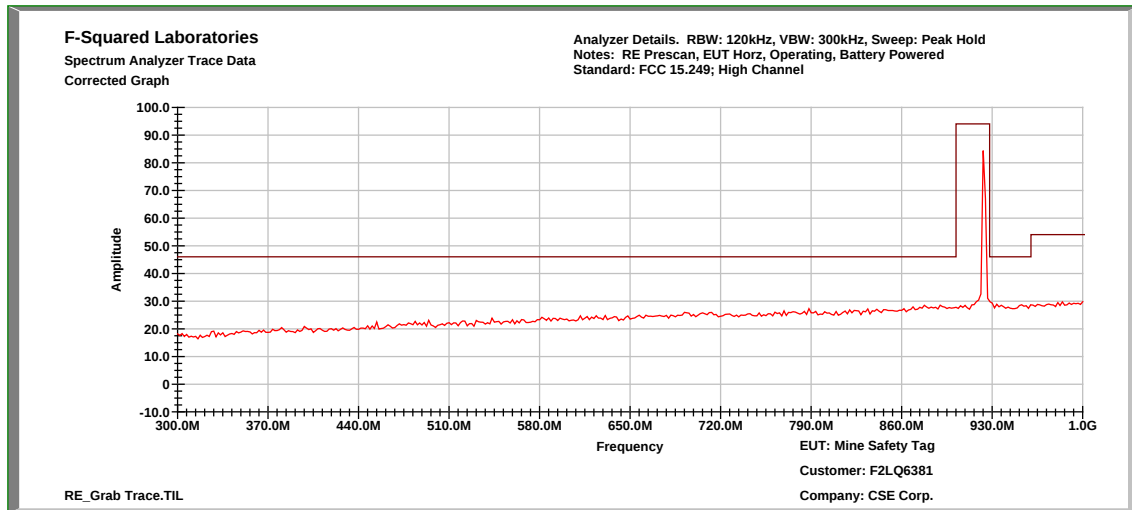


### High Channel, 30 MHz to 300 MHz, Vertical

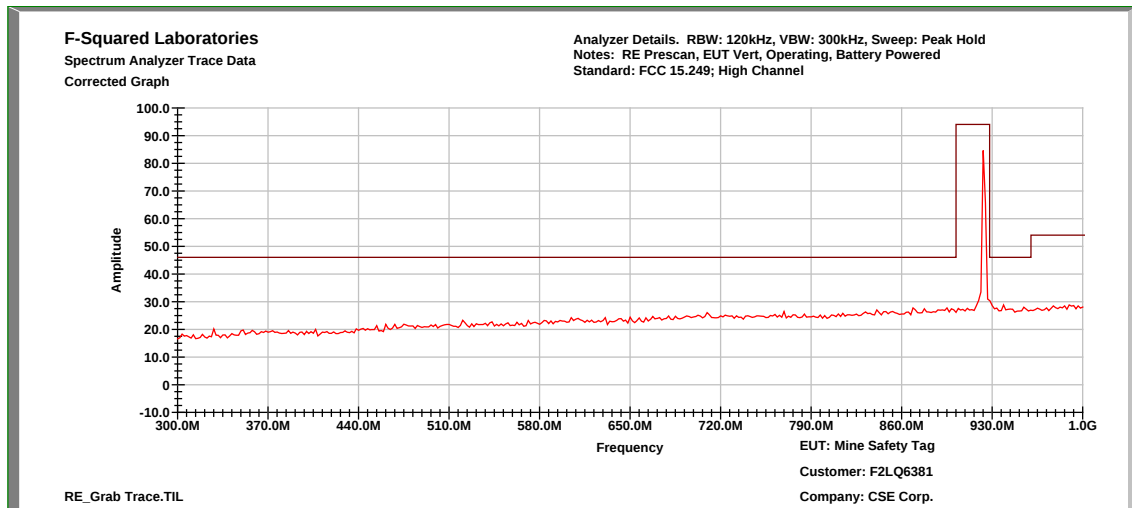




### High Channel, 300 MHz to 1 GHz, Horizontal

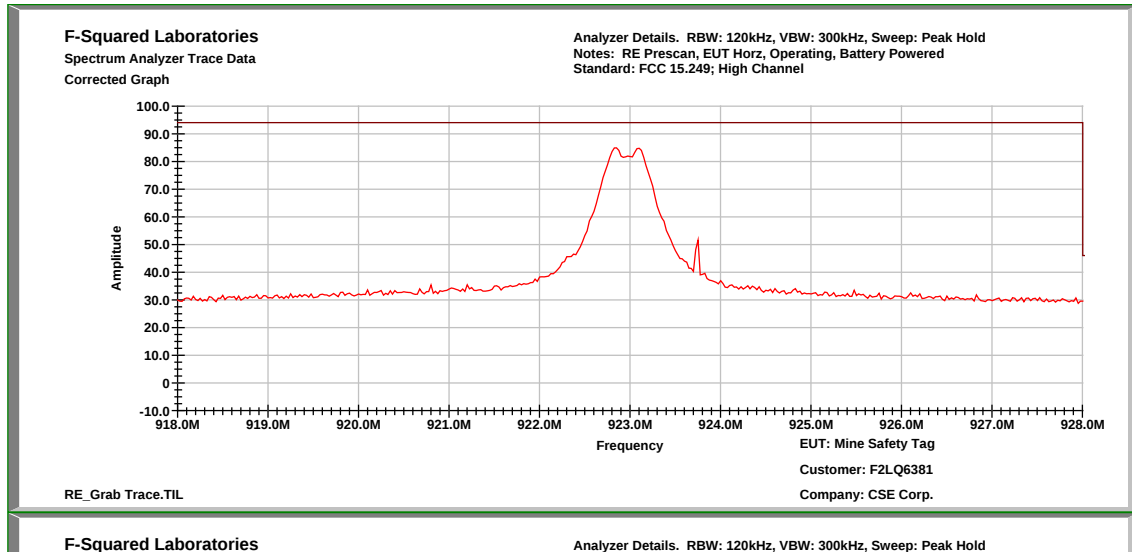


### High Channel, 300 MHz to 1 GHz, Vertical

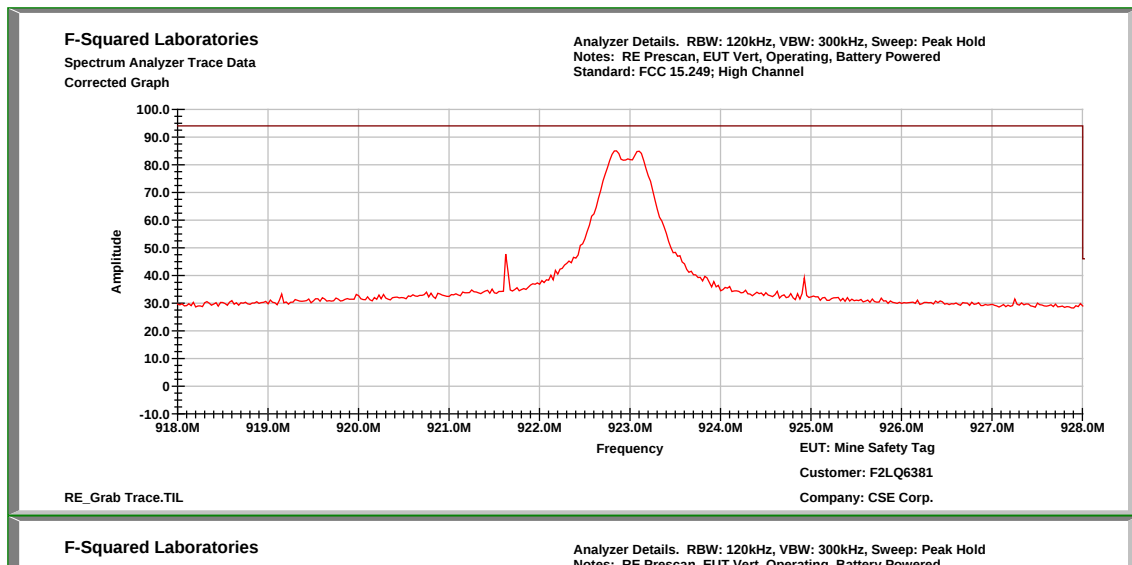




### High Channel, Fundamental, Horizontal

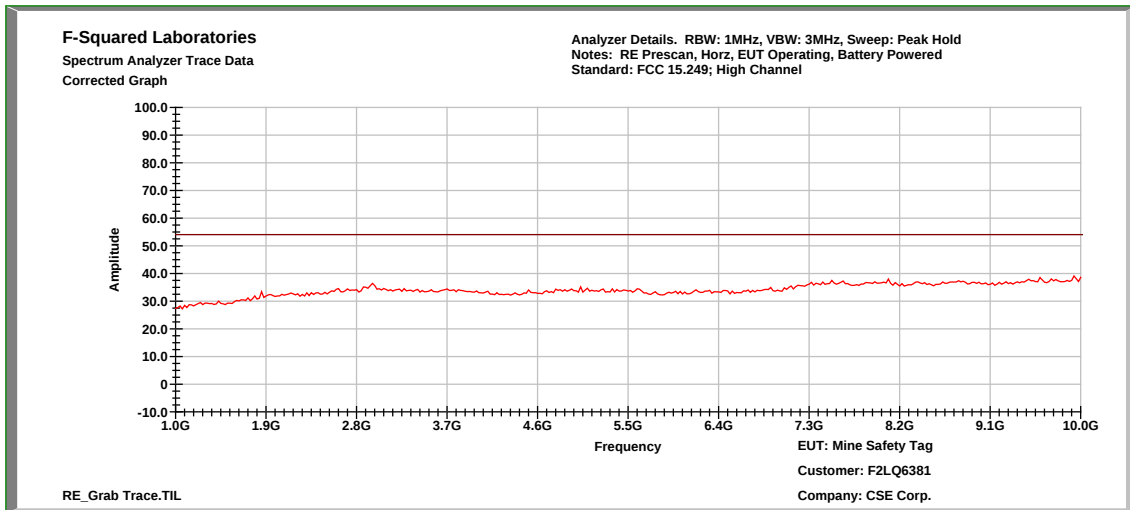


### High Channel, Fundamental, Vertical

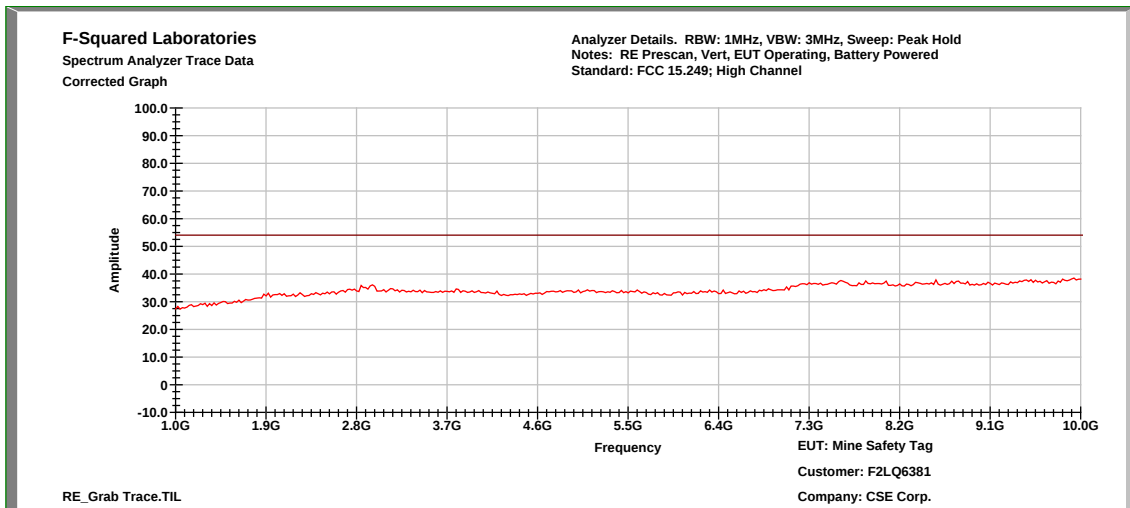




### High Channel, 1 GHz to 10 GHz, Horizontal

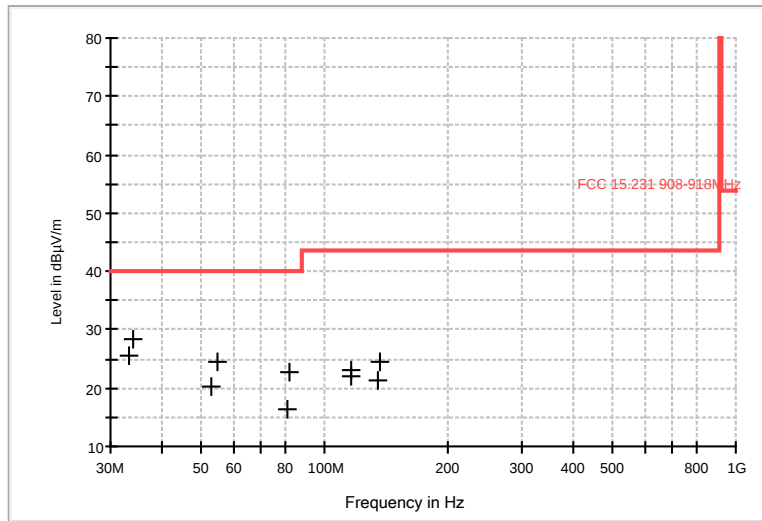


### High Channel, 1 GHz to 10 GHz, Vertical





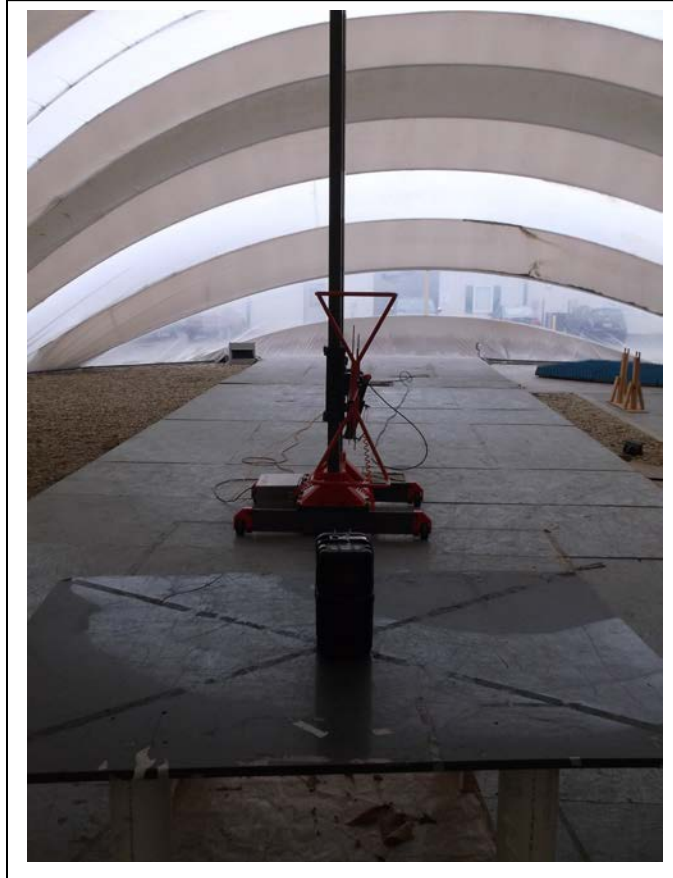
## High Channel



| Frequency (MHz) | Antenna Polarization | Bandwidth (kHz) | Reading (dBμV) | Cable Loss & Antenna Factor (dB) | Emission (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|----------------------|-----------------|----------------|----------------------------------|-------------------|----------------|-------------|
| 33.220000       | H                    | 120.000         | 6.3            | 19.4                             | 25.7              | 40.0           | -14.3       |
| 33.960000       | V                    | 120.000         | 9.1            | 19.4                             | 28.5              | 40.0           | -11.5       |
| 52.670000       | H                    | 120.000         | 11.6           | 8.7                              | 20.3              | 40.0           | -19.7       |
| 54.880000       | V                    | 120.000         | 15.7           | 8.7                              | 24.4              | 40.0           | -15.6       |
| 81.300000       | H                    | 120.000         | 7.1            | 9.1                              | 16.2              | 40.0           | -23.8       |
| 81.850000       | V                    | 120.000         | 13.6           | 9.1                              | 22.7              | 40.0           | -17.3       |
| 115.560000      | V                    | 120.000         | 7.6            | 15.5                             | 23.1              | 43.5           | -20.4       |
| 115.640000      | H                    | 120.000         | 6.5            | 15.5                             | 22.0              | 43.5           | -21.5       |
| 134.580000      | H                    | 120.000         | 6.1            | 15.4                             | 21.5              | 43.5           | -22.0       |
| 135.510000      | V                    | 120.000         | 9.2            | 15.4                             | 24.6              | 43.5           | -18.9       |

## 9 PHOTOGRAPHS/EXHIBITS – PRODUCT PHOTOS, TEST SETUPS

### Radiated Spurious Emissions, Occupied Bandwidth



Pre-scan

