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## **RADIO REPORT FOR CERTIFICATION**

**REPORT NUMBER: M180709 - 5V2**

**TEST STANDARDS: FCC PART 15 SUBPART C  
SECTION 15.247**

**ISED RSS-247 SECTION 5.0**

**CLIENT: GE DIGITAL MINING TECHNOLOGY**

**DEVICE: CAS-GPS NODE**

**MODEL: PROD1116-E2**

**DATE OF ISSUE: 1 MAY 2019**

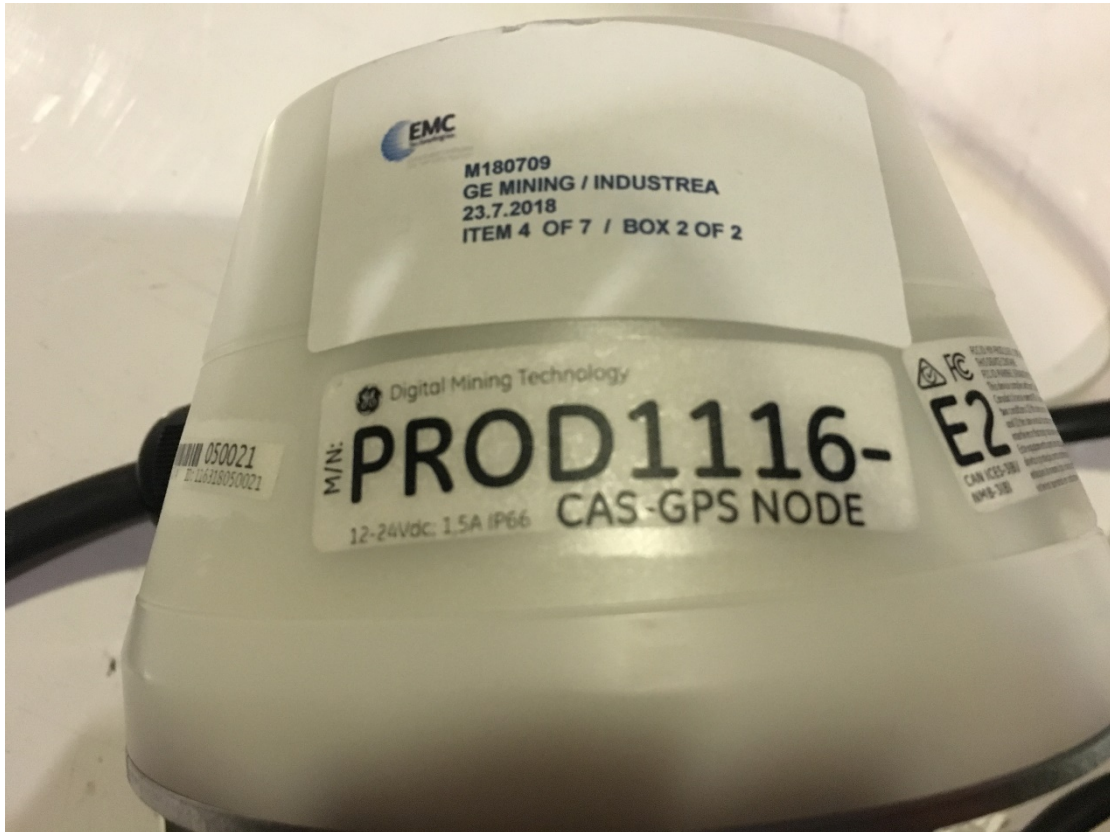
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**Equipment Under Test: CAS-GPS NODE**

**REVISION TABLE**

Version	Sec/Para Changed	Change Made	Date
1		Initial issue of document	1/05/2019

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## CERTIFICATE OF COMPLIANCE

Device: CAS-GPS Node  
Model Number: PROD1116-E2  
Serial Number: 116318050021  
Equivalent Model Numbers: PROD1116-E2X  
PROD1116-S2, PROD1116-L2, PROD1116-P2  
PROD1116-S2X, PROD1116-L2X, PROD1116-P2X  
Manufacturer: GE Digital Mining Technology

FCC ID: YIY-PROD11162  
IC: 8903A-PROD11162

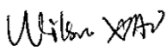
Tested for: GE Digital Mining Technology  
Address: 3 Co-Wyn Close, Fountaindale, NSW 2258, Australia  
Phone Number: +61 2 4336 1847  
Contact: Neil Mosley  
Email: Neil.mosley@ge.com

Standard: FCC Part 15, Subpart C, Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz  
  
ISED RSS-247, Issue 2, Section 5 Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

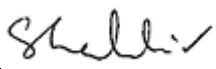
Result: The test sample complied with applicable requirements of the above standards.

Test Date(s): 7-8 Aug 2018 and 14-15 Feb 2019

Issue Date: 1 May 2019

Test Engineer(s):   
Wilson Xaio

Attestation: *I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*

Authorised Signatory:   
Shabbir Ahmed, PhD  
Senior EMC and RF Engineer  
EMC Technologies Pty Ltd

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## RADIO REPORT FOR CERTIFICATION

### 1 TEST SUMMARY

Sec.	Description	FCC	ISED	Result(s)
6.1	Antenna Requirement	§15.203	§RSS-Gen 6.8	Complied
6.2	Restricted Bands of Operation	§15.205	§RSS-Gen 8.10/ RSS-247 3.3	Complied
6.3	Conducted Limits	§15.207	§RSS-Gen 8.8	Not Applicable
6.4	Radiated emission limits; general requirements	§15.209	§RSS-Gen 8.9	Complied
6.5	6 dB bandwidth	§15.247(a)(2)	§RSS-247 5.2(a)	Complied
6.6	Peak Output Power	§15.247(b)(3)	§RSS-247 5.4(d)	Complied
6.7	Out-of-Band/Spurious Emissions	§15.247(d)	§RSS-247 5.5	Complied
6.8	Power spectral density	§15.247(e)	§RSS-247 5.2(b)	Complied
6.9	Maximum Permissible RF Exposure	§15.247(i)	§RSS-Gen 3.4/ RSS-102	Complied
6.10	Occupied Bandwidth – 99% power	§15.215	§RSS-Gen 6.7	Complied

### 2 TEST FACILITY

#### 2.1 General

EMC Technologies Pty Ltd is accredited by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies Pty Ltd has also been designated as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 and 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies Pty Ltd is also an ISED Canada recognized testing laboratory – **ISED company number: 9626A and CAB identifier number: AU0001.**

#### 2.2 NATA Accreditation

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system similar to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A<sup>2</sup>LA).

All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation to ISO 17025 for both testing and calibration and ISO 17020 for Inspection – **Accreditation Number 5292.**

The current full scope of accreditation can be found on the NATA website: [www.nata.com.au](http://www.nata.com.au)

### 3 TEST EQUIPMENT CALIBRATION

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA accredited laboratory such as Keysight Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI) or in-house. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yyyy	Due Date dd/mm/yyyy	Cal. Interval
Chamber	Frankonia SAC-3-2 (R-144)	17/07/2017	17/07/2020	3 Year*1
EMI Receiver	R&S ESW26 Sn: 101306 (R-143)	14/05/2018	14/05/2019	1 Year*2
Antennas	EMCO 6502 Active Loop 9 kHz – 30 MHz Sn. 9311-2801 (A-231)	15/08/2018	15/08/2021	3 Year*2
	SUNOL JB1 Sn. A061917 (A-425)	21/07/2017	21/07/2019	2 Year*2
	EMCO 3115 Double Ridge Horn Sn: 8908-3282 (A-004)	15/07/2016	15/07/2019	3 Year*1
Cables*4	Huber & Suhner Sucoflex 104A Sn: 503055 (C-457)	18/01/2019	18/01/2020	1 Year*1
	Huber & Suhner Sucoflex 104A Sn: 507099 (C-479)	18/01/2019	18/01/2020	1 Year*1
	Huber & Suhner Sucoflex 104A Sn: 503061 (C-463)	18/01/2019	18/01/2020	1 Year*1

- Note \*1. Internal NATA calibration.
- Note \*2. External NATA / A2LA calibration.
- Note \*3. Calibration date was valid during the time of testing.
- Note \*4. Cables are verified before measurements are taken.

### 4 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

<b>Conducted Emissions:</b>	9 kHz to 30 MHz	±3.2 dB
<b>Radiated Emissions:</b>	9 kHz to 30 MHz	±4.1 dB
	30 MHz to 300 MHz	±5.1 dB
	300 MHz to 1000 MHz	±4.7 dB
	1 GHz to 18 GHz	±4.6 dB
<b>Peak Output Power:</b>		±1.5 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

## 5 DEVICE DETAILS

(Information supplied by the Client)

CAS-GPS Node Intelligent multi-purpose node comprises of a high-performance GPS receiver, Vehicle to Vehicle (V2V) radio transceiver, high accuracy Ranging RF transceiver Time of Flight (ToF), RS-232/485 communications, Digital Input (2) / Output (1), Personal Area Network (PAN) and internal battery.

### 5.1 EUT (Transmitter) Details

<b>Radio:</b>	920 MHz V2V radio transceiver
<b>Operating Frequency:</b>	920 MHz
<b>Modulation:</b>	4GFSK
<b>Number of Channels:</b>	1
<b>Antenna:</b>	Integral PCB chip antenna
<b>Antenna gain:</b>	3.32 dBi (max)

### 5.2 EUT (Host) Details

<b>Test Sample:</b>	CAS-GPS Node
<b>Model Number:</b>	PROD1116-E2
<b>Serial Number:</b>	116318050021
<b>Equivalent Model Numbers:</b>	PROD1116-E2X PROD1116-S2, PROD1116-L2, PROD1116-P2 PROD1116-S2X, PROD1116-L2X, PROD1116-P2X
<b>Manufacturer:</b>	GE Digital Mining Technology
<b>Supply Rating:</b>	12 - 24V DC 1.5A 15W

### 5.3 Test Configuration

Testing was performed with the EUT set to transmit continuously (with modulation applied).

V2V parameter "Power: 127" was set via PT Manager software.

### 5.4 Modifications

No modification was required to achieve compliance.



## 6 RESULTS

### 6.1 §15.203/ RSS-Gen 6.8 Antenna Requirement

The CAS-GPS Node 920 MHz transceiver incorporates an integral PCB chip antenna and cannot be replaced by another type.

**Antenna Type:** Integral PCB chip antenna

**Antenna gain:** 3.32 dBi

**Connector:** N/A

### 6.2 §15.205/ RSS-Gen 8.10/ RSS-247 3.3 Restricted Bands of Operation

The provisions of the §15.205/ RSS-Gen 8.10/ RSS-247 3.3 restricted bands of operation and §15.209/ RSS-Gen 8.9 radiated emissions limits have been met, refer to section 6.7

### 6.3 §15.207/ RSS-Gen 8.8 Conducted Limits

The device is DC battery powered and does not connect directly or indirectly to the AC mains network. The test was not applicable.

### 6.4 §15.209/ RSS-Gen 8.9 Radiated emission limits; general requirements

The provisions of the §15.205/ RSS-Gen 8.10/ RSS-247 3.3 restricted bands of operation and §15.209/ RSS-Gen 8.9 radiated emissions limits have been met, refer to section 6.7

### 6.5 §15.247(a)(2)/ RSS-247 5.2(a) 6 dB bandwidth

#### 6.5.1 Test Procedure

The tests were performed in accordance with ANSI C63.10: 2013 Clause 11.8 DTS bandwidth.

The 6 dB bandwidth was measured while the device was transmitting with typical modulation applied. The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised when measuring the bandwidth.

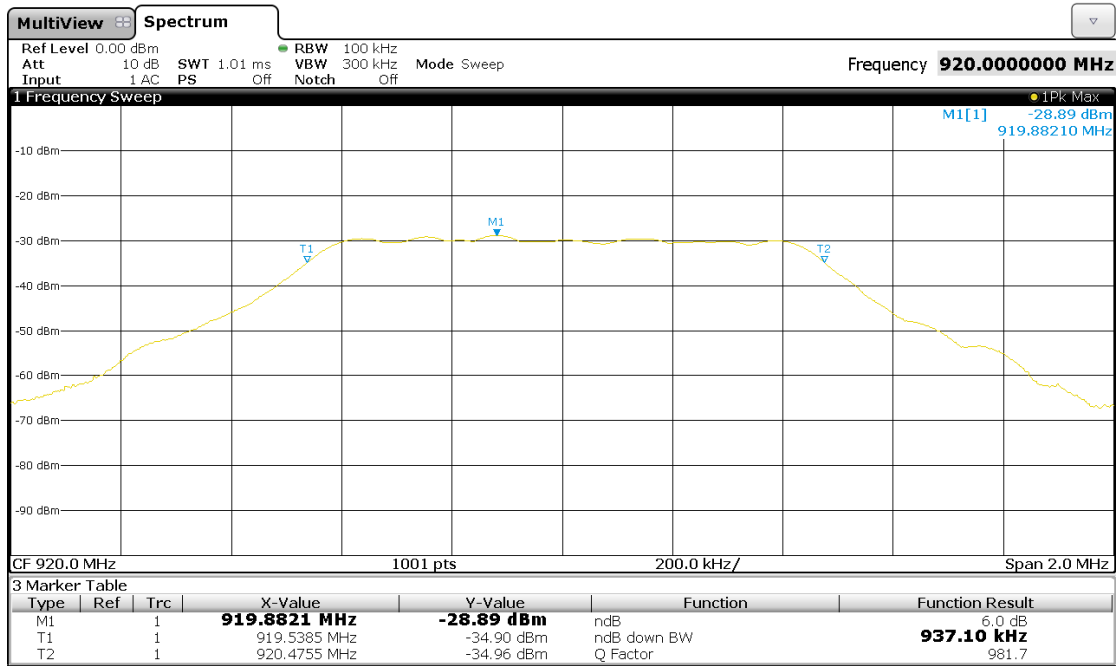
#### 6.5.2 Limits

In the band 902-928 MHz, the minimum 6 dB bandwidth is to be at least 500 kHz.

#### 6.5.3 Results

Table 6-1: 6 dB Bandwidth

Centre Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Results
920	937.10	$\geq 500$	Complied



Graph 6-1: 6-dB bandwidth

## 6.6 §15.247(b)(3)/ RSS-247 5.4(d) Peak Out Power

### 6.6.1 Test Procedure

The field strength of the fundamental transmitted frequency was measured inside a semi-anechoic chamber compliant with ANSI C63.4: 2014 in accordance to ANSI C63.10: 2013 clause 11.9.1.1.

The EUT was positioned on a test turn-table and rotated through 360° to determine the highest emissions. The measurement antenna was also varied between 1 and 4 metres height. Different orientations of the EUT (x, y and z-axis) and measurement antenna polarisations (vertical and horizontal) were investigated to produce the highest emission EIRP.

All measurements were made at a distance of 3 metres. The fundamental emissions were measured using a peak detector.

### 6.6.2 Limits

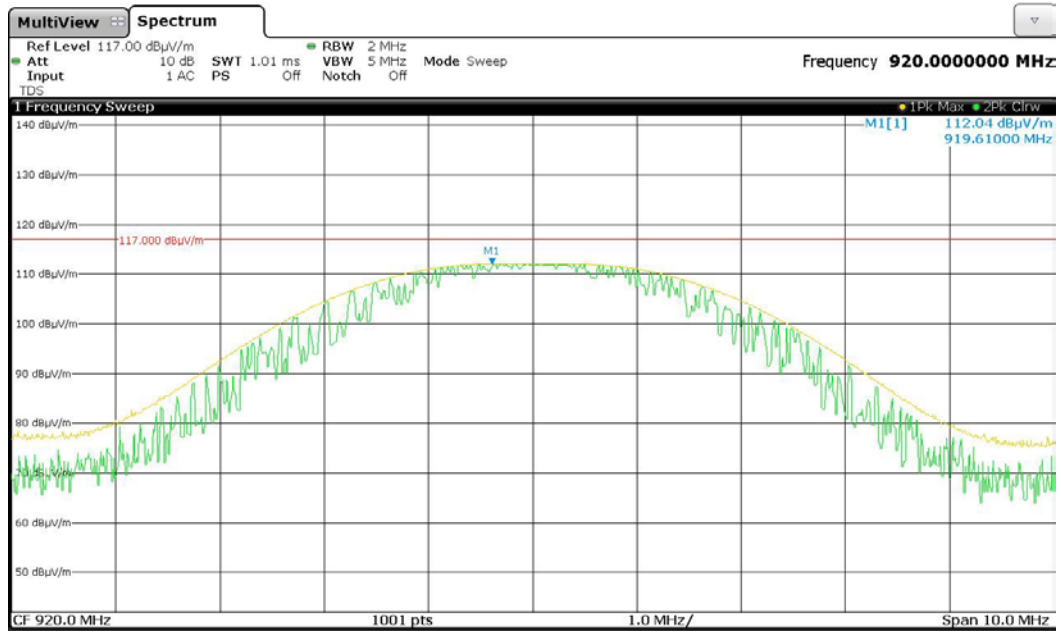
The maximum peak conducted output power at 902-928 MHz is 1 Watts or 30 dBm.

### 6.6.3 Results

The measured radiated field strength is converted to equivalent conducted output power for checking compliance (KDB 558074 D01 Section 3).

Table 6-2: Maximum peak power

Freq. (MHz)	E-Field @ 3 m (dBuV/m)	EIRP (dBm)	Antenna Gain (dBi)	Equivalent Conducted Output Power (dBm)	Limit (dBm)	Results
920	112.04	16.81	3.32	13.49	30	Complied



Graph 6-2: Radiated peak output power E-Field (dBuV/m @ 3 m)

## 6.7 §15.247(d)/ RSS-247 5.5 Out-of-Band/Spurious Emissions

### 6.7.1 Test procedure

Radiated out-of-band/spurious emissions measurements were performed in a semi-anechoic chamber compliant with ANSI C63.4: 2014.

The test frequency range was sub-divided into smaller bands with the defined resolution bandwidths to permit reliable display and identification of emissions.

Frequency range [MHz]	Measurement Bandwidth [kHz]	Measurement Distance [m]	Antenna
0.009 to 0.150	0.2	3	0.6 metre loop antenna
0.150 to 30	9	3	
30 to 1000	120	3	Biconilog hybrid
1000 to 18 000	1000	3	Standard gain or broadband horn
18 000 to 40 000	1000	1	

EUT was set at a height of 0.8 m for measurements below 1000 MHz and set at 1.5 m for measurements above 1000 MHz.

The sample was slowly rotated with the spectrum analyser set to Max-Hold. This was performed for at least two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. For below 1000 MHz the emissions were measured with a Quasi-Peak detector, and for above 1000 MHz the emissions were measured with Peak and Average detectors.

EUT was investigated on all three axes (x, y, and z). Measurements on the worst axis presented below.

The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical polarisations of the measurement antenna.

### 6.7.2 Limits

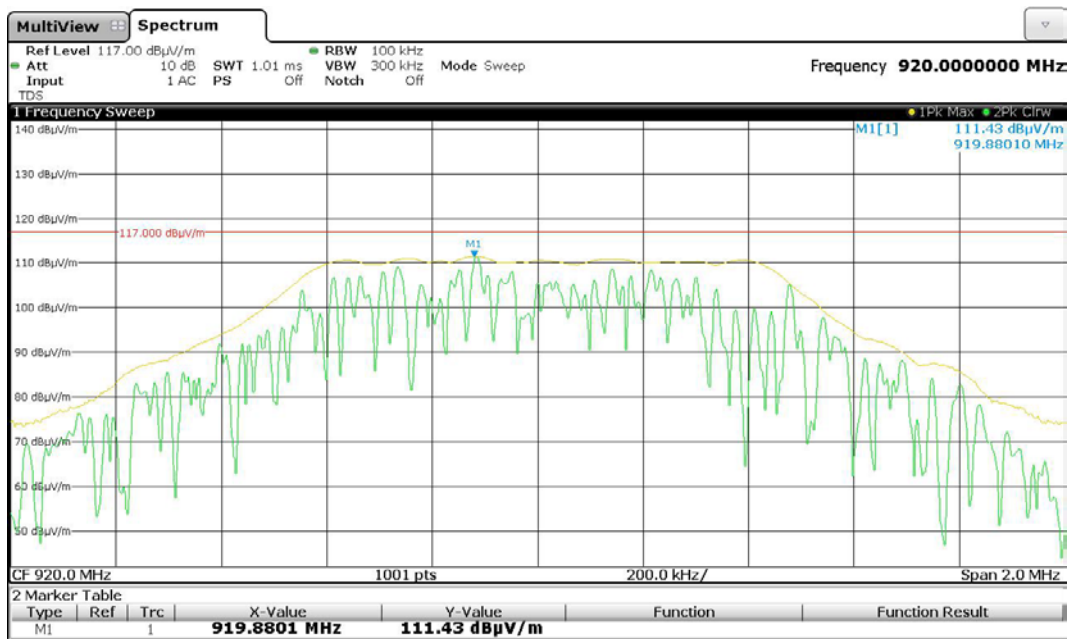
The limit applied is in accordance with the out-of-band/spurious emissions limit defined in §15.247(d)/ RSS-247 5.5.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The in-band peak PSD in 100 kHz bandwidth were measured. The maximum PSD level was used to establish the limit. However, the general limits of §15.209/ RSS-Gen 8.9 apply for the restricted bands of operation defined in §15.205/ RSS-Gen 8.10.

Table 6-3: 100 kHz reference level measurement

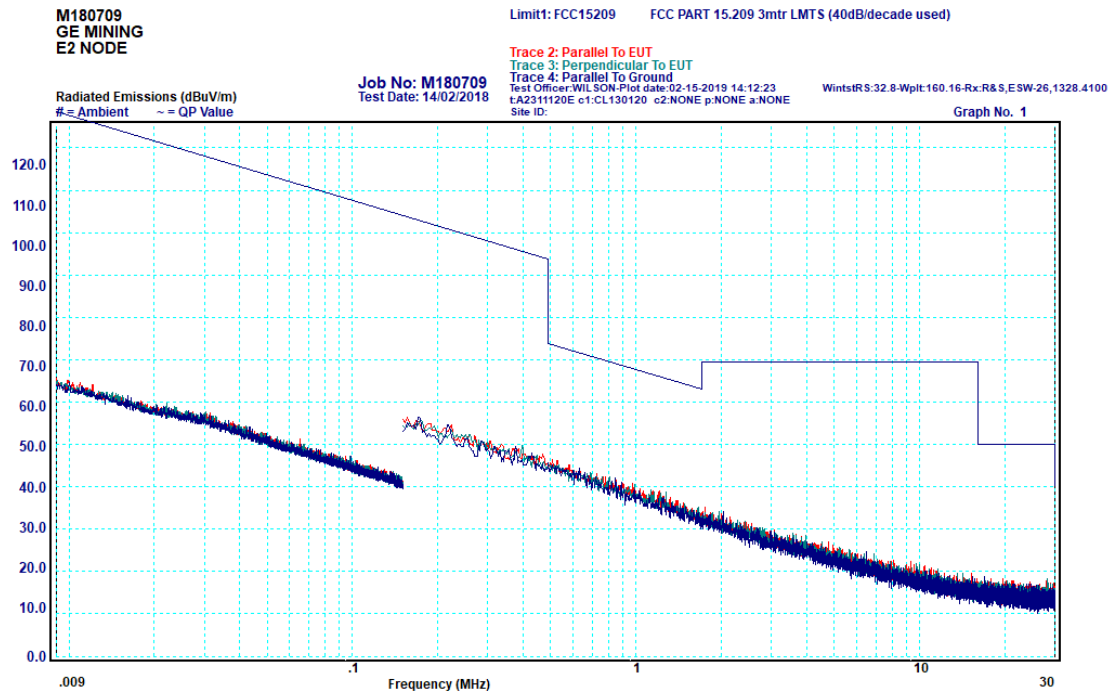
Frequency (MHz)	E-field at 3 m (dBµV/m)	Limit at 3m (dBµV/m)
920	111.43	91.43



Graph 6-3: Reference level measurement – 100 kHz bandwidth

### 6.7.3 Results: Frequency Band: 9 kHz - 30 MHz

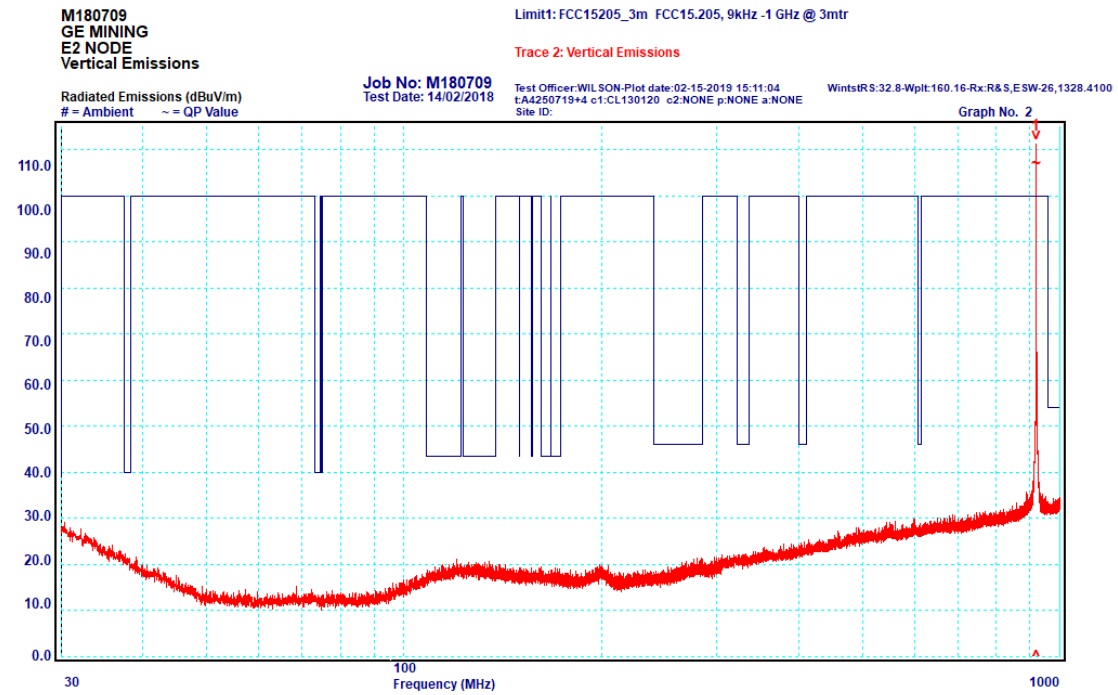
All emissions measured in the frequency band 9 kHz to 30 MHz complied with the requirements of §15.247/ RSS-247 5.0. The emissions were 10 dB or more below the limit.



Graph 6-4: Spurious emissions 9 kHz – 30 MHz

### 6.7.4 Results: Frequency Band: 30 - 1000 MHz

All spurious emissions measured in the frequency band 30 MHz to 1000 MHz complied with the requirements of §15.247/ RSS-247 5.0.



Graph 6-5: Spurious Emissions, 30 – 1000 MHz, Vertical

Table 6-4: Spurious Emissions, 30 - 1000 MHz, Vertical

Peak	Polarisation	Frequency (MHz)	Quasi-Peak (dBµV/m)	Limit (dBµV/m)	Delta Limit (dB)
1*	Vertical	920	N/A	N/A	N/A

\*Peak 1 is the fundamental transmission and is not subject to the spurious limits of the standard

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 Horizontal Emissions

Limit1: FCC15205\_3m FCC15.205, 9kHz -1 GHz @ 3mtr

Trace 2: Horizontal Emissions

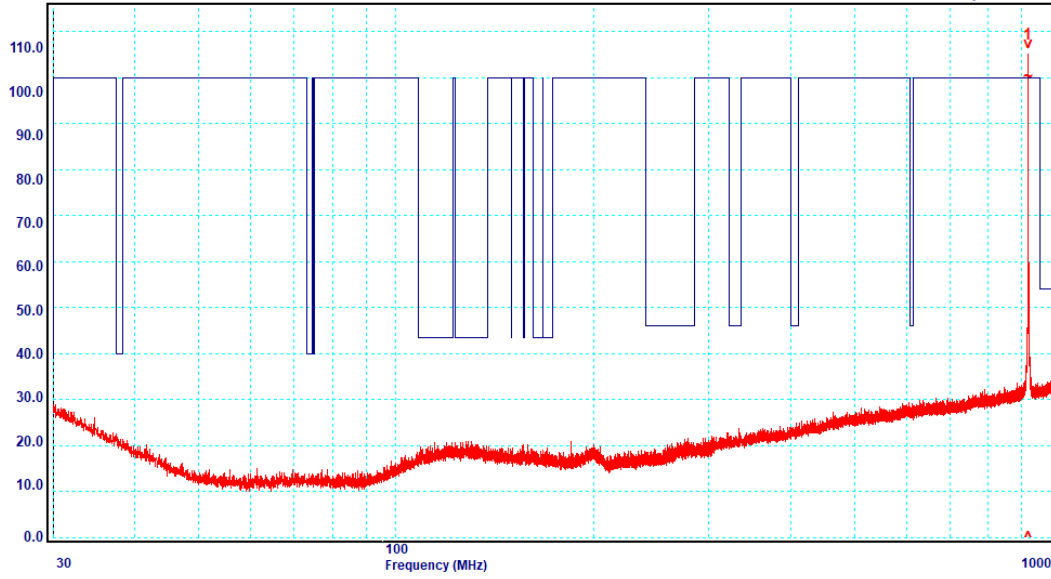
Job No: M180709  
 Test Date: 14/02/2018

Test Officer: WILSON-Plot date: 02-15-2019 15:11:36  
 t:A4250719+4 c1:CL130120 c2:NONE p:NONE a:NONE  
 Site ID:

WinstRS:32.8-Wpit:160.16-Rx:R&S,ESW-26,1328.4100

Radiated Emissions (dBuV/m)  
 # = Ambient ~ = QP Value

Graph No. 3



Graph 6-6: Spurious Emissions, 30 – 1000 MHz, Horizontal

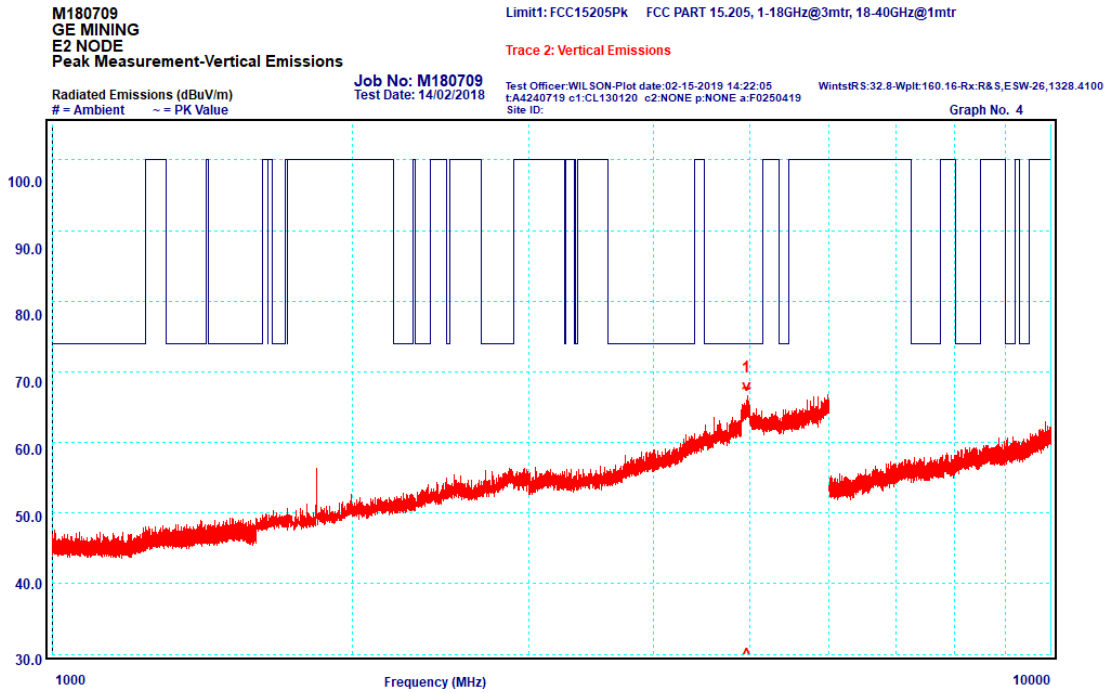
Table 6-5: Spurious Emissions, 30 - 1000 MHz, Horizontal

Peak	Polarisation	Frequency (MHz)	Quasi-Peak (dBµV/m)	Limit (dBµV/m)	Delta Limit (dB)
1*	Horizontal	920	N/A	N/A	N/A

\*Peak 1 is the fundamental transmission and is not subject to the spurious limits of the standard

### 6.7.5 Results: Frequency Band: 1000 – 10000 MHz

All spurious emissions measured in the frequency band 1000 MHz to 10000 MHz complied with the requirements of §15.247/ RSS-247 5.0.



Graph 6-7: Spurious Emissions, 1000 - 10000 MHz, Vertical, Peak

Table 6-6: Spurious Emissions, 1000 - 10000 MHz, Vertical, Peak

Peak	Polarisation	Frequency (MHz)	Peak (dBuV/m)	Limit (dBuV/m)	Delta Limit (dB)
1	Vertical	4961.33	67.5	74.0	-6.5



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 Peak Measurement-Horizontal Emissions

Limit1: FCC15205Pk FCC PART 15.205, 1-18GHz@3mtr, 18-40GHz@1mtr

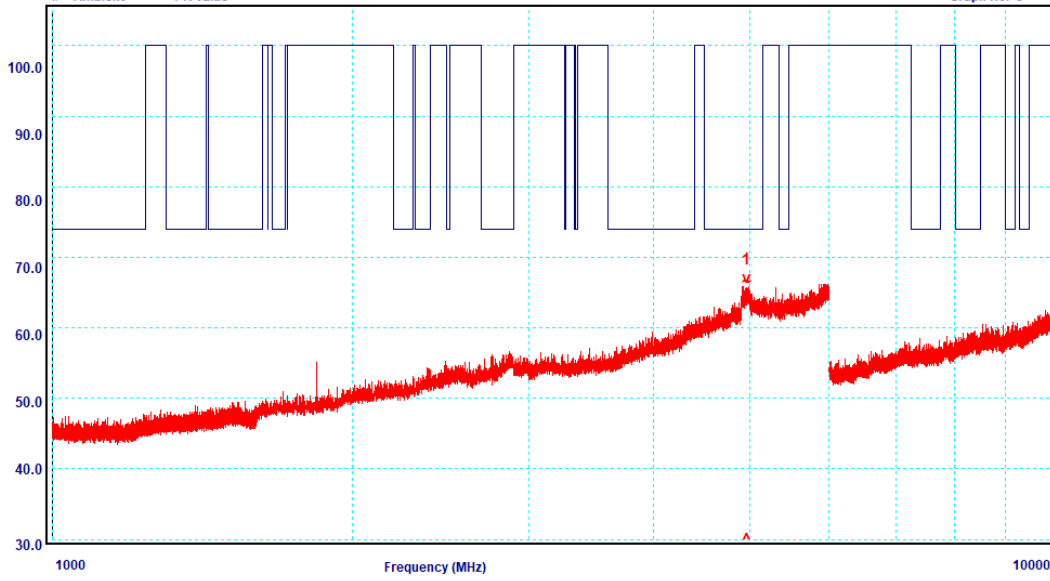
Trace 2: Horizontal Emissions

Radiated Emissions (dBuV/m)  
 # = Ambient ~ = PK Value

Job No: M180709  
 Test Date: 14/02/2018

Test Officer: WILSON-Plot date: 02-15-2019 14:24:32 WinstRS: 32.8-Wplit: 160.16-Rx: R&S,ESW-26,1328.4100  
 t: A4240719 c1: CL130120 c2: NONE p: NONE a: F0250419  
 Site ID:

Graph No. 5



Graph 6-8: Spurious Emissions, 1000 - 10000 MHz, Horizontal, Peak

Table 6-7: Spurious Emissions, 1000 - 10000 MHz, Horizontal, Peak

Peak	Polarisation	Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Delta Limit (dB)
1	Horizontal	4961.21	66.5	74.0	-7.5

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 Average Measurement-Vertical Emissions

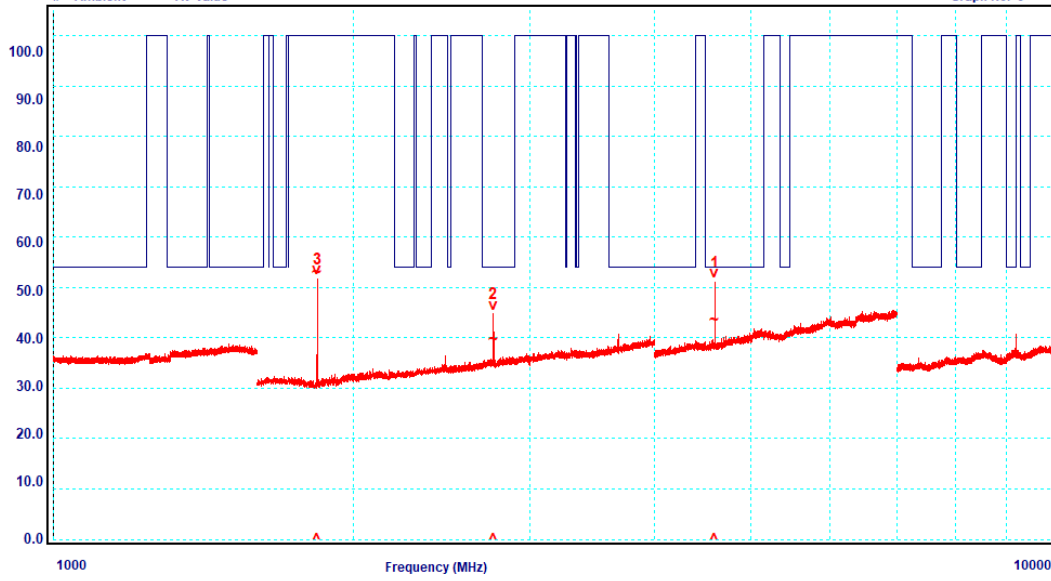
Limit1: FCC15205Av FCC PART 15.205, 1-18GHz@3mtr, 18-40GHz@1mtr

Trace 2: Vertical Emissions

Radiated Emissions (dBuV/m)  
 # = Ambient ~ = AV Value

Job No: M180709  
 Test Date: 15/02/2018

Test Officer: WILSON-Plot date: 02-15-2019 14:33:11 WinstRS: 32.8-Wpit: 160.16-Rx: R&S,ESW-26,1328.4100  
 t: A4240719 c1: CL130120 c2: NONE p: A2880919 a: F0310919  
 Site ID: Graph No. 6



Graph 6-9: Spurious Emissions, 1000 - 10000 MHz, Vertical, Average

Table 6-8: Spurious Emissions, 1000 - 10000 MHz, Vertical, Average

Peak	Polarisation	Frequency (MHz)	Avg. (dBµV/m)	Limit (dBµV/m)	Delta Limit (dB)
1	4599.48	Vertical	43.5	54	-10.5
2	2759.96	Vertical	39.8	54	-14.2
3	1839.99	Vertical	52.9	91.43	-38.53

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 GE MINING  
 E2 NODE  
 Average Measurement-Horizontal Emissions

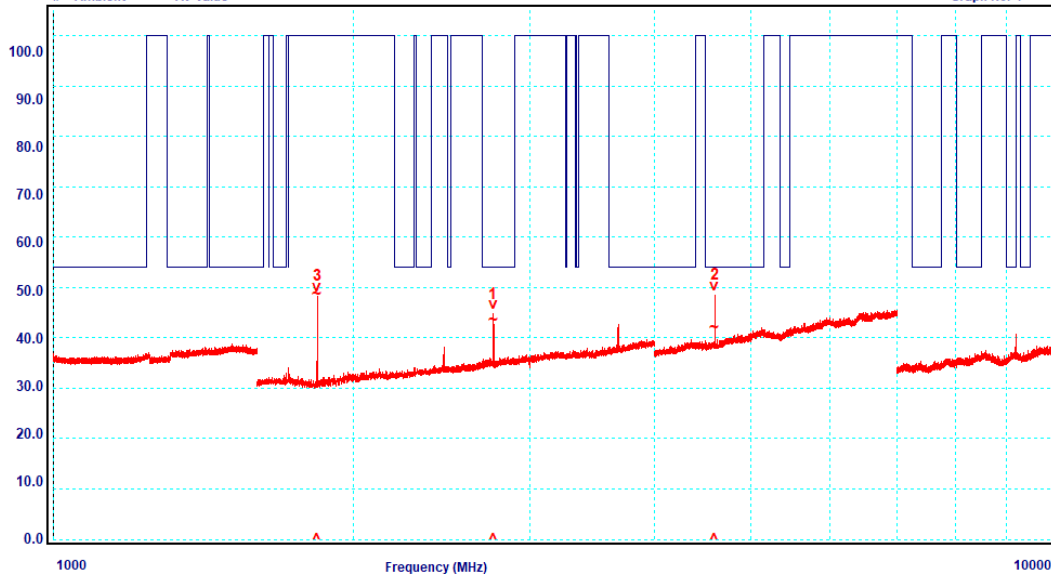
Limit1: FCC15205Av FCC PART 15.205, 1-18GHz@3mtr, 18-40GHz@1mtr

Trace 2: Horizontal Emissions

Radiated Emissions (dBuV/m)  
 # = Ambient ~ = AV Value

Job No: M180709  
 Test Date: 15/02/2018

Test Officer: WILSON-Plot date: 02-15-2019 14:36:38 WinstRS: 32.8-Wpl1: 160.16-Rx: R&S,ESW-26,1328.4100  
 t: A4240719 c1: CL130120 c2: NONE p: A2880919 a: F0310919  
 Site ID: Graph No. 7



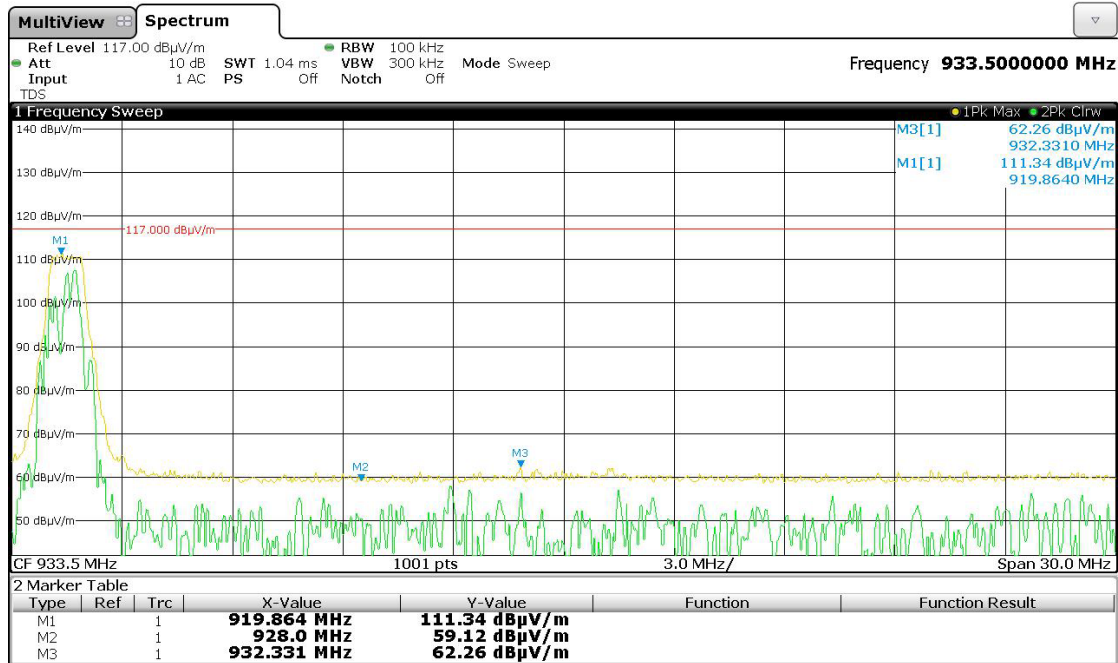
Graph 6-10: Spurious Emissions, 1000 - 10000 MHz, Horizontal, Average

Table 6-9: Spurious Emissions, 1000 - 10000 MHz, Horizontal, Average

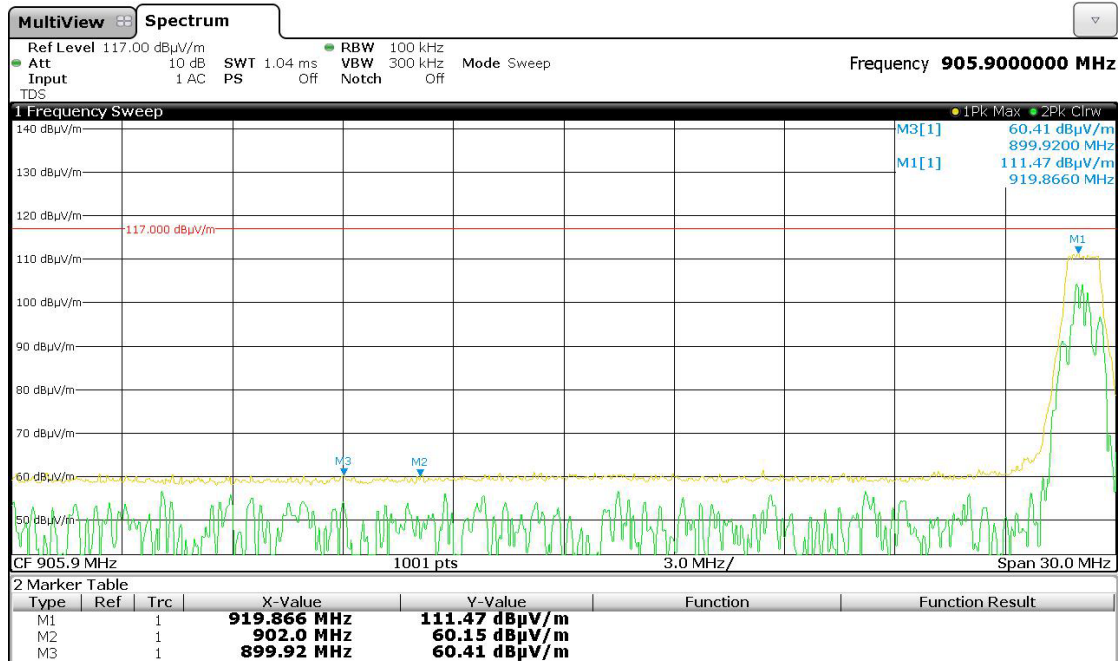
Peak	Polarisation	Frequency (MHz)	Avg. (dBµV/m)	Limit (dBµV/m)	Delta Limit (dB)
1	2760.02	Horizontal	43.6	54	-10.4
2	4598.67	Horizontal	42.1	54	-11.9
3	1839.99	Horizontal	48.6	91.43	-42.83

### 6.7.6 Band-edge Emission Measurements

Band-edge measurements were done using radiated methods in accordance to ANSI C63.10 clause 6.10. All emissions measured near the lower and higher band edge complied with the requirements of §15.247/ RSS-247 5.0. The orientation of the EUT and the measurement antenna height and polarisation that produced the highest EIRP was used.



Graph 6-11: Higher band-edge 928 MHz



Graph 6-12: Lower band-edge 902 MHz

## 6.8 §15.247(e)/ RSS-247 5.2(b) Power Spectral Density

### 6.8.1 Test procedure

The tests were performed in accordance with ANSI C63.10: 2013 Clause 11.10 Maximum power spectral density level in the fundamental emissions.

Power spectral density measurements were made at 3 metres. The measurement resolution bandwidth was 3 kHz. The orientation of the EUT and the measurement antenna height and polarisation that produced the highest EIRP was used.

### 6.8.2 Limits

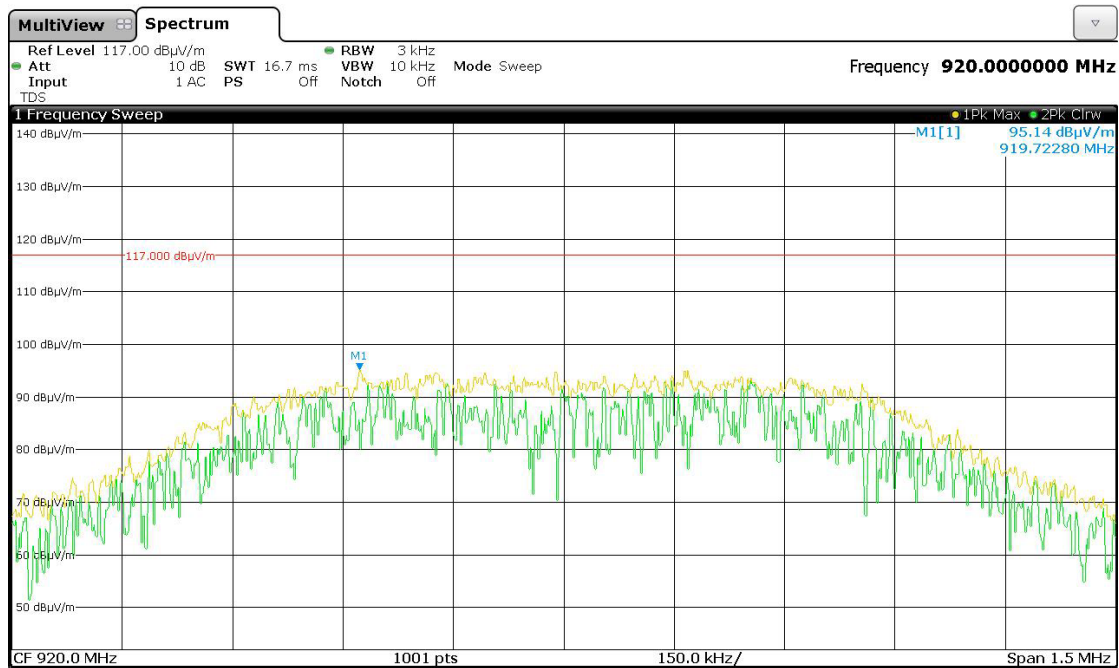
The maximum peak conducted power spectral density (PSD) is 8 dBm per 3 kHz.

### 6.8.3 Results

The measured radiated field strength is converted to equivalent conducted output power spectral density for checking compliance (KDB 558074 D01 Section 3).

Table 6-10: Power spectral density, RBW = 3kHz

Freq. (MHz)	E-Field @ 3 m (dBuV/m)	EIRP (dBm)	Antenna Gain (dBi)	Equivalent Conducted Output PSD (dBm)	Limit (dBm)	Δ Limit (dBm)	Results
920	95.14	-0.09	3.32	-3.41	8	-11.41	Complied



Graph 6-13: Radiated – Power spectral density measurement

### 6.9 §15.247(i)/ RSS-102 Maximum Permissible RF Exposure

The EUT complied with the applicable maximum permissible exposure levels. Refer to EMC Technologies report M180709-7/ M180709-8.

### 6.10 §15.215/ RSS-Gen 6.7 Occupied Bandwidth – 99% power

#### 6.10.1 Test procedure

The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 clause 6.9.

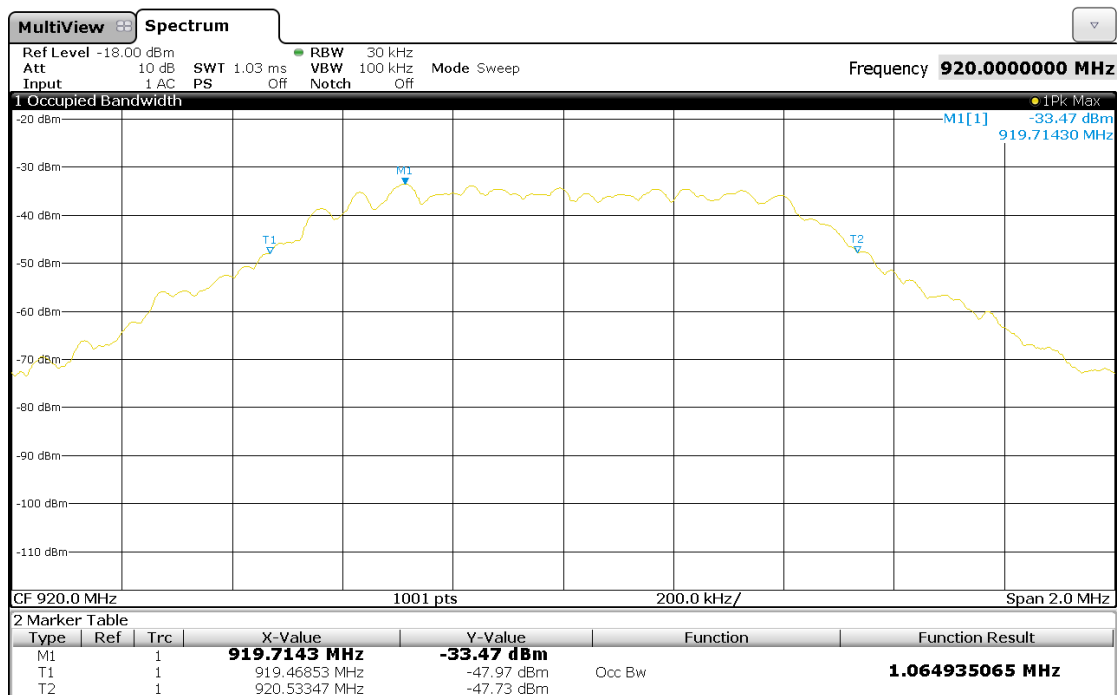
#### 6.10.2 Limits

The 99% power should be contained within the frequency band 902 – 928 MHz.

#### 6.10.3 Results

Table 6-11: Occupied Bandwidth

Frequency [MHz]	99% Bandwidth [MHz]	Low Frequency [MHz]	High Frequency [MHz]	Result
920	1.0649	919.46853	920.53347	Complied



Graph 6-14: Occupied bandwidth

**END OF REPORT**