Engineering Test Report No. 2004170-01		
Report Date	October 27, 2020	
Manufacturer Name	Badger Meter	
Manufacturer Address	4545 W. Brown Deer Road Milwaukee, WI 53223	
Model No.	ORION Cellular C	
Date Received	October 13, 2020	
Test Dates	October 13, 2020 through October 15, 2020	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B Innovation, Science, and Economic Development Canada, RSS-247 Innovation, Science, and Economic Development Canada, RSS-GEN	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature	Mark E. Longinotti	
Tested by	Mark E. Longinotti	
Signature	Raymond J. Klouda	
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	395267	

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247 and RSS-GEN test specifications. The data presented in this test report pertains to the EUT on the test date(s) specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification. This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Table of Contents

1. Report Revision History

Revision	Date	Description
–	28 OCT 2020	Initial Release of Engineering Test Report No. 2004170-01

2. Introduction

2.1. Scope of Tests

This document presents the results of a series of RF emissions tests that were performed on the Badger Meter Water Meter Transceiver (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured and submitted for testing by Badger Meter located in Milwaukee, WI.

2.2. Purpose

The test series was performed to determine if the EUT meets the RF emission requirements of the FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B, Section 15.107 and 15.109 for Receivers and Part 15, Subpart C, Sections 15.247 for a Frequency Hopping Spread Spectrum intentional radiator operating within the 902-928MHz band.

The test series was also performed to determine if the EUT meets the RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen and Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-247 for a Frequency Hopping Spread Spectrum intentional radiator operating within the 902-928MHz band.

Testing was performed in accordance with ANSI C63.10-2013 and ANSI C63-4-2014.

2.3. Identification of the EUT

The EUTs are identified as follows:

EUT Identification	
Product Description	Water Meter
Model/Part No.	ORION Cellular C
S/N	130000005
Device Type	Frequency Hopping Transmission Device
Band of Operation	902-928MHz
Modulation Type	FHSS
Software/Firmware Version	0.2.94
Conducted Output Power	20.4mW (13.1dBm)
Rated Output Power	N/A
Antenna Type	SMD, Lucida Part No. SR4L002
Antenna Gain (dBi)	-2
20dB Bandwidth	319.7kHz
Occupied Bandwidth (99% CBW)	268.73kHz
Size of EUT	12.5cm x 5cm x 4.5cm
Product Description	Water Meter
Model/Part No.	ORION Cellular C
S/N	130000006
Device Type	Frequency Hopping Transmission Device
Band of Operation	902-928MHz
Modulation Type	FHSS
Software/Firmware Version	0.2.94
Conducted Output Power	N/A
Antenna Type	SMD, Lucida Part No. SR4L002
Antenna Gain (dBi)	-2
Rated Output Power	26.3mW (14.2dBm)
Size of EUT	12.5cm x 5cm x 4.5cm

Serial No. 130000006 was used for EIRP and spurious radiated emissions tests. Serial No. 130000005 was used for all other tests. For testing purposes, Serial No. 130000005 was modified for testing by adding a coaxial connector to the antenna port.

3. Power Input

The EUT normally obtains 3.6VDC from an internal Tadiran Lithium Inorganic Battery. For testing purposes, the EUT was powered with 3.65VDC from an external power supply via 2 wires.

4. Grounding

The EUT was not connected to ground.

5. Support Equipment

The EUT was submitted for testing along with the following support equipment:

Description	Model #
Dell Laptop Computer	Latitude E5540
USB to IR Dongle	ACT-IR224UN-L+

The laptop computer and the USB to IR dongle were used to program the device. For all radiated emissions tests, they were removed from the test chamber prior to test.

6. Interconnect Leads

No interconnect leads were used during the tests.

7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

8. Modes of Operation

The EUT and all peripheral equipment were energized. The unit was programmed to transmit in one of the following modes:

Mode	Description
904.94MHz	Power Setting = 16dBm
914.1MHz	Power Setting = 16dBm
923.79MHz	Power Setting = 16dBm
Hopping Enabled	Power Setting = 16dBm

9. Test Specifications

The tests were performed to selected portions of, and in accordance with the following test specifications:

- Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart C
- Federal Communications Commission “Code of Federal Regulations”, Title 47, Part 15, Subpart B
- 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 9kHz to 40 GHz”
- ANSI C63.10-2013, “American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”
- Federal Communications Commission Office of Engineering and Technology Laboratory Division,

Guidance For Compliance Measurements On Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 April 2, 2019 KDB 558074 D01v05r02

- RSS-247 Issue 2, February 2017, “Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices”

- RSS-Gen Issue 5, March 2019, Amendment 1, Innovation, Science, and Economic Development Canada, “Spectrum Management and Telecommunications, Radio Standards Specification, General Requirements for Compliance of Radio Apparatus”

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Badger Meter and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247, and ANSI C63.10-2014 specifications.

11. Deviation, Additions to, or Exclusions from Test Specifications

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

Ambient Parameters	Value
Temperature	22°C
Relative Humidity	22%
Atmospheric Pressure	1014mb

13. Summary

The following EMC tests were performed and the results are shown below:

Test Description	Requirements	Test Methods	S/N	Results
Receiver Radiated Emissions Test	FCC 15B 15.107 ISED RSS-GEN	ANSI C63.4: 2014	130000006	Conforms
20dB Bandwidth	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Occupied Bandwidth (99%)	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Carrier Frequency Separation	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Number of Carrier Channels	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Average Time of Occupancy	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Maximum Peak Conducted Output Power	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms
Effective Isotropic Radiated Power (EIRP)	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000006	Conforms
Duty Cycle Factor Measurements	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	—
Case Spurious Radiated Emissions	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000006	Conforms
Band-Edge Compliance	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	130000005	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB).

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

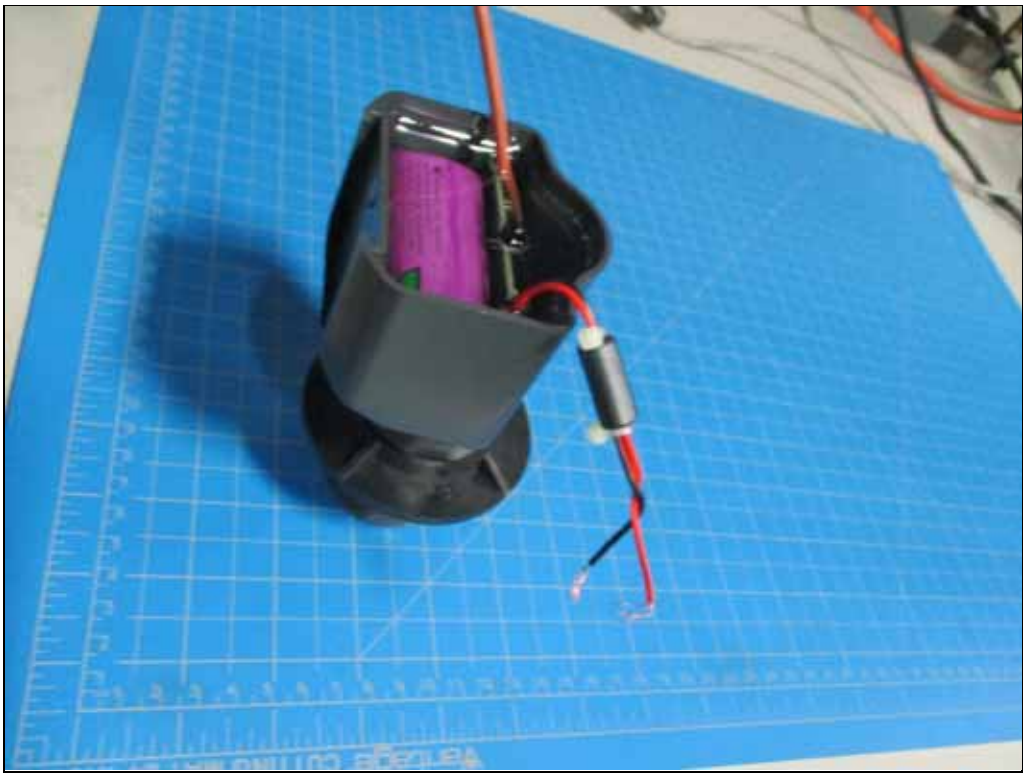
15. Statement of Conformity

The Badger Meter Water Meter Transceiver, Model No. ORION Cellular C, did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247 and FCC “Code of Federal Regulations” Title 47 Part 15, Subpart B, Section 15.109.

16. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247 test specifications. The data presented in this test report pertains to the EUT on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

17. Photographs of EUT

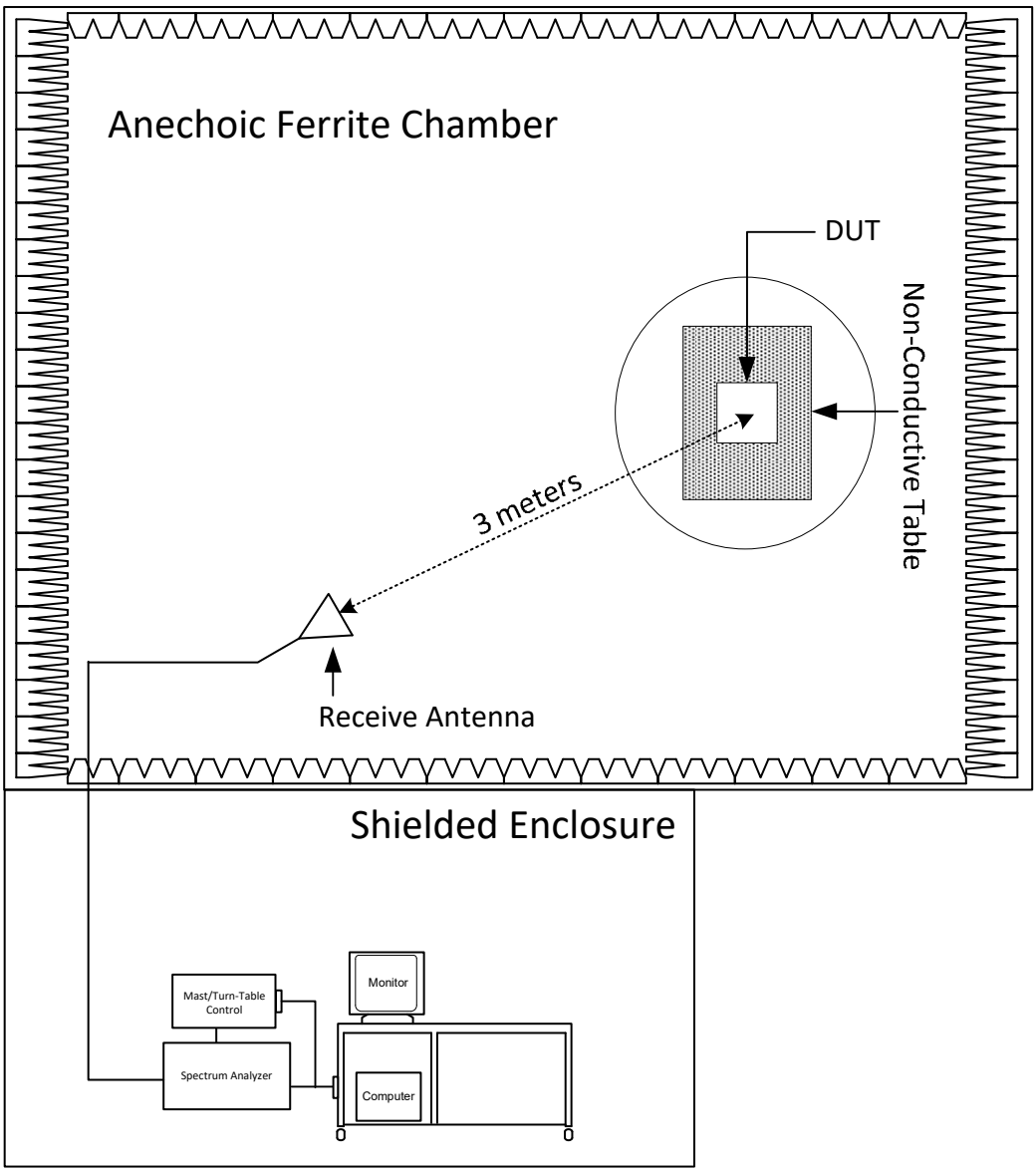


18. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW14	PREAMPLIFIER	PLANAR	PE2-35-120-5R0-10-12-SFF	PL22671	1-20GHz	9/24/2020	9/24/2021
CDZ4	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
GRE1	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	2/25/2020	2/25/2021
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	7/28/2020	7/28/2022
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	10/20/2020	10/20/2021
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/28/2020	4/28/2022
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/23/2020	3/23/2021
SHC2	Power Supplies	HENGFU	HF60W-SL-24	A11372702	24V	NOTE 1	
VBV2	CISPR EN FCC ICES RE.EXE	ELITE	CISPR EN FCC ICES RE.EXE	---	---	N/A	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ3	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	4	1.8GHZ-10GHZ	9/6/2019	9/6/2021

N/A: Not Applicable I/O: Initial Only CNR: Calibration Not Required
NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

19. Block Diagram of Test Setup



Radiated Measurements Test Setup

20. Receiver Radiated Emissions Test

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000006
Mode	Receive at 904.94MHz, Receive at 914.1MHz, Receive at 923.79MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-Anechoic Chamber
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Highest Internal Frequency of the EUT:	923.79MHz
Highest Measurement Frequency:	5000MHz
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

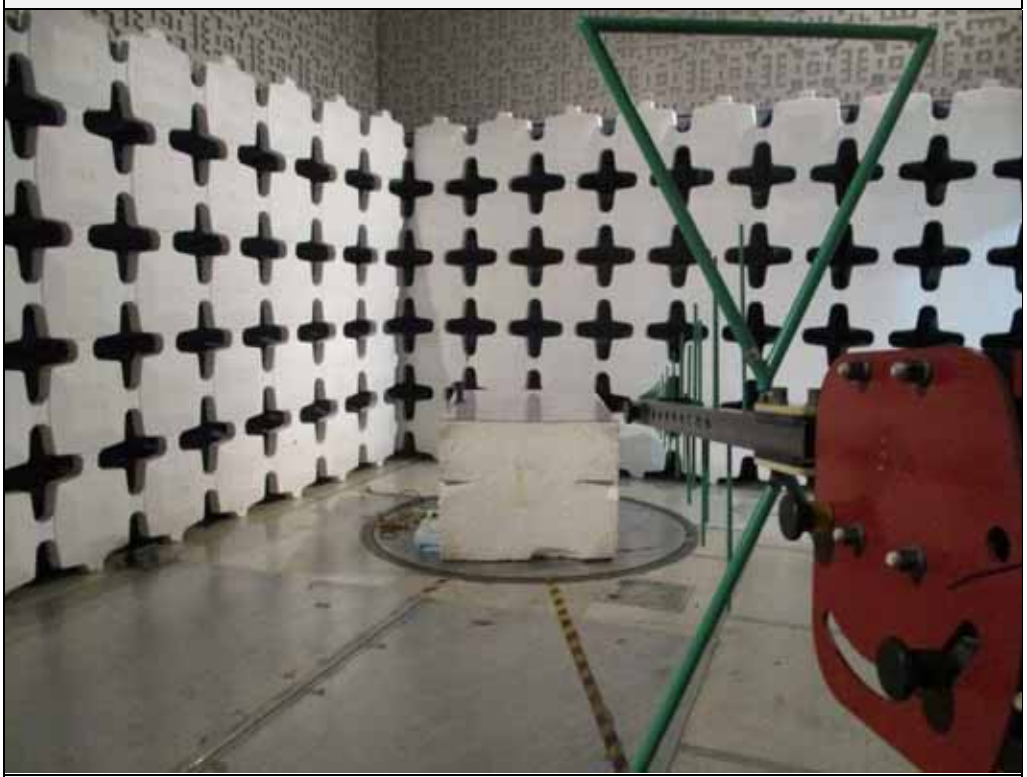
Requirements	
The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:	
Frequency of Emission (MHz)	Field Strength (µV/m)
30-88	100
88-216	150
216-960	200
Above 960	500

Procedures
Since a quasi-peak detector and an average detector require long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector. The EUT was placed on a non-conductive stand. The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 5GHz was investigated using a peak detector function with the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. Final radiated emissions were performed on all significant broadband and narrowband emissions found in the exploratory sweeps using the following methods:

Procedures
1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna. 2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken: a) The EUT was rotated so that all sides were exposed to the receiving antenna. b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured. c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

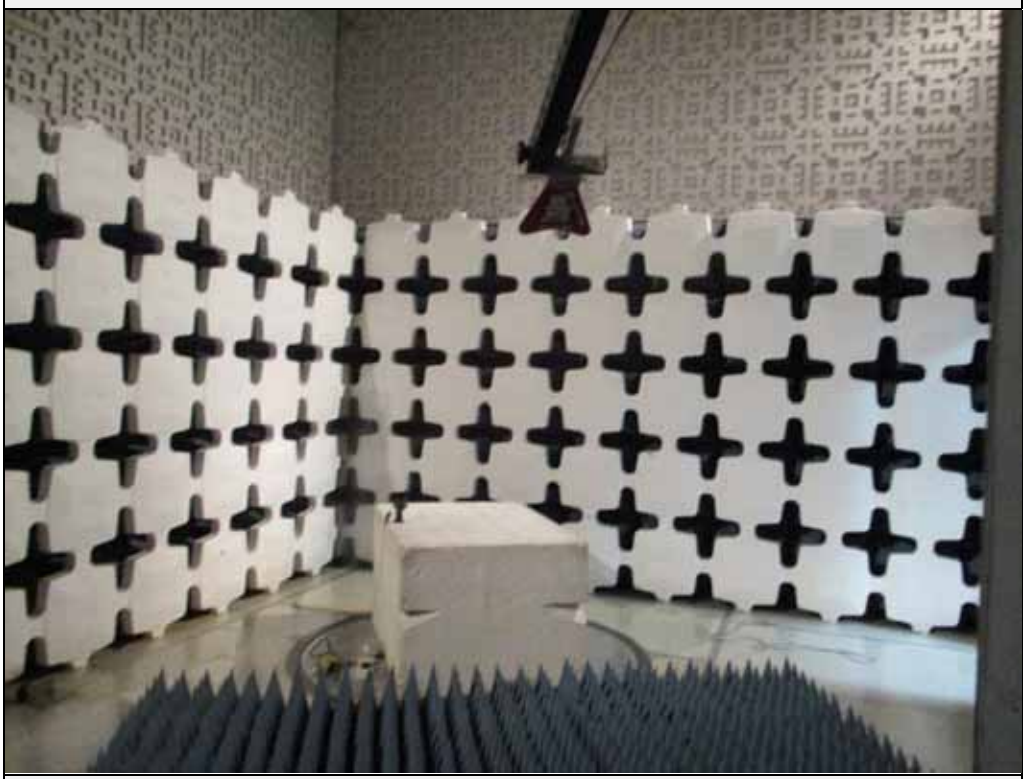
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

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



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

Test Setup for Radiated Emissions above 1GHz, Horizontal Polarization



Test Setup for Radiated Emissions above 1GHz, Vertical Polarization

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

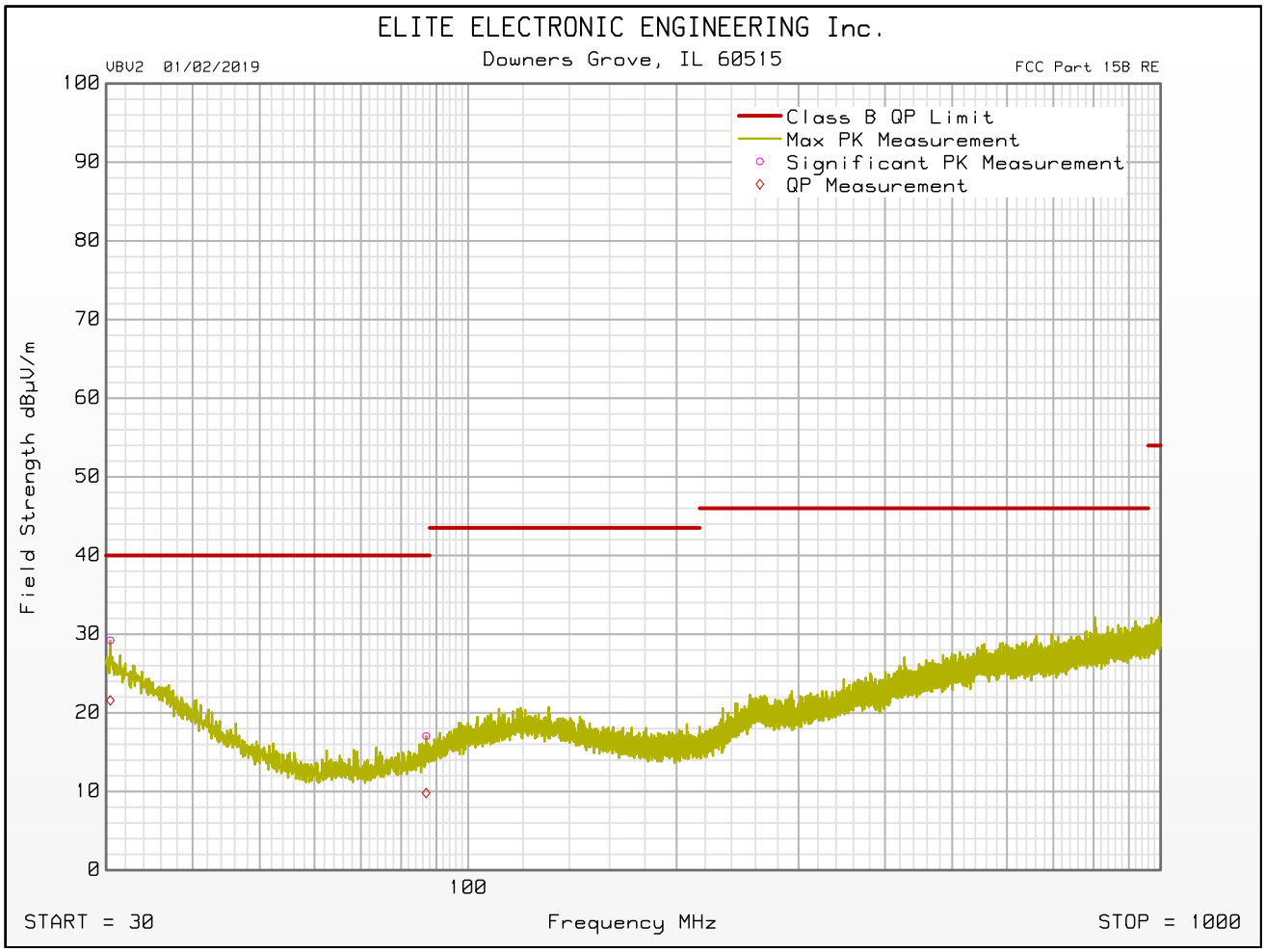
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 904.94MHz
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 02:57:10 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
30.420	4.9	-2.7	23.8	0.0	0.5	0.0	29.2	21.6	40.0	-18.4	V	340	45
86.940	2.1	-5.1	14.4	0.0	0.5	0.0	17.0	9.8	40.0	-30.2	V	340	270
122.500	2.4	-5.0	18.2	0.0	0.6	0.0	21.2	13.8	43.5	-29.7	H	340	180
258.180	2.9	-4.6	19.3	0.0	1.0	0.0	23.2	15.7	46.0	-30.3	H	340	270
541.140	2.9	-4.5	24.4	0.0	1.5	0.0	28.8	21.4	46.0	-24.6	H	120	270
845.880	4.3	-4.2	26.0	0.0	2.0	0.0	32.4	23.9	46.0	-22.1	H	120	315

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

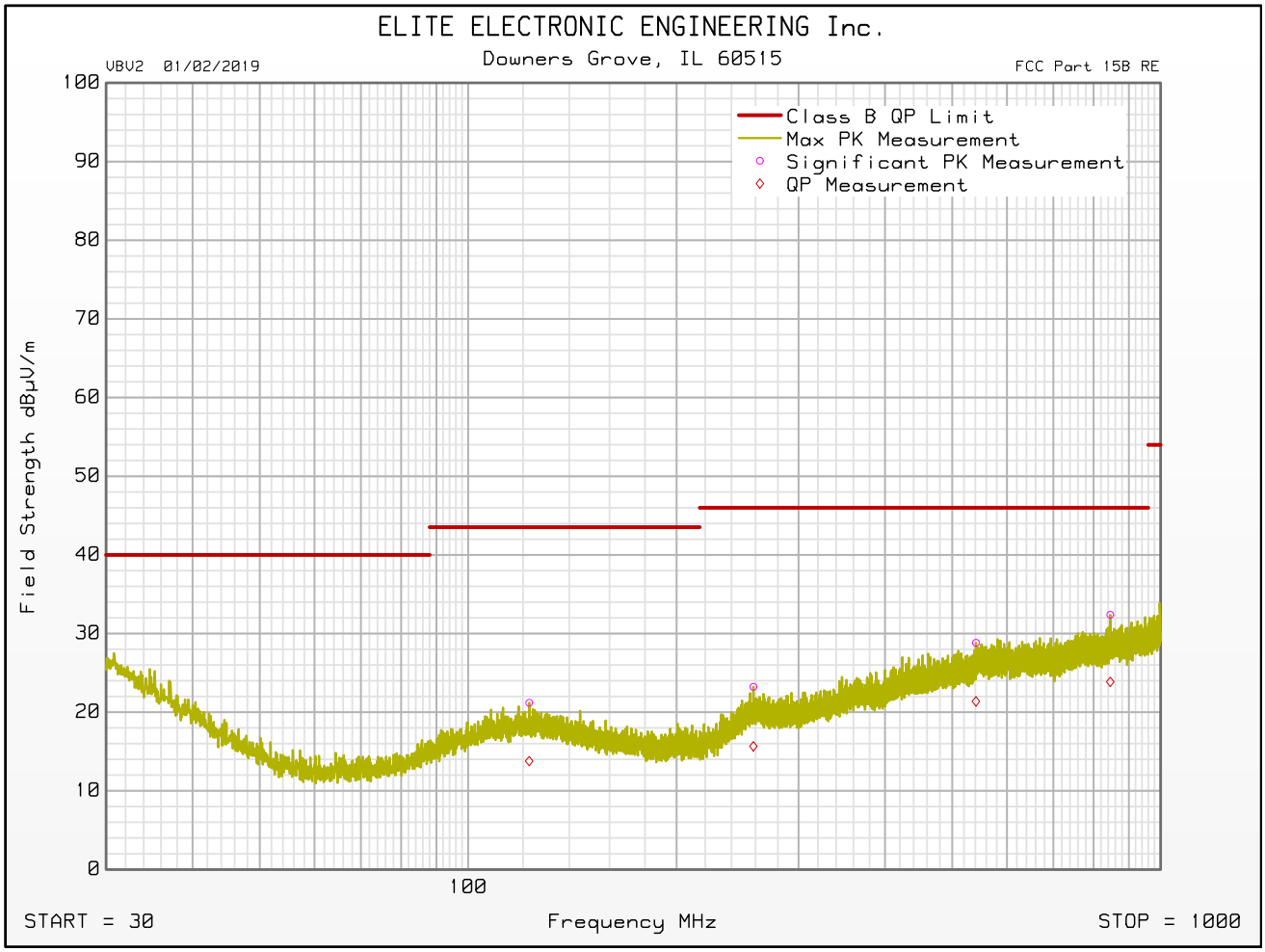
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 904.94MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 02:57:10 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 904.94MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 02:57:10 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

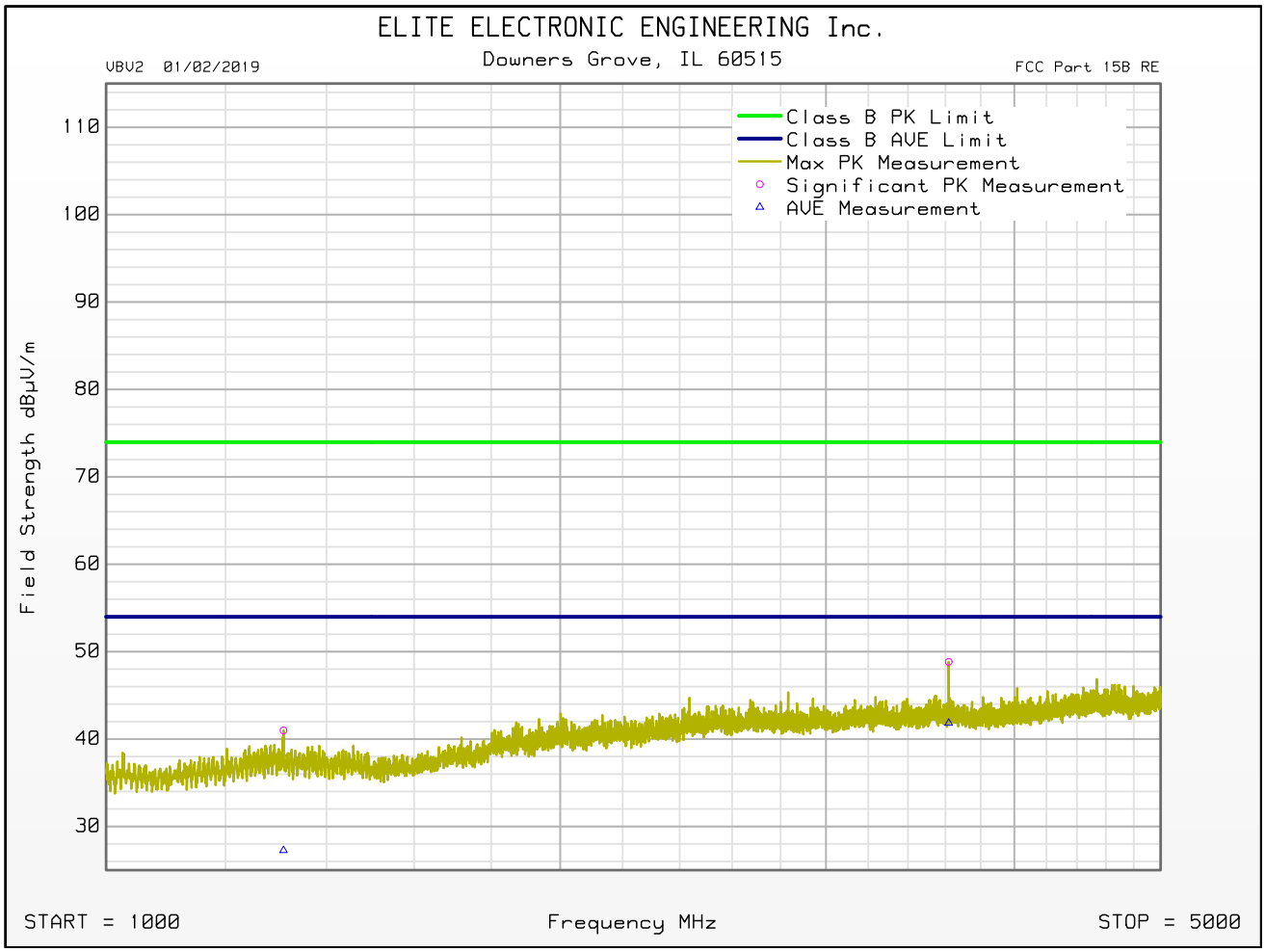
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @904.94MHz
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:30:55 AM

Freq MHz	Peak Mtr Rdg dBuV	Average Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
1261.500	49.7	36.4	29.1	-40.7	2.3	0.0	40.4	74.0	-33.5	27.2	54.0	-26.8	H	340	90
1311.000	50.1	36.4	29.1	-40.5	2.4	0.0	41.0	74.0	-33.0	27.3	54.0	-26.7	V	200	90
2175.500	48.6	35.3	31.4	-39.9	3.2	0.0	43.2	74.0	-30.7	29.9	54.0	-24.0	H	120	270
2401.500	52.6	35.2	32.2	-40.2	3.4	0.0	48.0	74.0	-26.0	30.6	54.0	-23.4	H	340	225
3618.500	51.1	44.1	32.9	-39.5	4.3	0.0	48.8	74.0	-25.1	41.8	54.0	-12.1	V	200	225
4970.000	47.6	33.6	34.3	-39.6	5.0	0.0	47.3	74.0	-26.7	33.2	54.0	-20.7	H	200	225

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

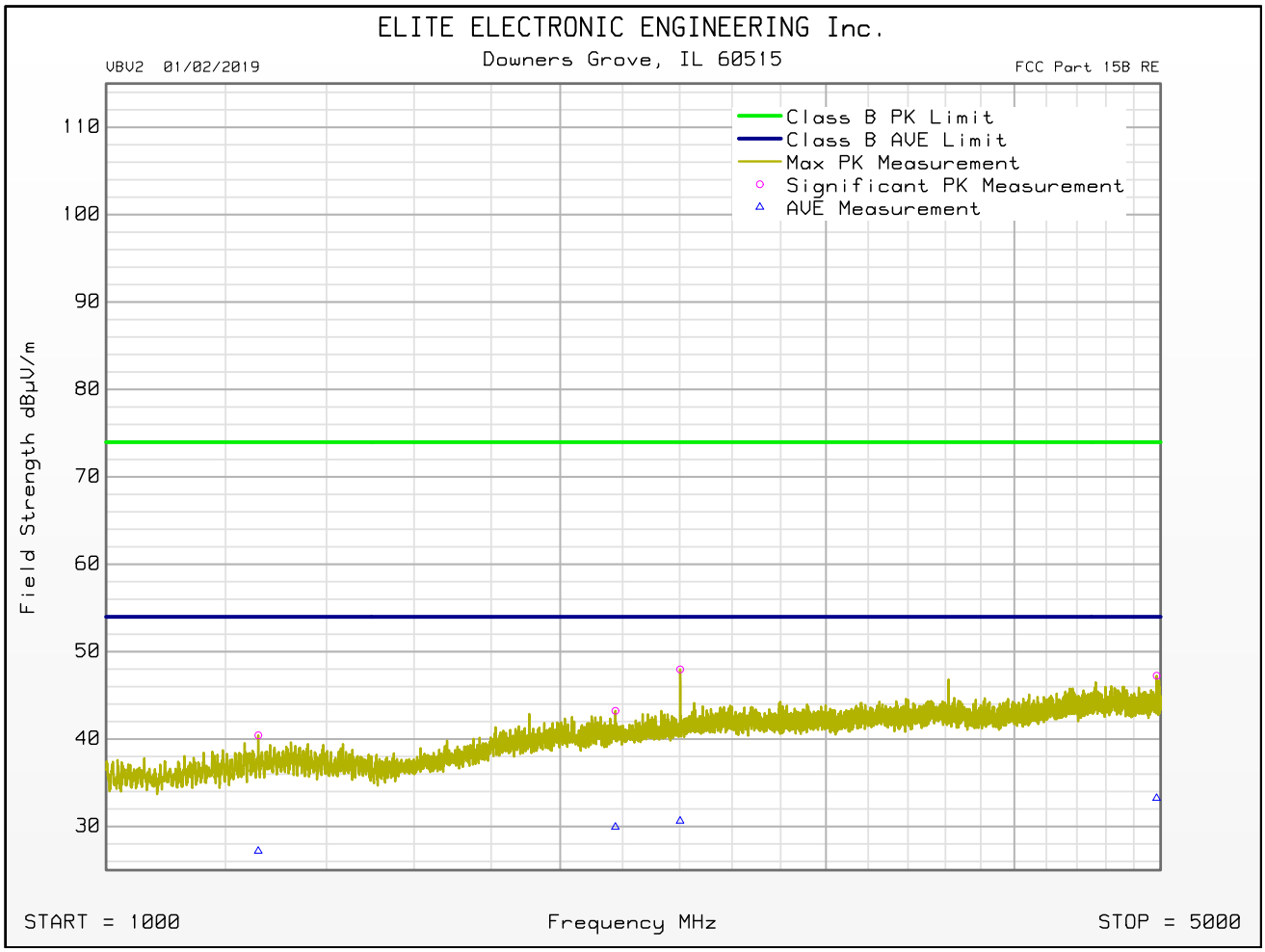
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @904.94MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:30:55 AM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @904.94MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:30:55 AM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

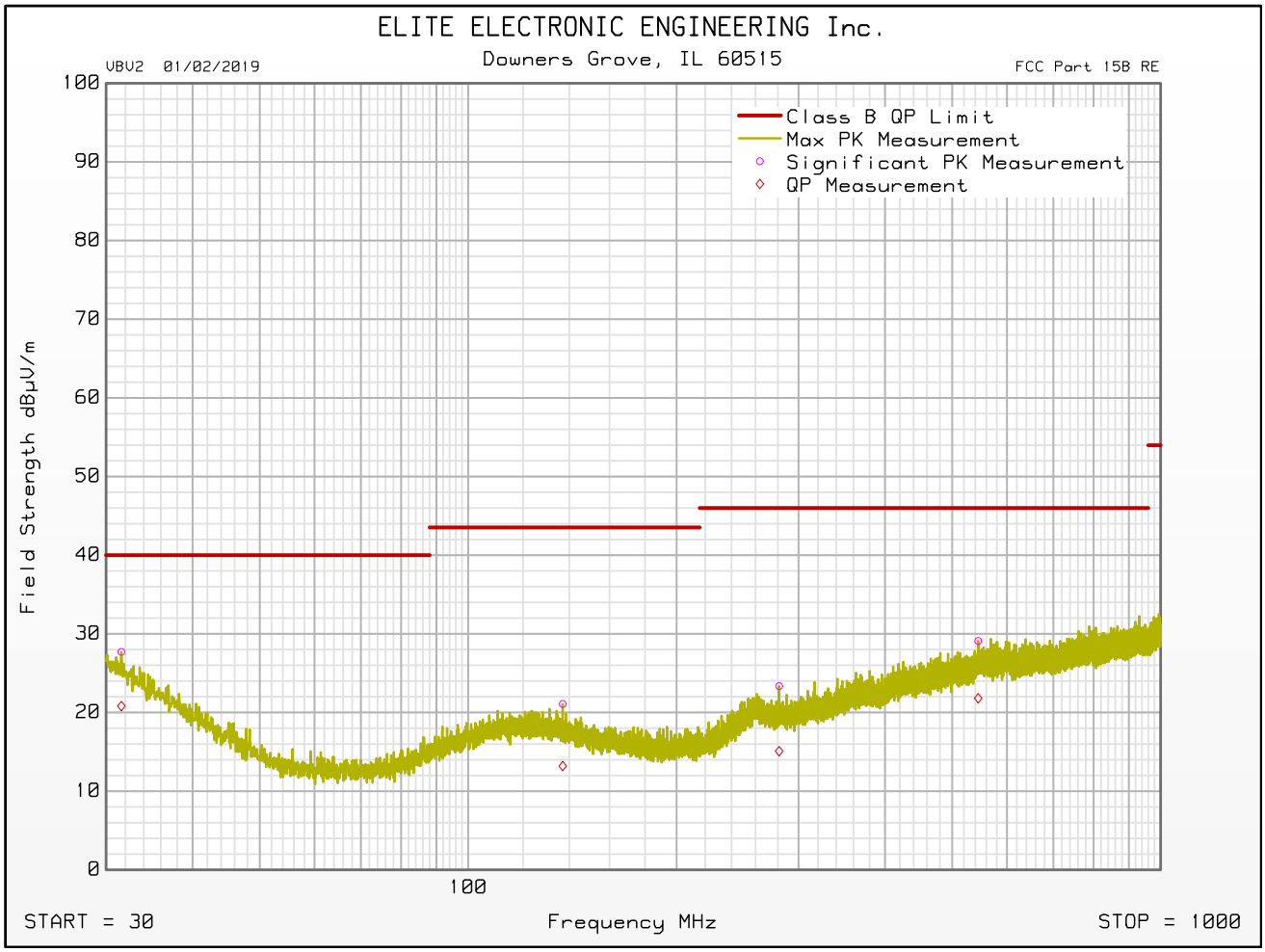
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @914.1MHz
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 04:19:59 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
31.560	4.0	-2.9	23.2	0.0	0.5	0.0	27.7	20.8	40.0	-19.2	V	200	90
85.860	2.4	-5.1	14.2	0.0	0.5	0.0	17.1	9.6	40.0	-30.4	H	200	225
136.960	2.8	-5.1	17.6	0.0	0.7	0.0	21.1	13.2	43.5	-30.3	V	200	270
281.220	3.6	-4.7	18.8	0.0	1.0	0.0	23.4	15.1	46.0	-30.9	V	340	225
545.160	2.7	-4.6	24.9	0.0	1.5	0.0	29.1	21.8	46.0	-24.2	V	340	45
956.520	3.9	-4.4	26.7	0.0	2.0	0.0	32.6	24.3	46.0	-21.7	H	340	270

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

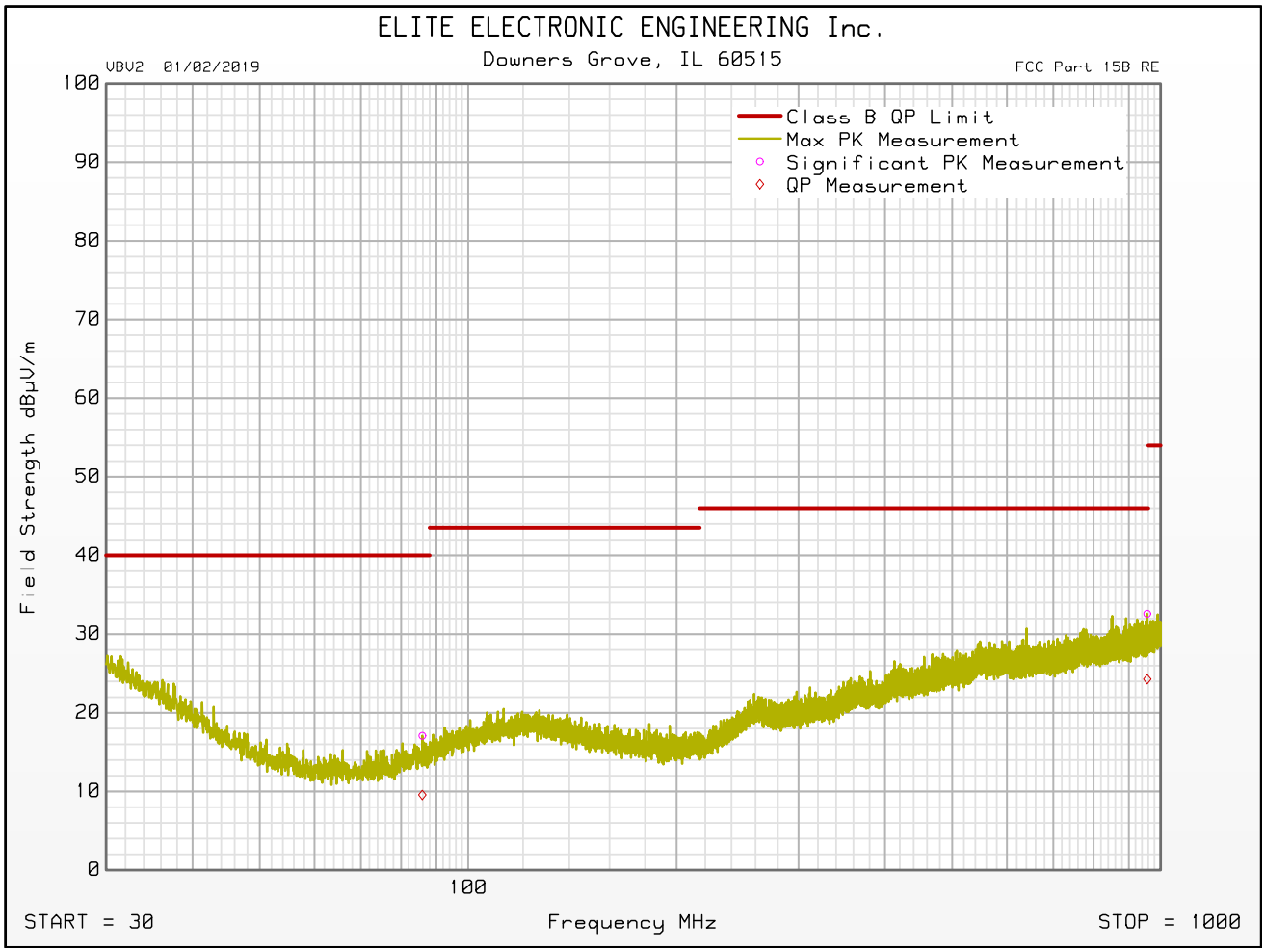
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @914.1MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 04:19:59 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @914.1MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 04:19:59 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

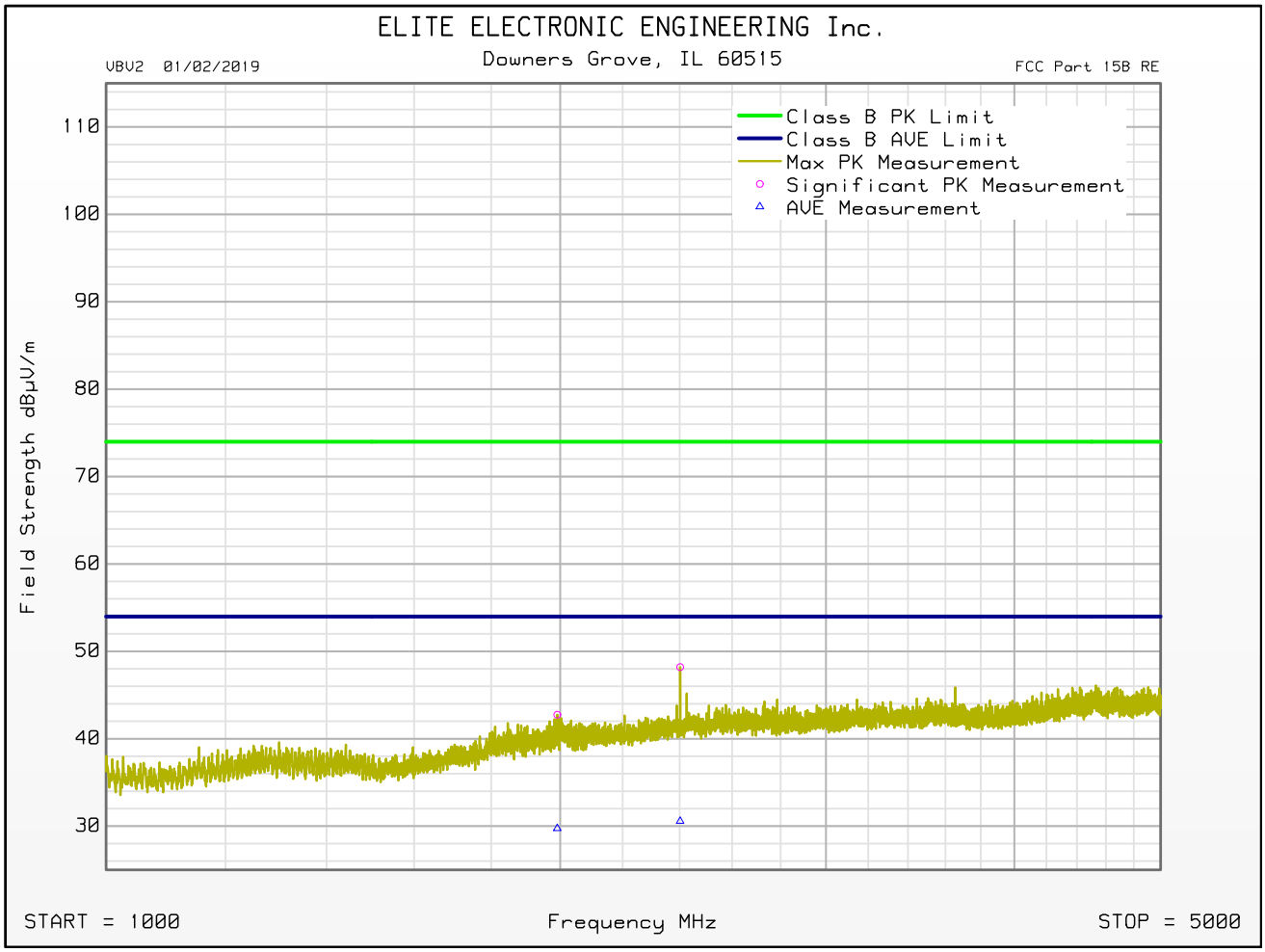
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 914.1MHz
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:46:24 AM

Freq MHz	Peak Mtr Rdg dBuV	Average Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
1270.000	49.5	36.2	29.1	-40.6	2.3	0.0	40.3	74.0	-33.7	27.0	54.0	-27.0	H	120	315
1325.500	49.5	36.3	29.0	-40.5	2.4	0.0	40.4	74.0	-33.6	27.2	54.0	-26.8	H	200	45
1991.000	48.1	35.1	31.5	-39.9	3.0	0.0	42.7	74.0	-31.2	29.7	54.0	-24.2	V	120	90
2401.500	52.8	35.2	32.2	-40.2	3.4	0.0	48.2	74.0	-25.8	30.6	54.0	-23.4	V	120	0
3655.500	49.4	40.3	33.0	-39.6	4.3	0.0	47.1	74.0	-26.9	38.0	54.0	-16.0	H	200	0
4504.500	47.1	33.7	34.0	-39.6	4.8	0.0	46.3	74.0	-27.7	32.9	54.0	-21.1	H	120	0

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

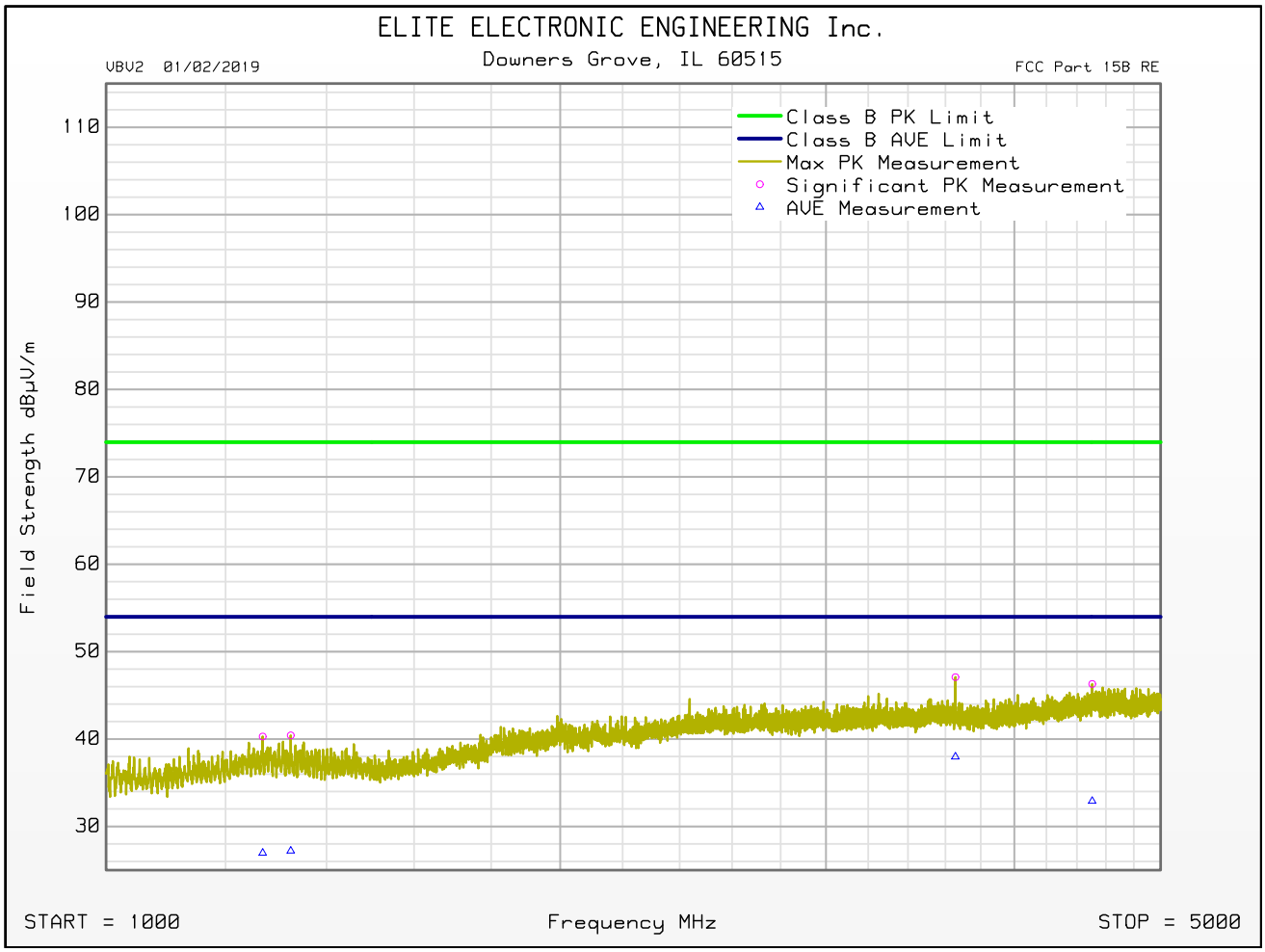
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 914.1MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:46:24 AM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 914.1MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 08:46:24 AM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

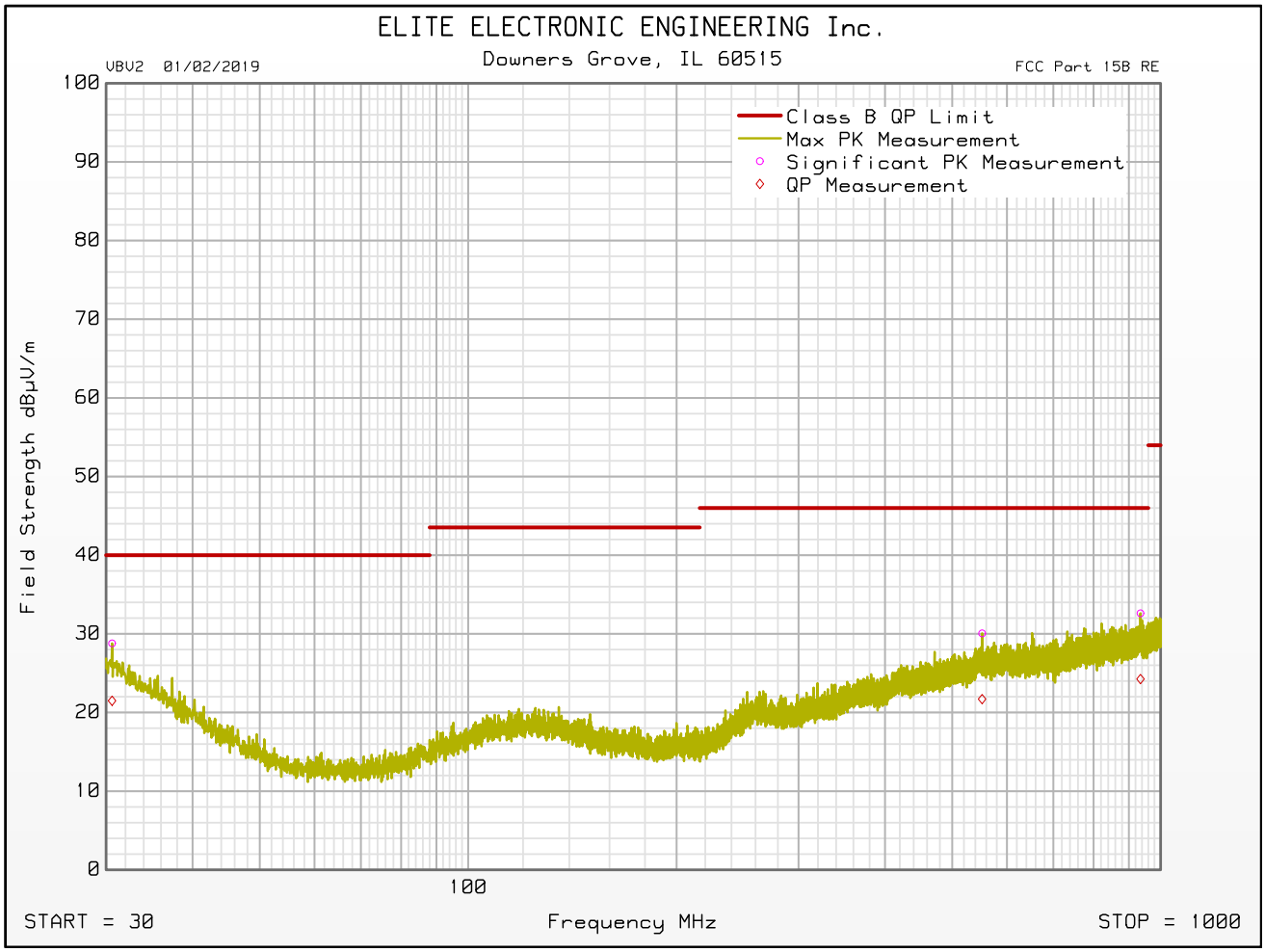
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 03:41:24 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
30.600	4.6	-2.7	23.7	0.0	0.5	0.0	28.8	21.5	40.0	-18.5	V	340	90
87.900	2.4	-5.2	14.6	0.0	0.5	0.0	17.5	9.9	40.0	-30.1	H	340	270
119.380	2.9	-5.1	18.2	0.0	0.6	0.0	21.7	13.6	43.5	-29.9	H	340	135
279.480	4.1	-4.7	18.7	0.0	1.0	0.0	23.9	15.0	46.0	-31.0	H	200	315
552.360	3.8	-4.6	24.8	0.0	1.5	0.0	30.1	21.7	46.0	-24.3	V	340	270
935.280	4.2	-4.2	26.4	0.0	2.0	0.0	32.6	24.3	46.0	-21.7	V	200	315

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

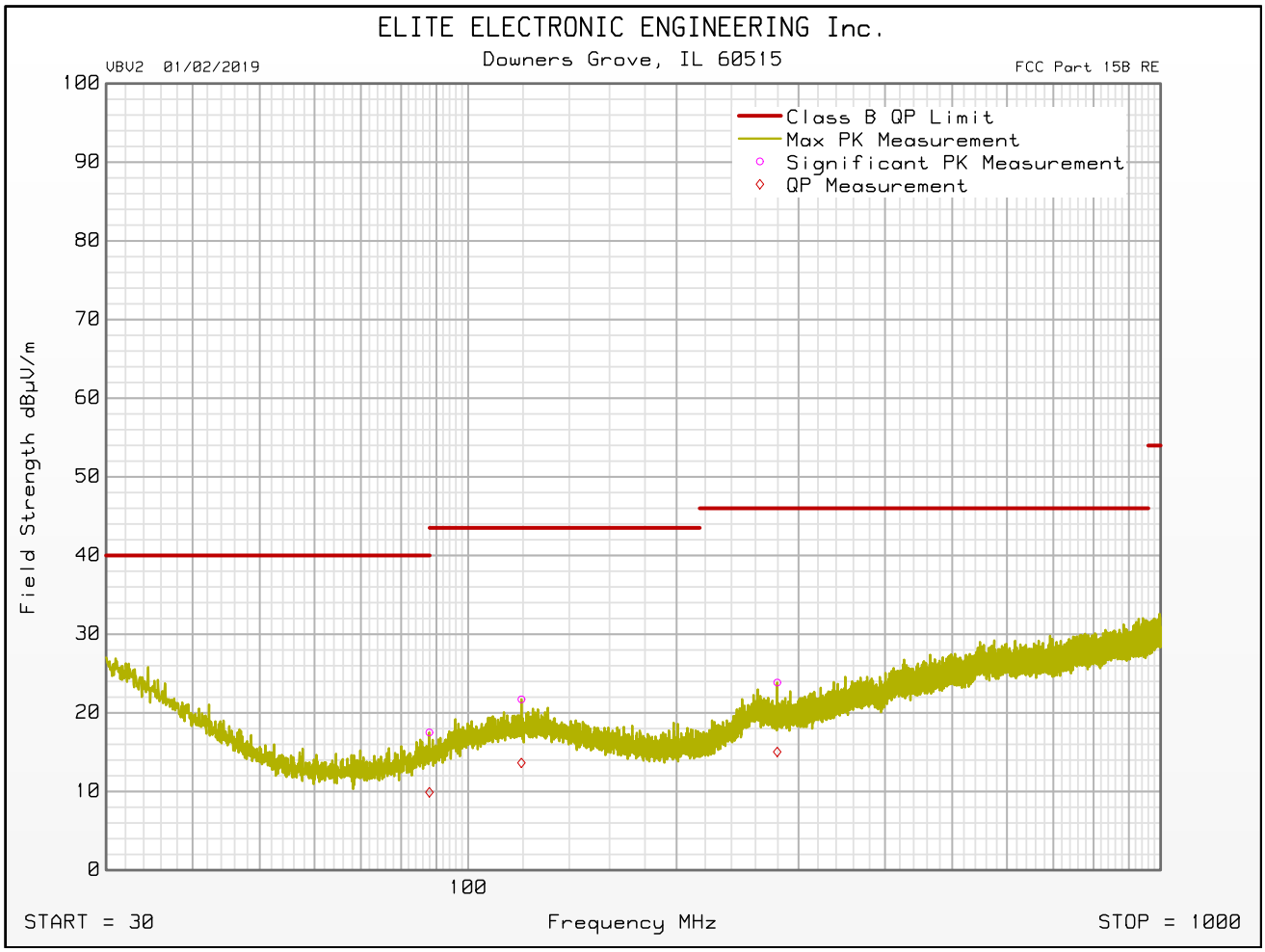
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 03:41:24 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 13, 2020 03:41:24 PM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

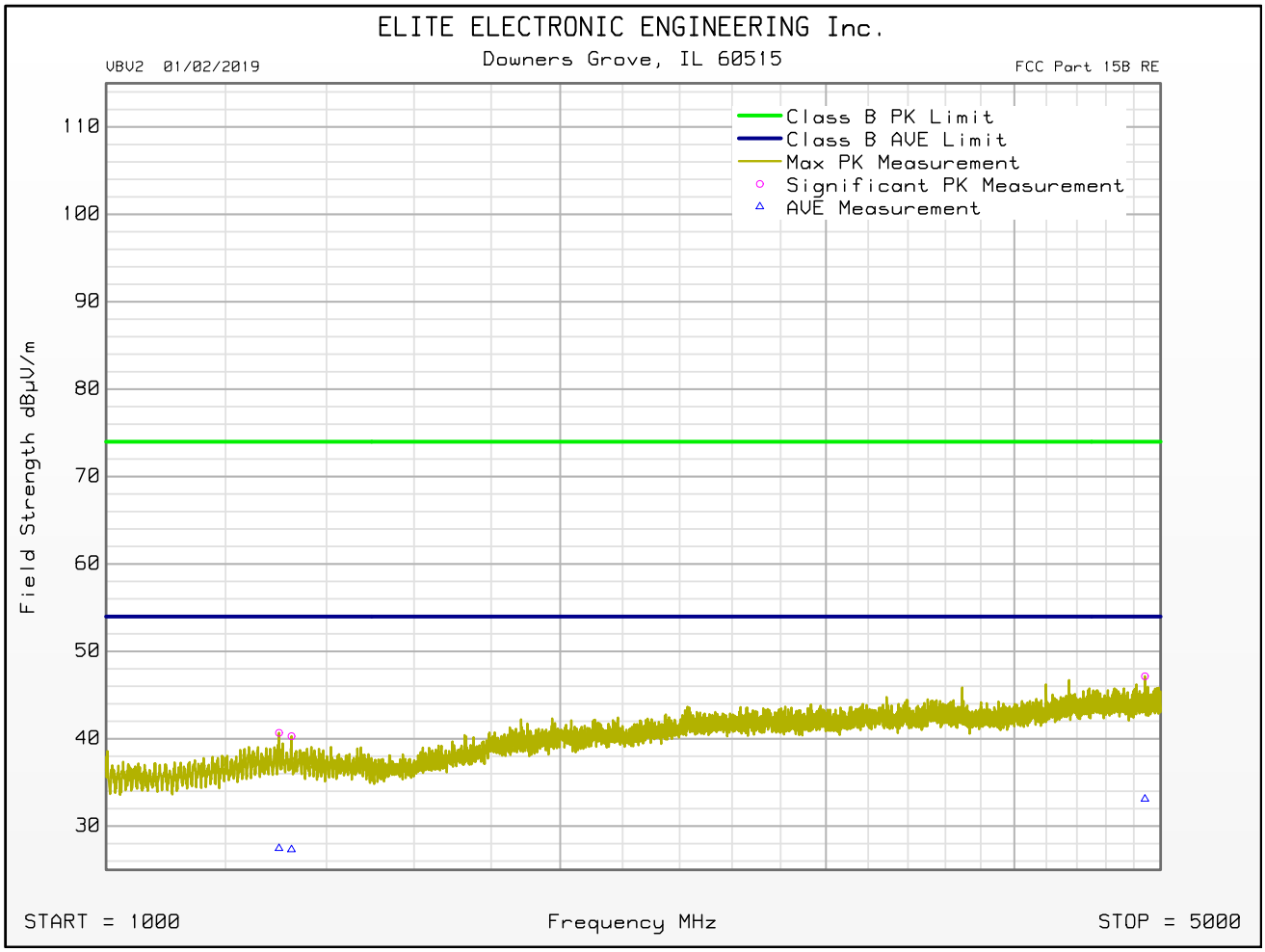
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 09:07:14 AM

Freq MHz	Peak Mtr Rdg dBuV	Average Mtr Rdg dBuV	Ant Fac dB	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °
1302.000	49.8	36.6	29.1	-40.6	2.4	0.0	40.7	74.0	-33.3	27.5	54.0	-26.5	V	200	225
1327.000	49.3	36.4	29.0	-40.5	2.4	0.0	40.3	74.0	-33.7	27.3	54.0	-26.7	V	340	270
1904.000	52.8	34.6	31.3	-40.0	2.9	0.0	47.0	74.0	-27.0	28.7	54.0	-25.3	H	120	270
2694.500	48.4	35.3	32.5	-40.2	3.7	0.0	44.4	74.0	-29.6	31.3	54.0	-22.7	H	340	225
3693.500	49.9	41.3	33.0	-39.5	4.3	0.0	47.7	74.0	-26.2	39.1	54.0	-14.9	H	340	90
4882.000	47.4	33.4	34.4	-39.6	4.9	0.0	47.1	74.0	-26.8	33.1	54.0	-20.9	V	120	225

FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

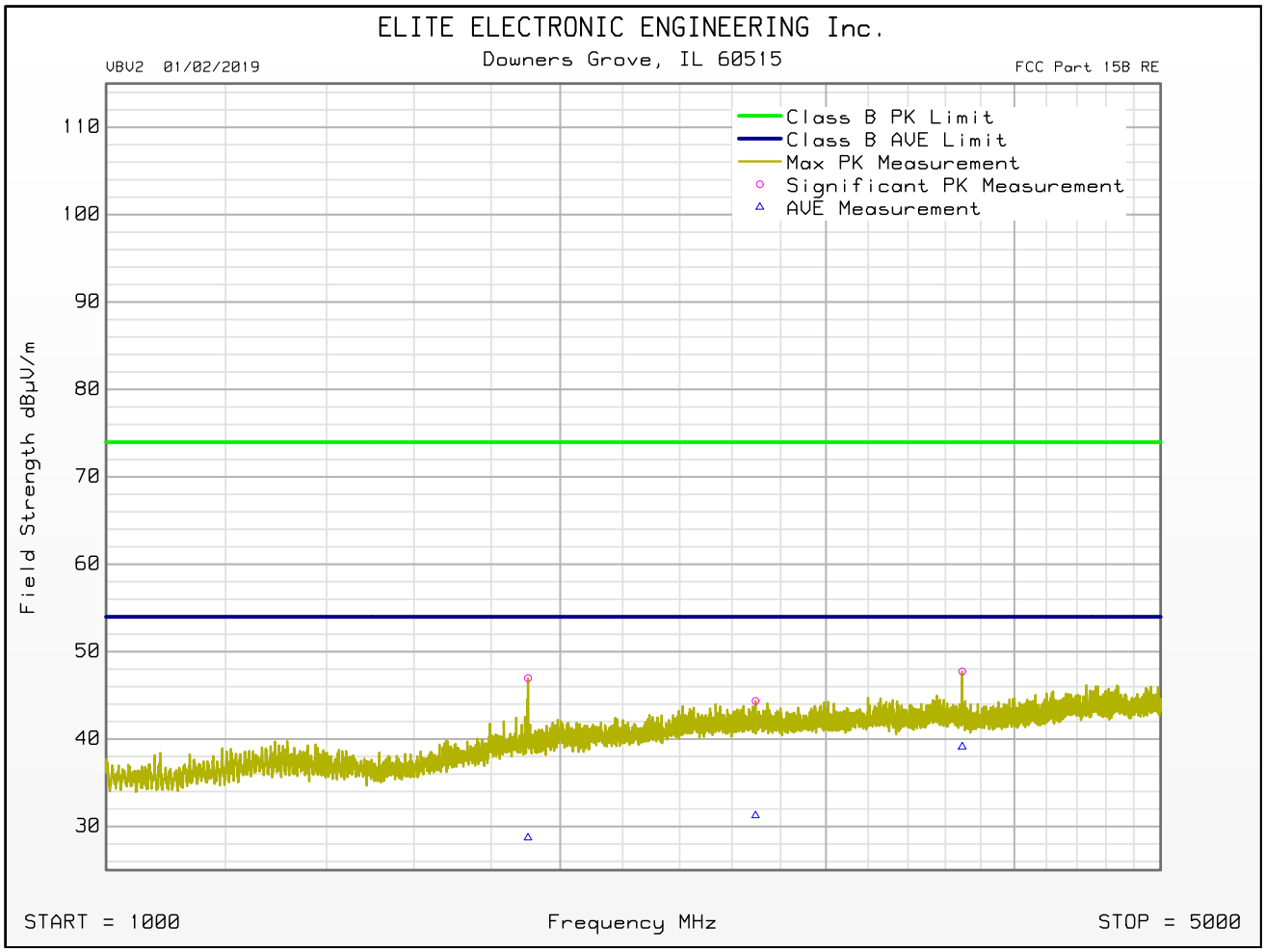
Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Ant. Polarization(s)	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 09:07:14 AM



FCC Part 15B Class B Radiated RF Emissions Test

SW ID/Rev: VBV2 01/02/2019

Manufacturer	:	Badger Meter
Model	:	ORION Cellular C
Serial Number	:	130000006
DUT Mode	:	Rx @ 923.79MHz
Ant. Polarization(s)	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	M. Longinotti
Test Date	:	Oct 15, 2020 09:07:14 AM



21. 20dB Bandwidth

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Transmit at 904.94MHz, Transmit at 914.1MHz, Transmit at 923.79MHz

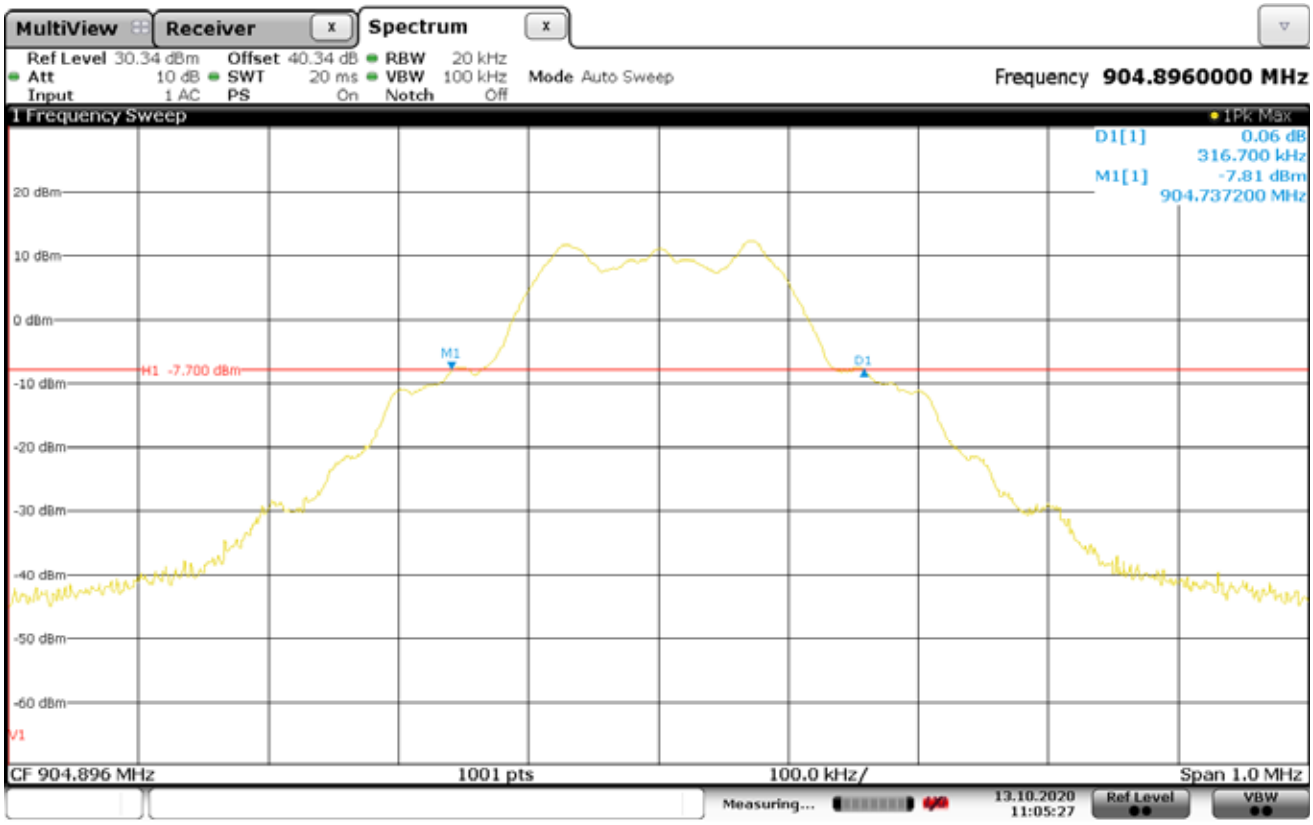
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Requirements
Systems using frequency hopping techniques, operating in the 902-928MHz band, are allowed a maximum 20dB bandwidth of 500kHz.

Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to ≥ 1% of the 20 dB BW. The span was set to approximately 2 to 3 times the 20 dB bandwidth. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

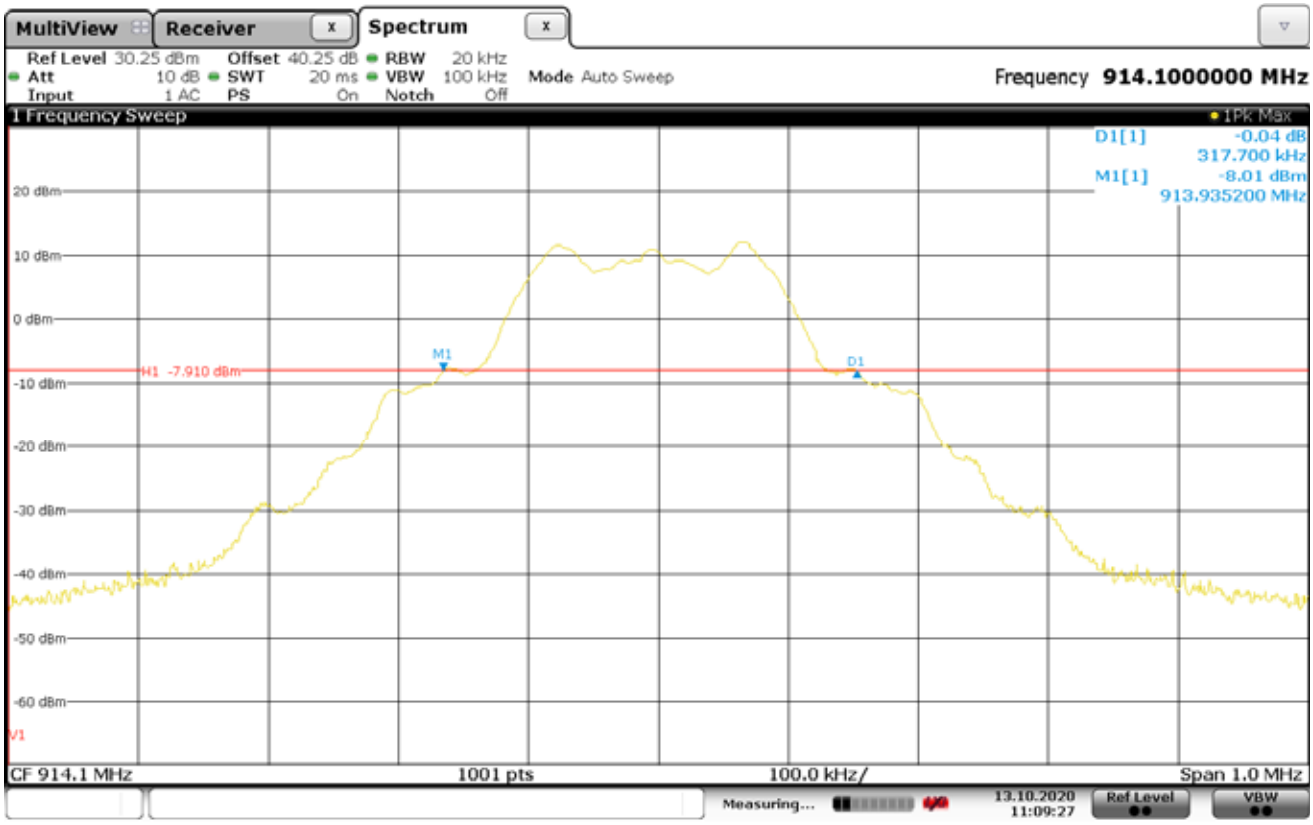
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	20dB BW = 316.7kHz
Notes	None



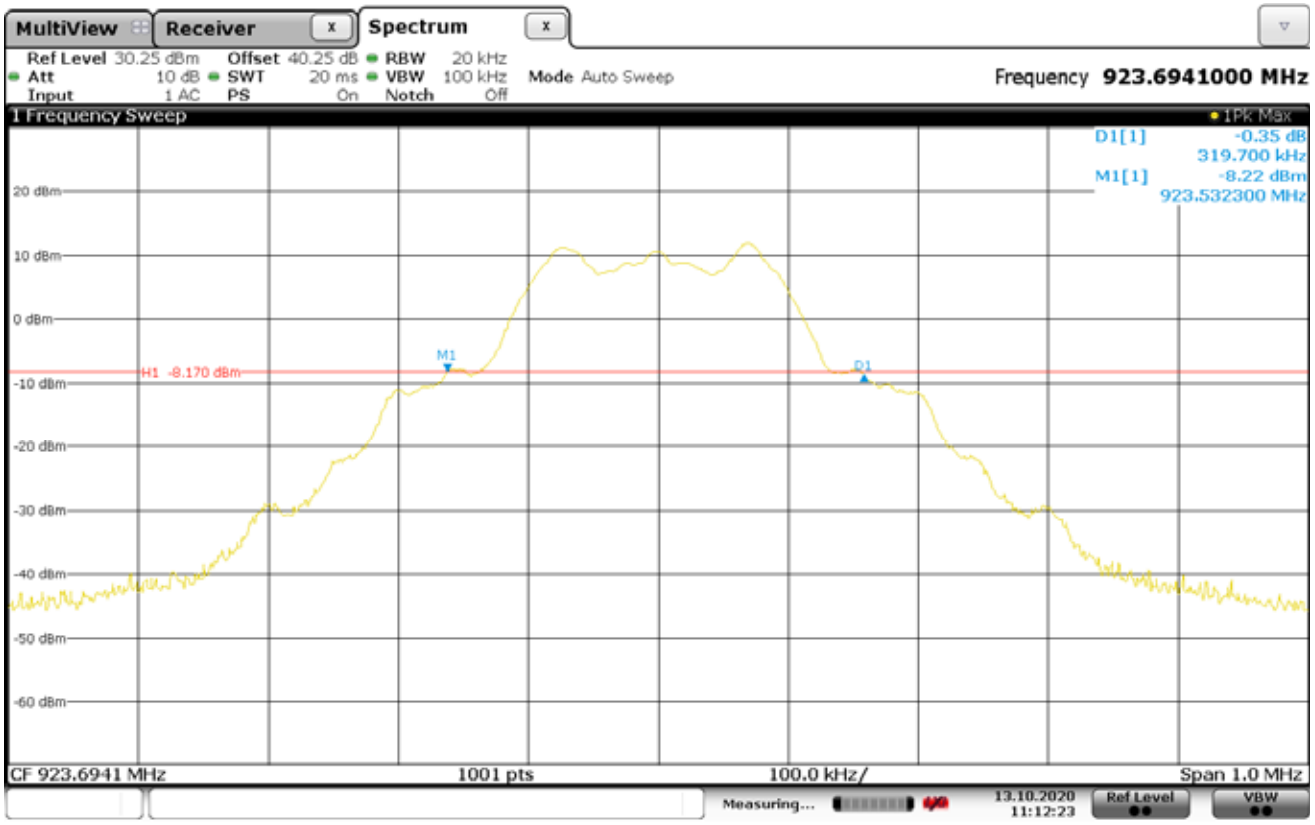
Date: 13.OCT.2020 11:05:27

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 914.1MHz
Parameters	20dB BW = 317.7kHz
Notes	None



Date: 13.OCT.2020 11:09:26

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 923.79MHz
Parameters	20dB BW = 319.7kHz
Notes	None



Date: 13.OCT.2020 11:12:23

22. Occupied Bandwidth (99%)

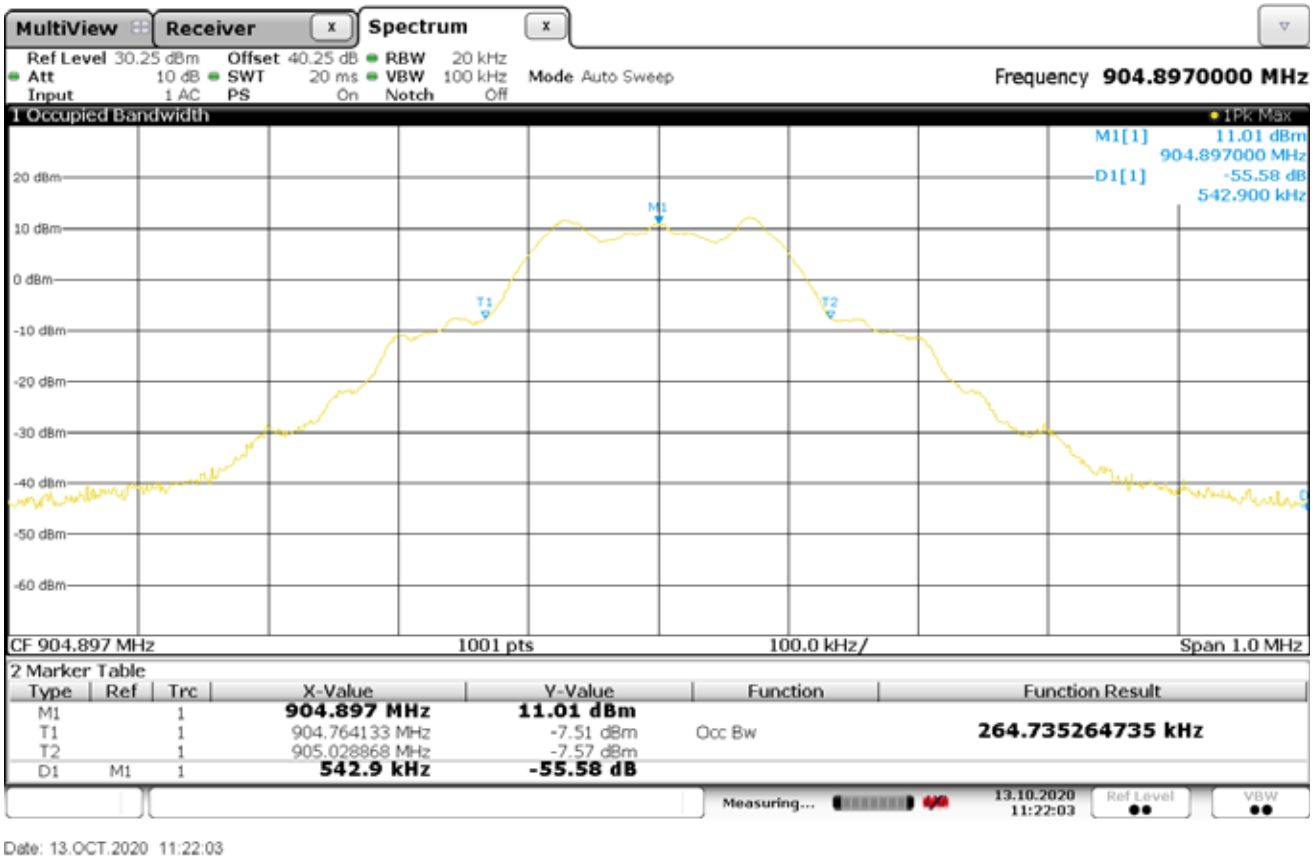
Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Transmit at 904.94MHz, Transmit at 914.1MHz, Transmit at 923.79MHz

Test Setup Details	
Setup Format	Floor Standing
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 1% to 5% of the actual occupied 20 dB bandwidth, the video bandwidth (VBW) was set to at least 3 times greater than the RBW, and the span was set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's 99% bandwidth function was enabled. The analyzer's display was plotted using a 'screen dump' utility.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Carrier Frequency	
Parameters	OBW = 264.74kHz
Notes	None

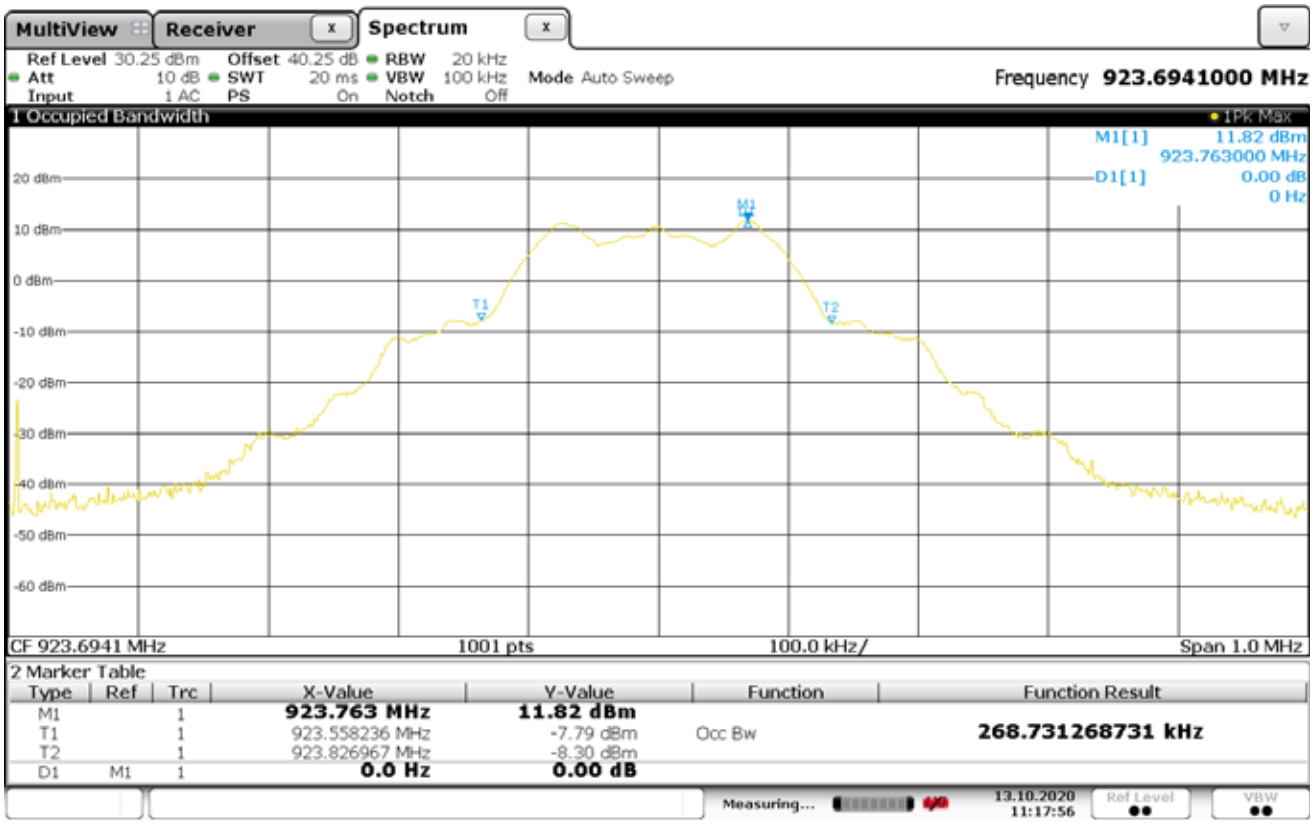


Date: 13.OCT.2020 11:22:03

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 914.1MHz
Carrier Frequency	
Parameters	OBW = 264.74kHz
Notes	None

Date: 13.OCT.2020 11:19:17

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 923.79MHz
Carrier Frequency	
Parameters	OBW = 268.73kHz
Notes	None



Date: 13.OCT.2020 11:17:56

23. Carrier Frequency Separation

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Hopping Enabled

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Requirements
Channel carrier frequencies shall be separated by a minimum of 25kHz or the 20dB bandwidth, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously. Span was set wide enough to capture the peaks of two adjacent channels. The resolution bandwidth was set to approximately 30% of the channel spacing. The peak detector and 'Max-Hold' function were engaged. When the trace had stabilized after multiple scans, the marker-delta function was used to determine the separation between the peaks of the adjacent channels. The analyzer's display was plotted using a 'screen dump' utility.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	Separation = 400.6kHz
Notes	None

24. Number of Carrier Channels

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Hopping Enabled

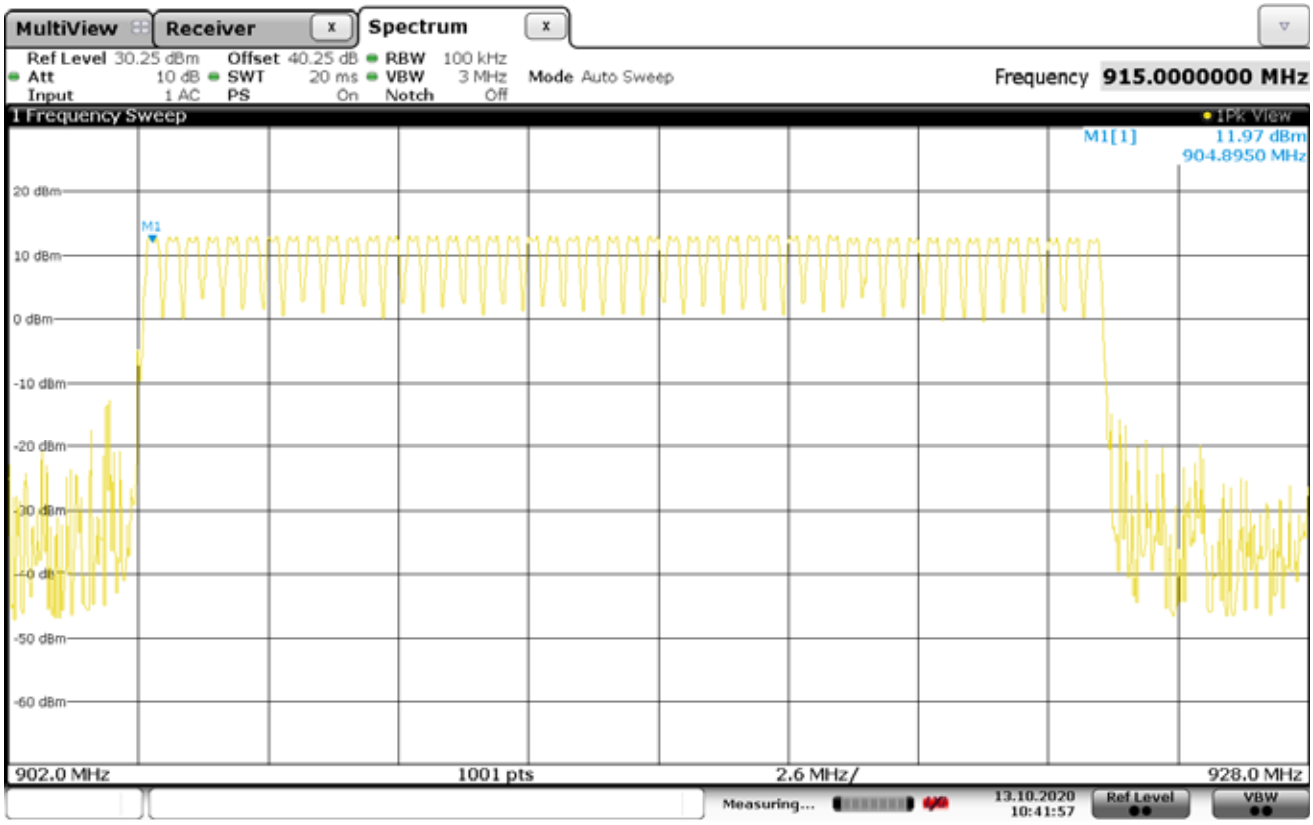
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
FOR 902-928 MHz, 20dB BW ≥ 250kHz The system shall use at least 25 hopping frequencies.

Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously. The resolution bandwidth (RBW) was set to less than 30% of the channel spacing or the 20dB bandwidth, whichever is smaller. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the entire frequency band of operation. The EUT's signal was allowed to stabilize after multiple scans. The number of hopping frequencies was counted. The analyzer's display was plotted using a 'screen dump' utility.

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Hopping Enabled
Parameters	48 channels
Notes	None



25. Average Time of Occupancy

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Hopping Enabled

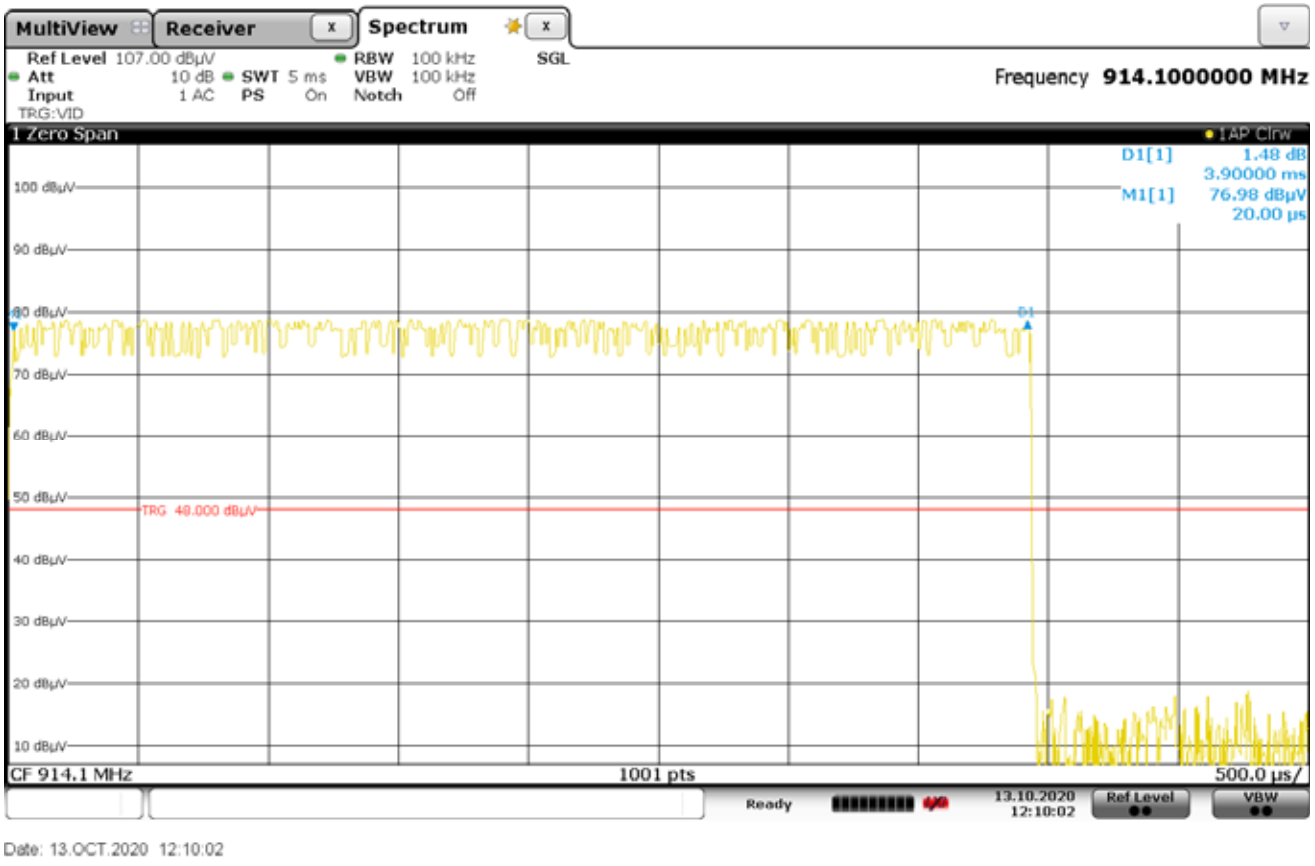
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
For 902-928 MHz, 20dB BW ≥ 250kHz The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

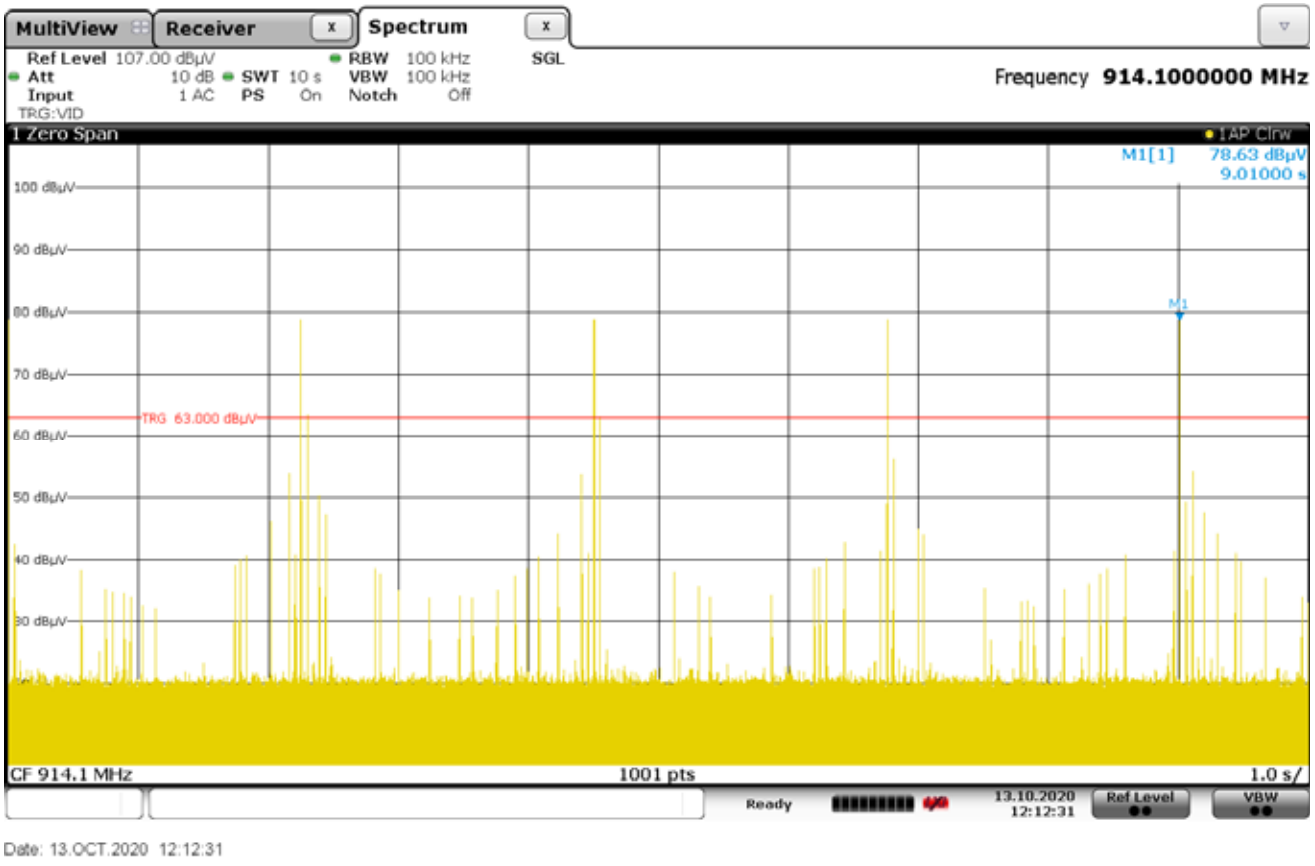
Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously. The spectrum analyzer was set to zero span centered on a hopping channel. The resolution bandwidth (RBW) was set ≥ to the channel spacing. The sweep was set to capture the entire dwell time per hopping channel. The peak detector and 'Max-Hold' function were engaged. The analyzer's display was plotted using a 'screen dump' utility.

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Hopping Enabled
Parameters	Pulse on time = 3.9msec
Notes	None



Date: 13.OCT.2020 12:10:02

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Hopping Enabled
Parameters	Time of Occupancy in a 10 second period = 5 pulses x 3.9msec/pulse Time of Occupancy in 10 second period = 19.5msec
Notes	None



26. Maximum Peak Conducted Output Power

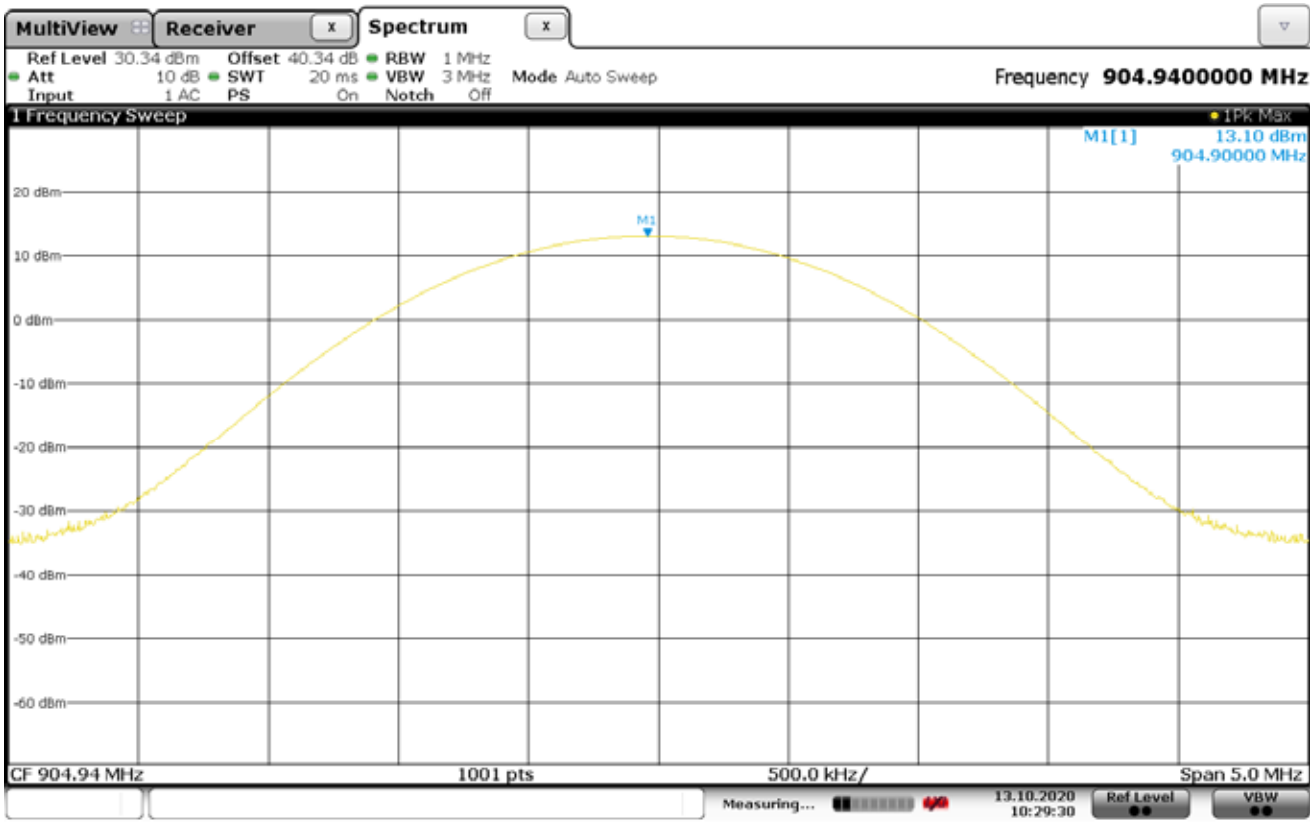
Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Transmit at 904.94MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

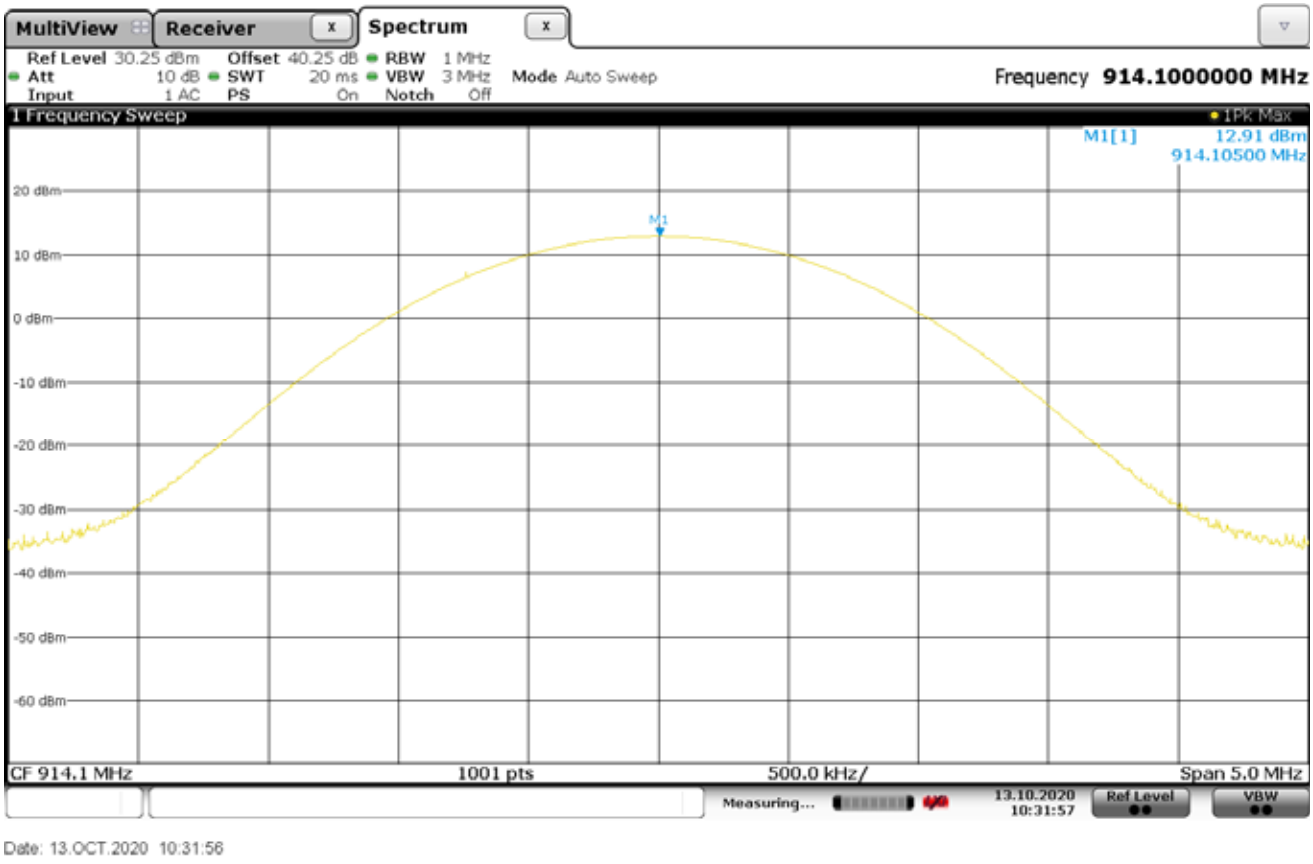
Requirements
FOR FREQUENCY HOPPING SYSTEMS IN THE 902-928 MHz, CHANNELS < 50 The output power shall not exceed 250mW (24dBm).

Procedures
The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB bandwidth. The 'Max-Hold' function was engaged. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high hopping frequencies.

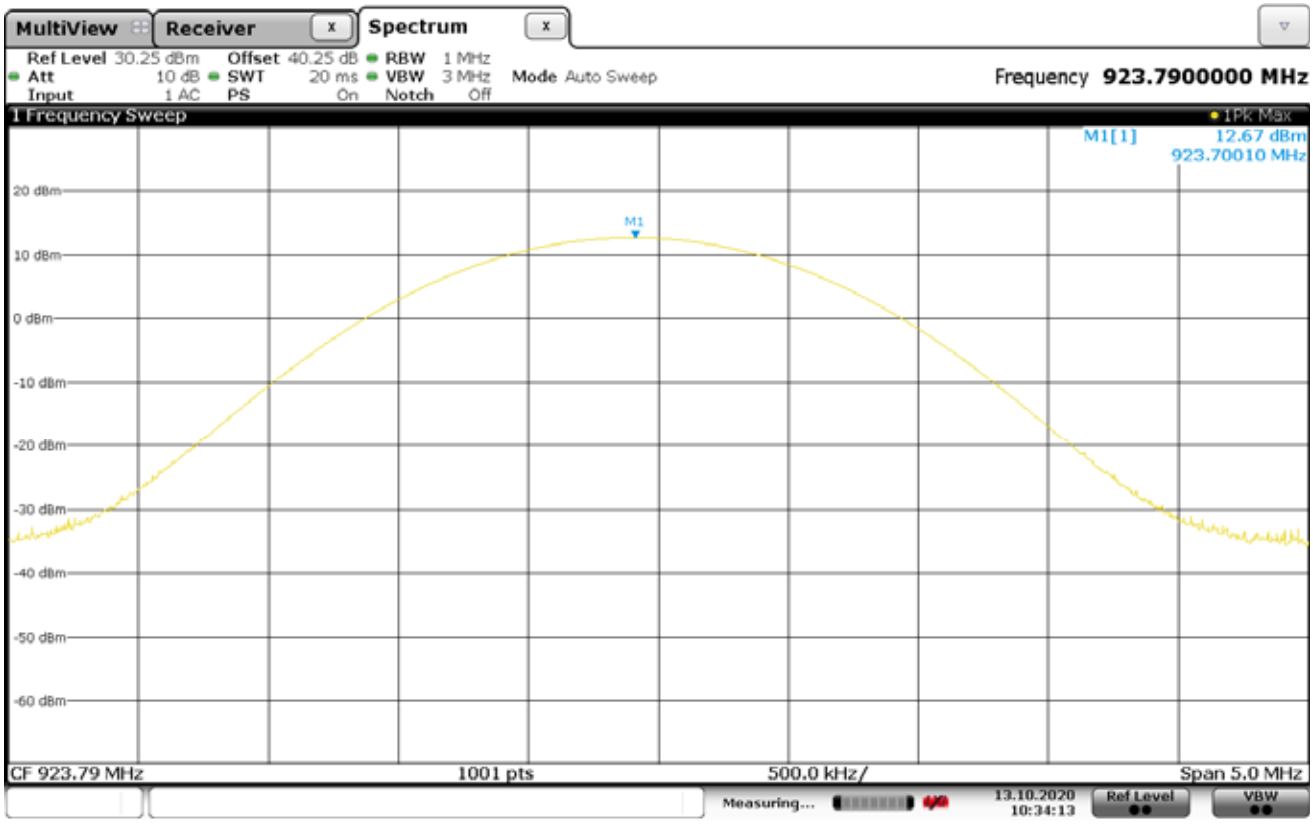
Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	Output Power = 20.4mW (13.1dBm)
Notes	None



Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 914.1MHz
Parameters	Output Power = 19.5mW (12.91dBm)
Notes	None



Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 923.79MHz
Parameters	Output Power = 18.49mW (12.67dBm)
Notes	None



27. Effective Isotropic Radiated Power (EIRP)

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000006
Mode	Transmit at 904.94MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent) NA
Notes	None

Requirements
FOR FREQUENCY HOPPING SYSTEMS IN THE 902-928 MHz, CHANNELS < 50 The output power shall not exceed 1W (30dBm).

Procedures
The EUT was placed on an 80cm high, non-conductive stand and set to transmit. A bilog antenna was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high hopping frequencies. The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a dipole antenna was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss, as required. The peak power output was calculated for low, middle, and high hopping frequencies.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 904.94MHz
Parameters	EIRP = 22.4mW (13.5dBm)
Notes	None

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
904.94	H	71.4	1.1	2.2	1.6	1.6	30.0	-28.4
904.94	V	81.3	13.0	2.2	1.6	13.5	30.0	-16.5

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 914.1MHz
Parameters	EIRP = 26.3mW (14.2dBm)
Notes	None

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
914.10	H	69.1	-0.8	2.2	1.6	-0.3	30.0	-30.3
914.10	V	81.9	13.7	2.2	1.6	14.2	30.0	-15.8

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 923.79MHz
Parameters	EIRP = 23.4mW (13.7dBm)
Notes	None

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
923.79	H	73.9	3.9	2.2	1.7	4.4	30.0	-25.6
923.79	V	81.5	13.2	2.2	1.7	13.7	30.0	-16.3

28. Duty Cycle Factor Measurements

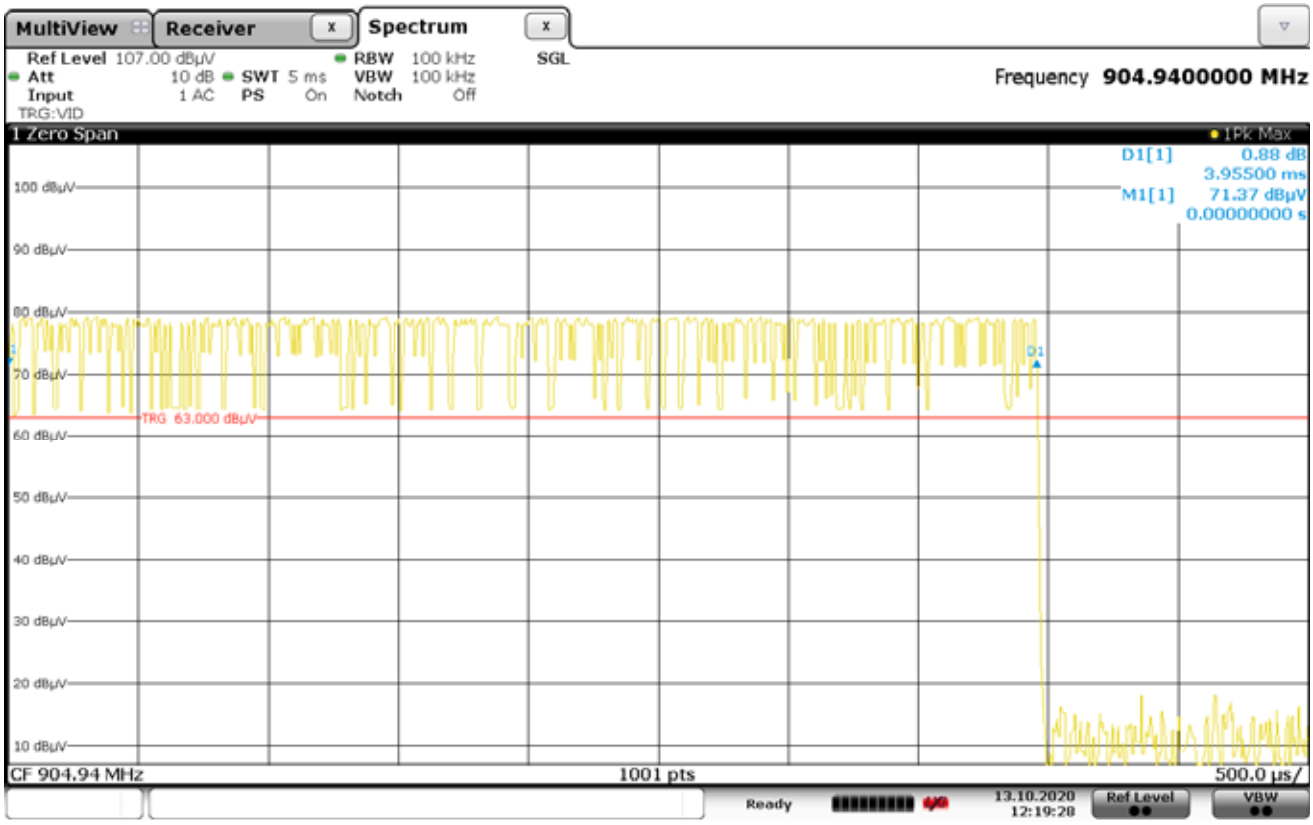
Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Transmit at 904.94MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Procedures
The duty cycle factor is used to convert peak detected readings to average readings when pulsed modulation is employed. This factor is computed from the time domain trace of the pulse modulation signal. With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 0.5 msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of the “on-time”. The trace is recorded. Next the spectrum analyzer center frequency is set to the transmitter frequency with a zero span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less than 100msec, the display is set to show at least one word. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

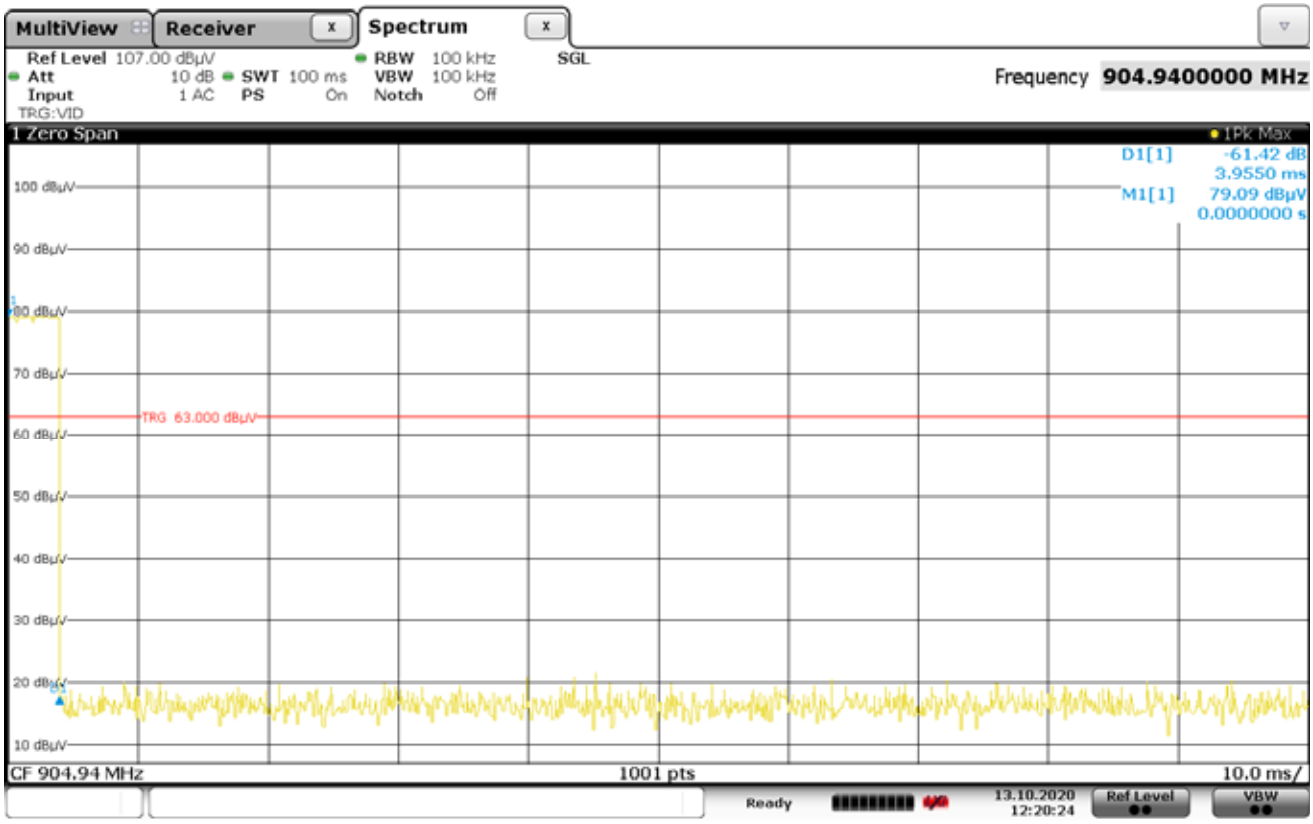
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	On-time per pulse = 3.955msec
Notes	None



Date: 13.OCT.2020 12:19:28

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	On-time per pulse = 3.955msec; 1 pulse in a 100msec period; Total on time in a 100msec period = 3.995msec
Notes	None



Date: 13.OCT.2020 12:20:25

Duty Cycle Factor $= 20\log\left(\frac{On-Time}{100\text{msec}}\right)$ = -28.06dB

29. Case Spurious Radiated Emissions

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000006
Mode	Transmit at 904.94MHz, Transmit at 914.1MHz, Transmit at 923.79MHz

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Procedures
Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads. Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 10.0GHz was investigated using a peak detector function. The final open field emission tests were then manually performed over the frequency range of 30MHz to 10.0GHz. 1) For all harmonics not in the restricted bands, the following procedure was used: a) The field strength of the fundamental was measured using a bilog antenna. The bilog antenna was

positioned at a 3 meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5m high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

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

i) The EUT was rotated so that all sides were exposed to the receiving antenna.

ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

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

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

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

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

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

c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:

i) The EUT was rotated so that all sides were exposed to the receiving antenna.

ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

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

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

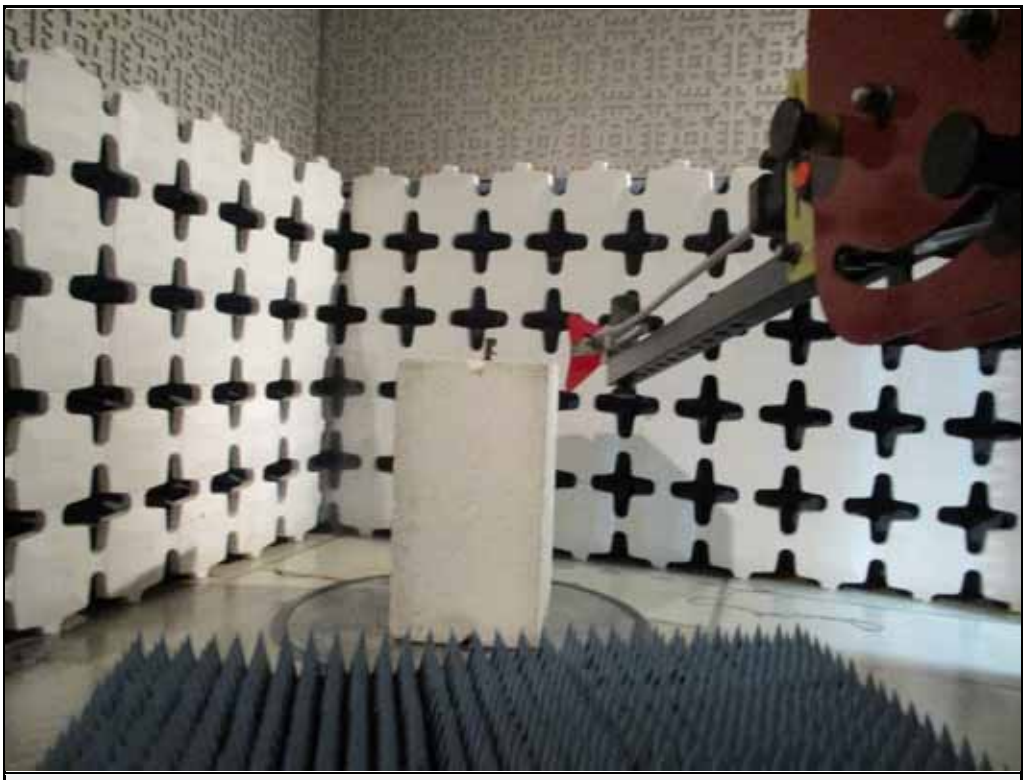
e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment

under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

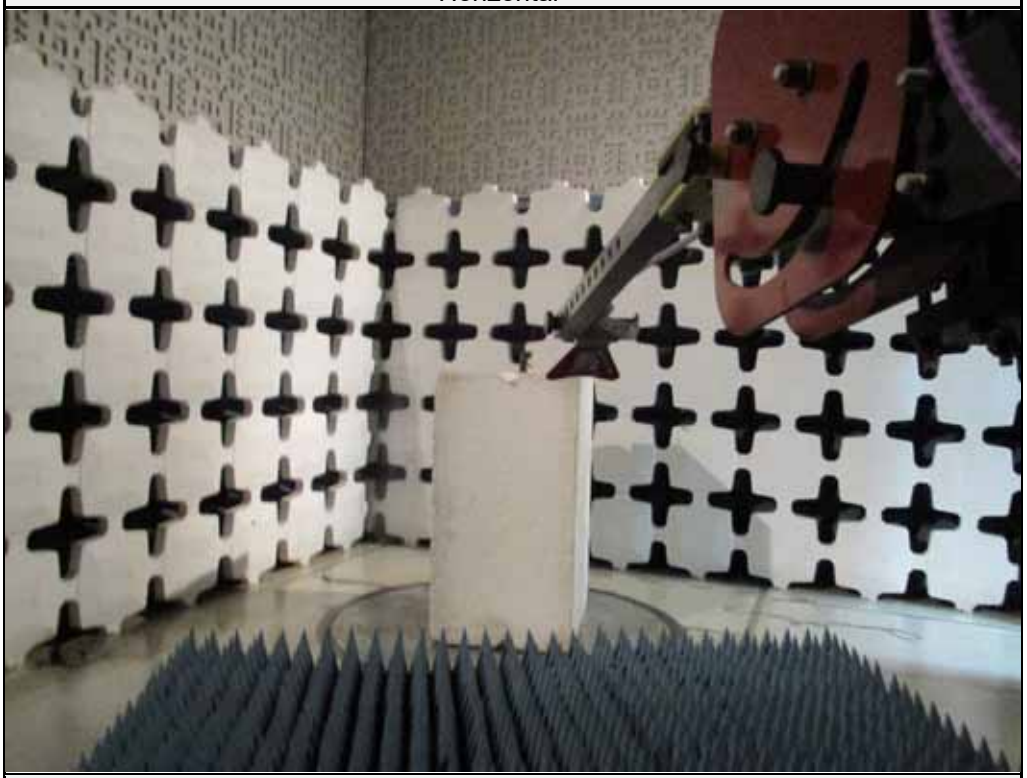
If the dwell time per channel of the hopping signal is less than 100msec, then the reading obtained with the 10 Hz video bandwidth may be further adjusted by a “duty cycle correction factor”, derived from 20*log(dwell time/100msec). These readings must be no greater than the limits specified in 15.209(a).

Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Horizontal

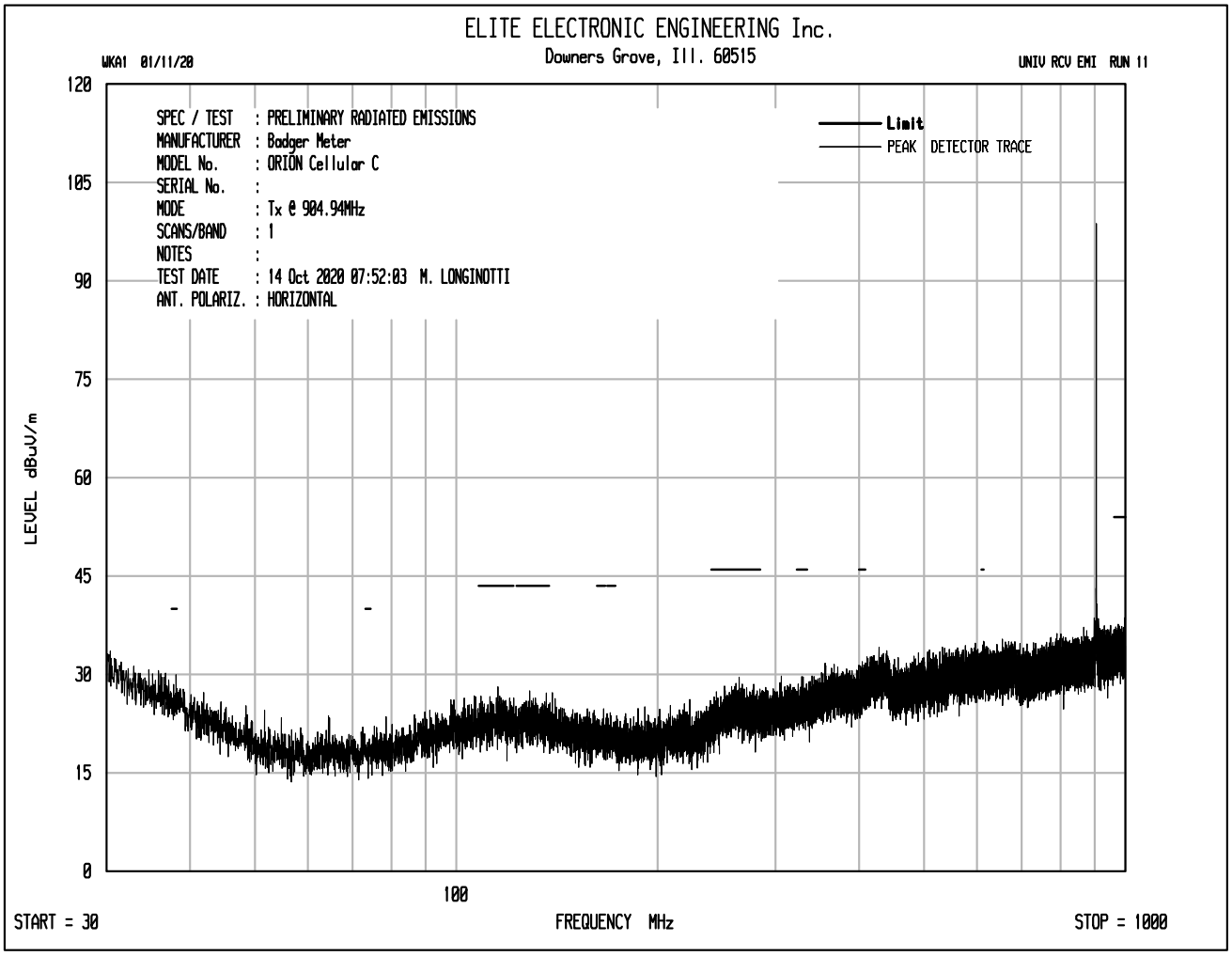
Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Vertical

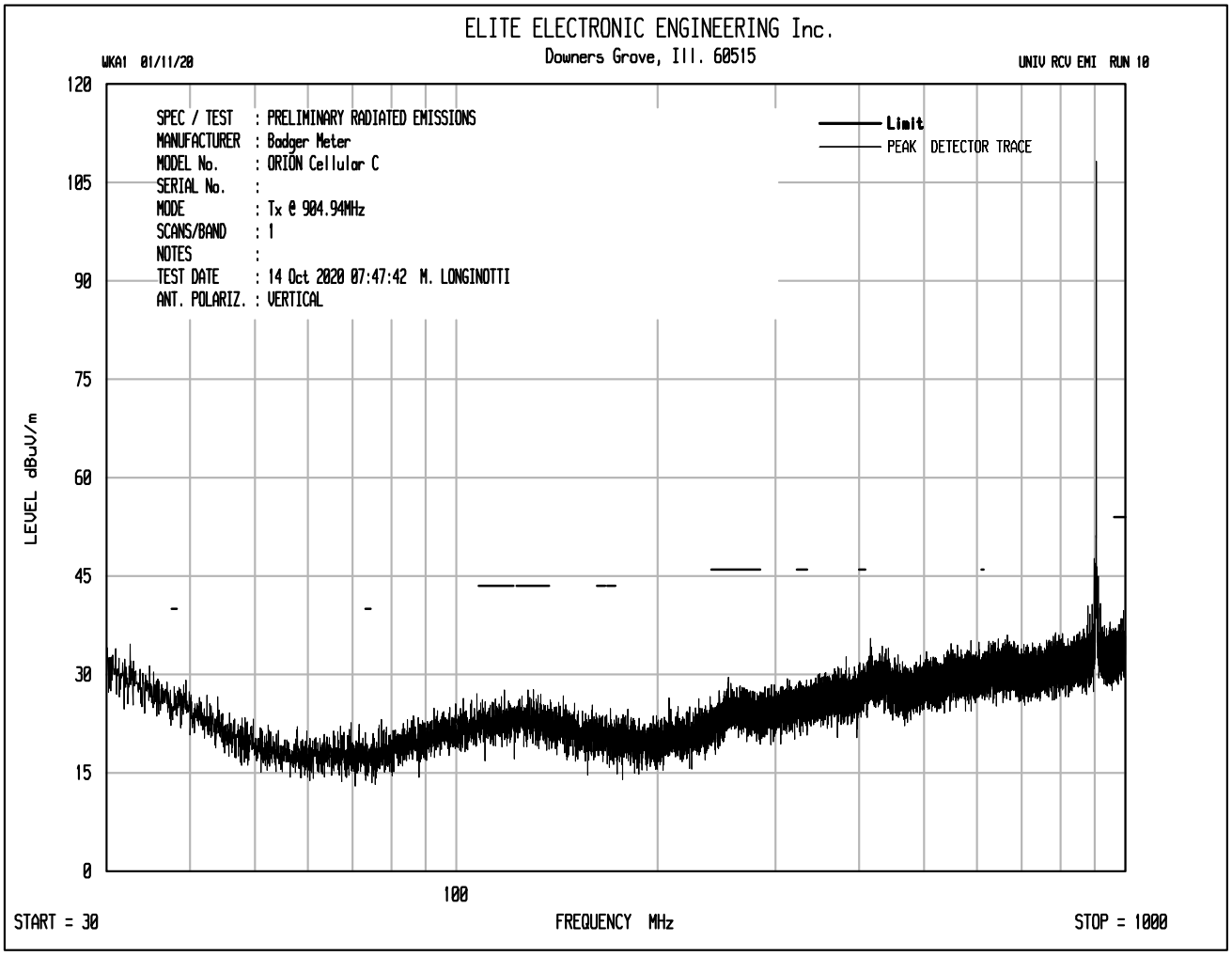


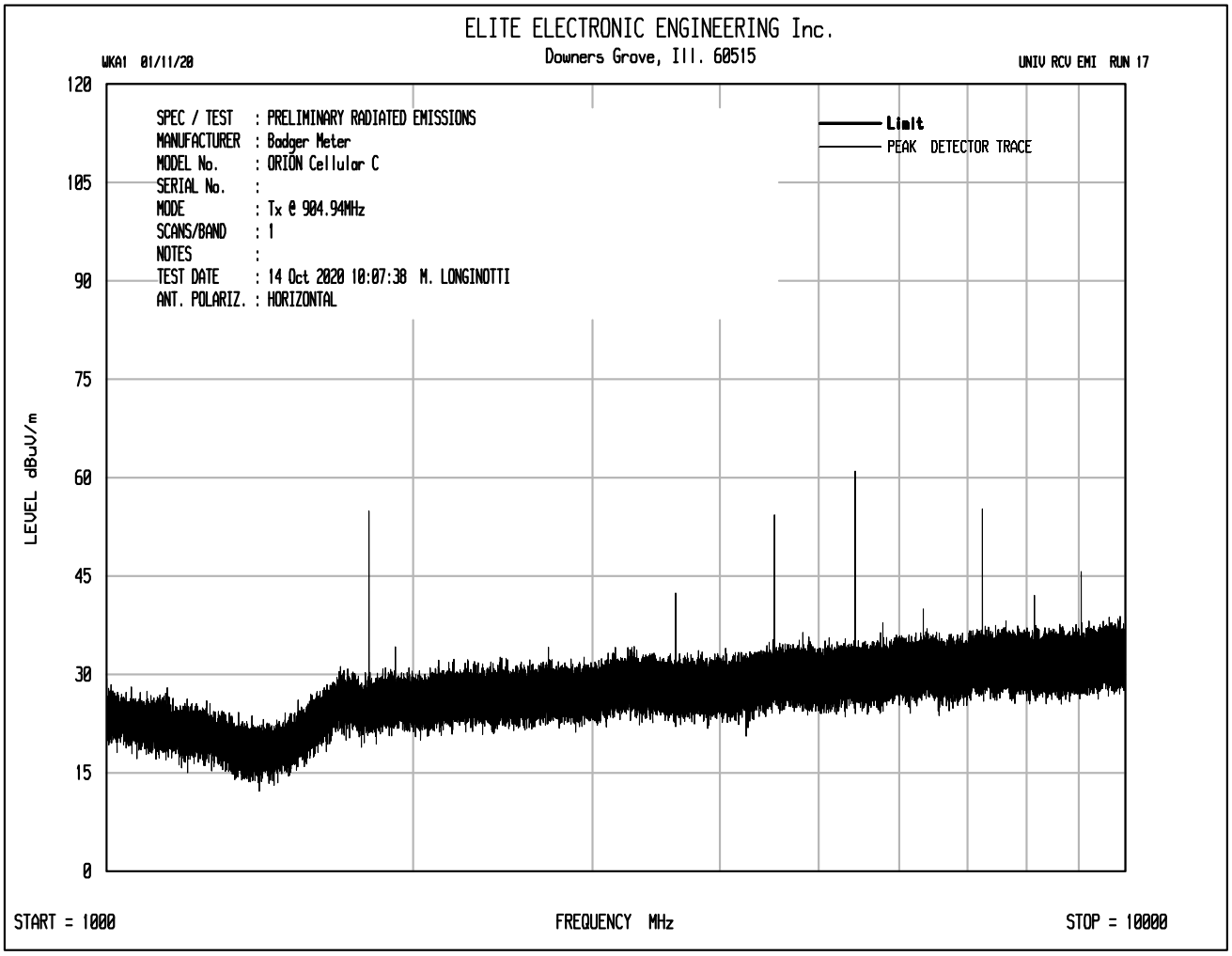
Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Horizontal

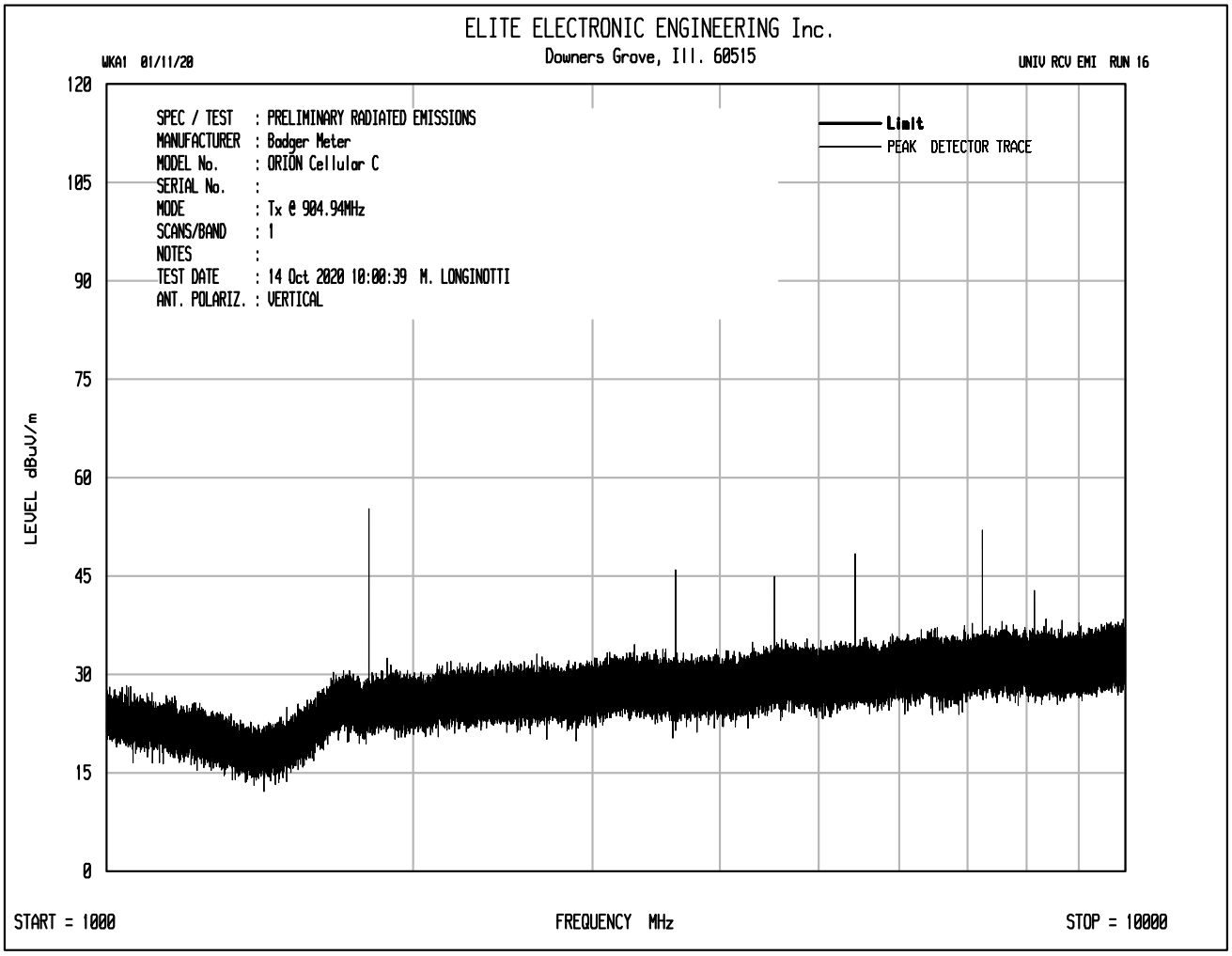


Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Vertical


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 904.94MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 07:52:03 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 904.94MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 07:47:42 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 17
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 904.94MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 10:07:38 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 16
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 904.94MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 10:00:39 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 904.94MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	None

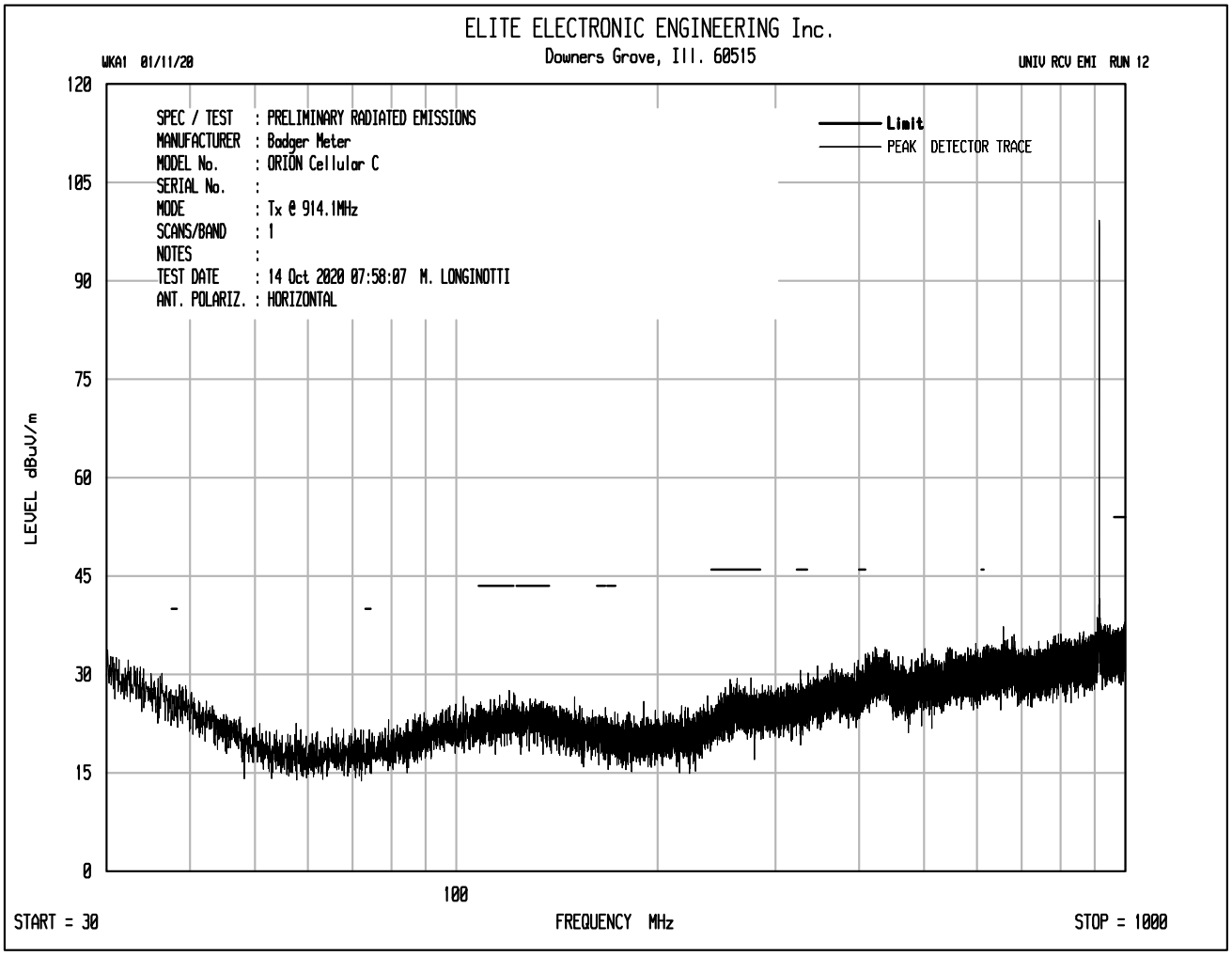
Frequency (MHz)	Ant Pol	Meter Reading (dBµV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBµV/m at 3m	Peak Total µV/m at 3 m	Peak Limit µV/m at 3 m	Margin (dB)
2714.82	H	53.1		3.7	32.6	-40.2	49.2	286.8	5000.0	-24.8
2714.82	V	51.4		3.7	32.6	-40.2	47.5	235.9	5000.0	-26.5
3619.76	H	57.9		4.3	33.2	-39.5	55.8	619.5	5000.0	-18.1
3619.76	V	56.4		4.3	33.2	-39.5	54.3	521.3	5000.0	-19.6
4524.70	H	64.6		4.7	34.2	-39.6	63.9	1575.6	5000.0	-10.0
4524.70	V	61.2		4.7	34.2	-39.6	60.5	1065.2	5000.0	-13.4
5429.64	H	73.0		5.2	35.0	-39.4	73.7	4844.8	5000.0	-0.3
5429.64	V	65.7		5.2	35.0	-39.4	66.4	2090.6	5000.0	-7.6
8144.46	H	52.8		6.5	35.8	-39.6	55.5	598.7	5000.0	-18.4
8144.46	V	54.8		6.5	35.8	-39.6	57.5	753.7	5000.0	-16.4
9049.40	H	53.3		6.5	36.3	-39.4	56.7	685.1	5000.0	-17.3
9049.40	V	53.1		6.5	36.3	-39.4	56.5	669.5	5000.0	-17.5

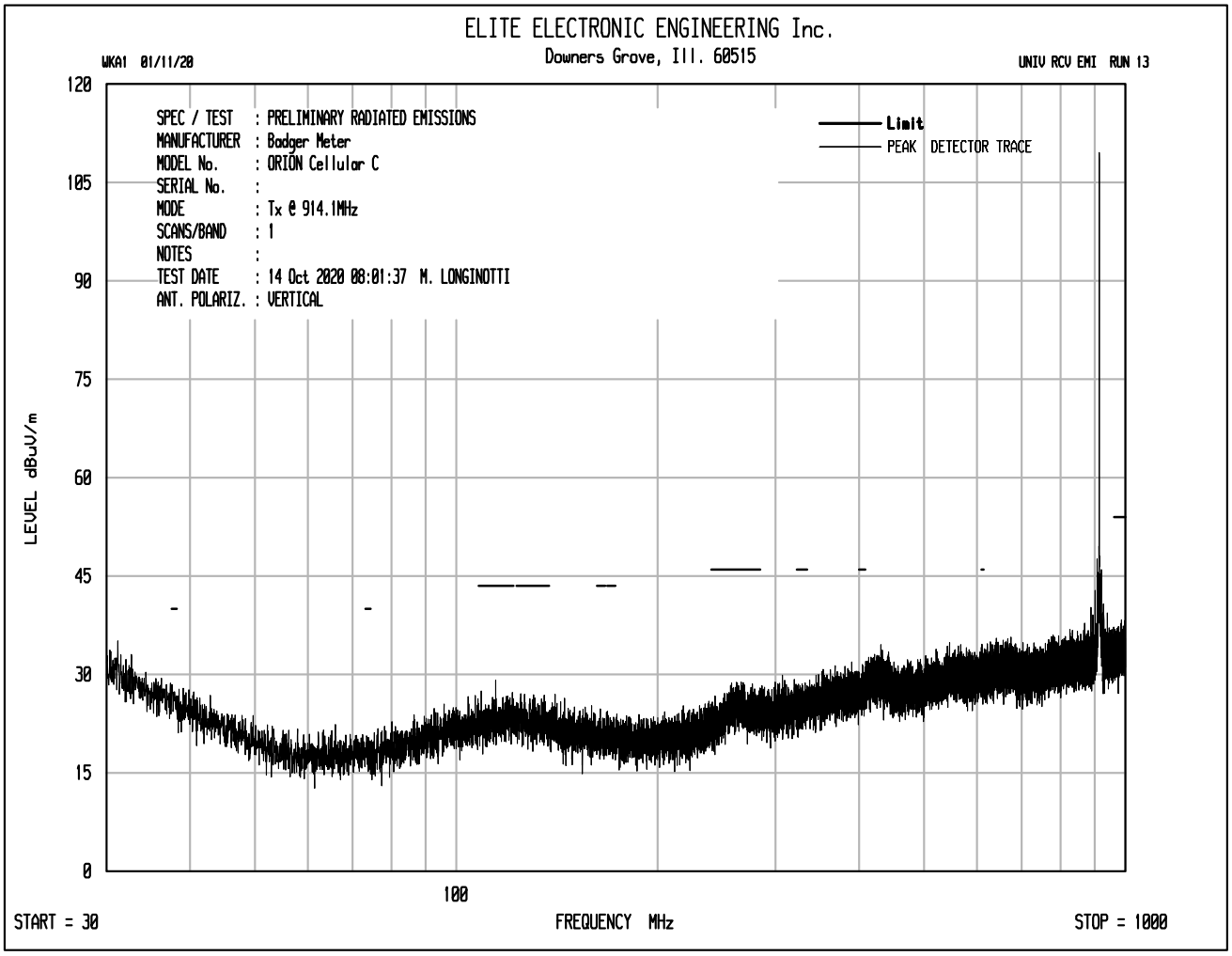
Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 904.94MHz
Parameters	Average Measurements in the Restricted Bands
Notes	None

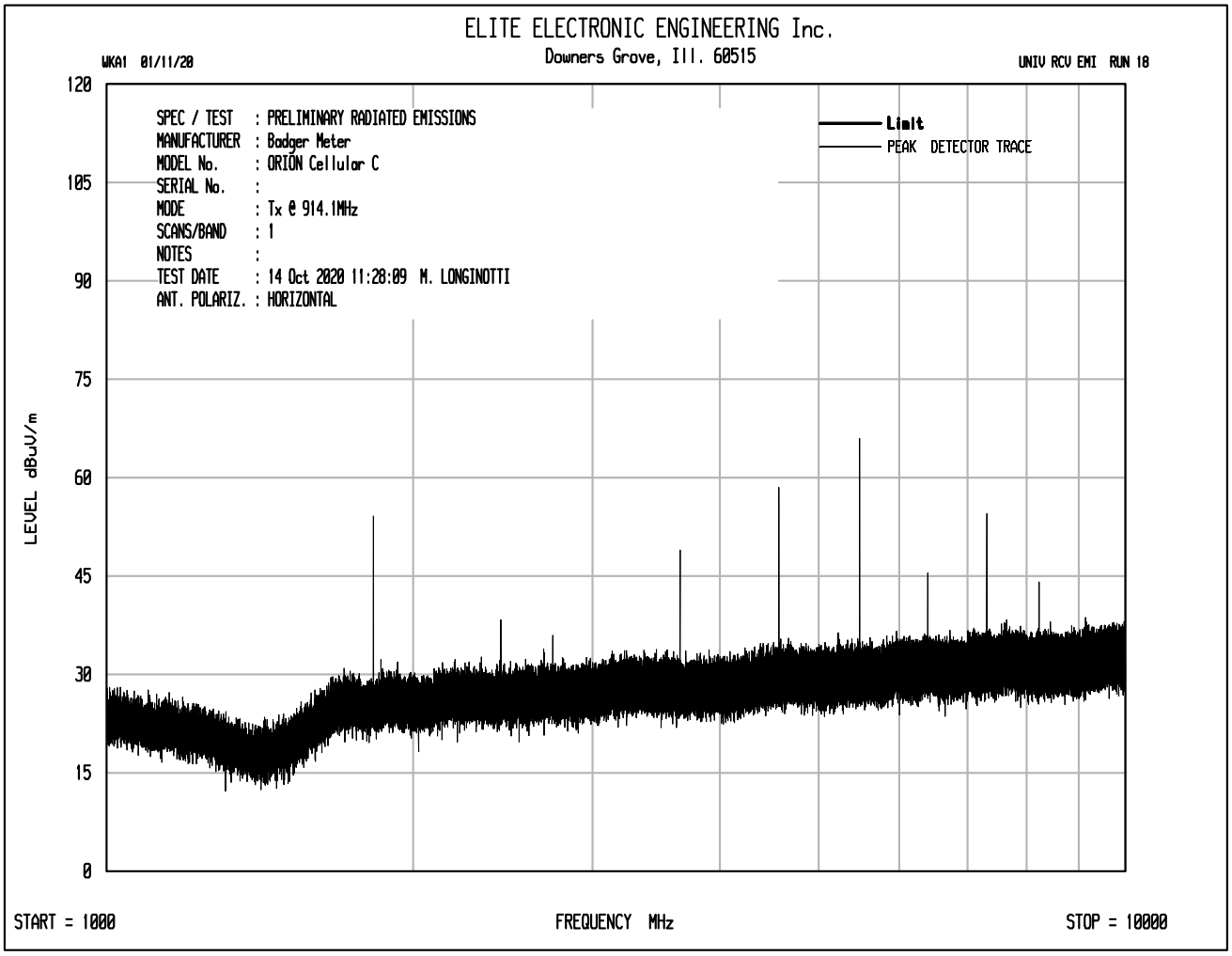
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2714.82	H	52.60		3.7	32.6	-40.2	-28.1	20.6	10.7	500.0	-33.4
2714.82	V	51.4		3.7	32.6	-40.2	-28.1	19.4	9.3	500.0	-34.6
3619.76	H	57.9		4.3	33.2	-39.5	-28.1	27.8	24.5	500.0	-26.2
3619.76	V	56.4		4.3	33.2	-39.5	-28.1	26.3	20.6	500.0	-27.7
4524.70	H	64.6		4.7	34.2	-39.6	-28.1	35.9	62.3	500.0	-18.1
4524.70	V	61.2		4.7	34.2	-39.6	-28.1	32.5	42.1	500.0	-21.5
5429.64	H	73.0		5.2	35.0	-39.4	-28.1	45.6	191.5	500.0	-8.3
5429.64	V	65.7		5.2	35.0	-39.4	-28.1	38.3	82.7	500.0	-15.6
8144.46	H	52.8		6.5	35.8	-39.6	-28.1	27.5	23.7	500.0	-26.5
8144.46	V	54.8		6.5	35.8	-39.6	-28.1	29.5	29.8	500.0	-24.5
9049.40	H	53.3		6.5	36.3	-39.4	-28.1	28.7	27.1	500.0	-25.3
9049.40	V	53.1		6.5	36.3	-39.4	-28.1	28.5	26.5	500.0	-25.5

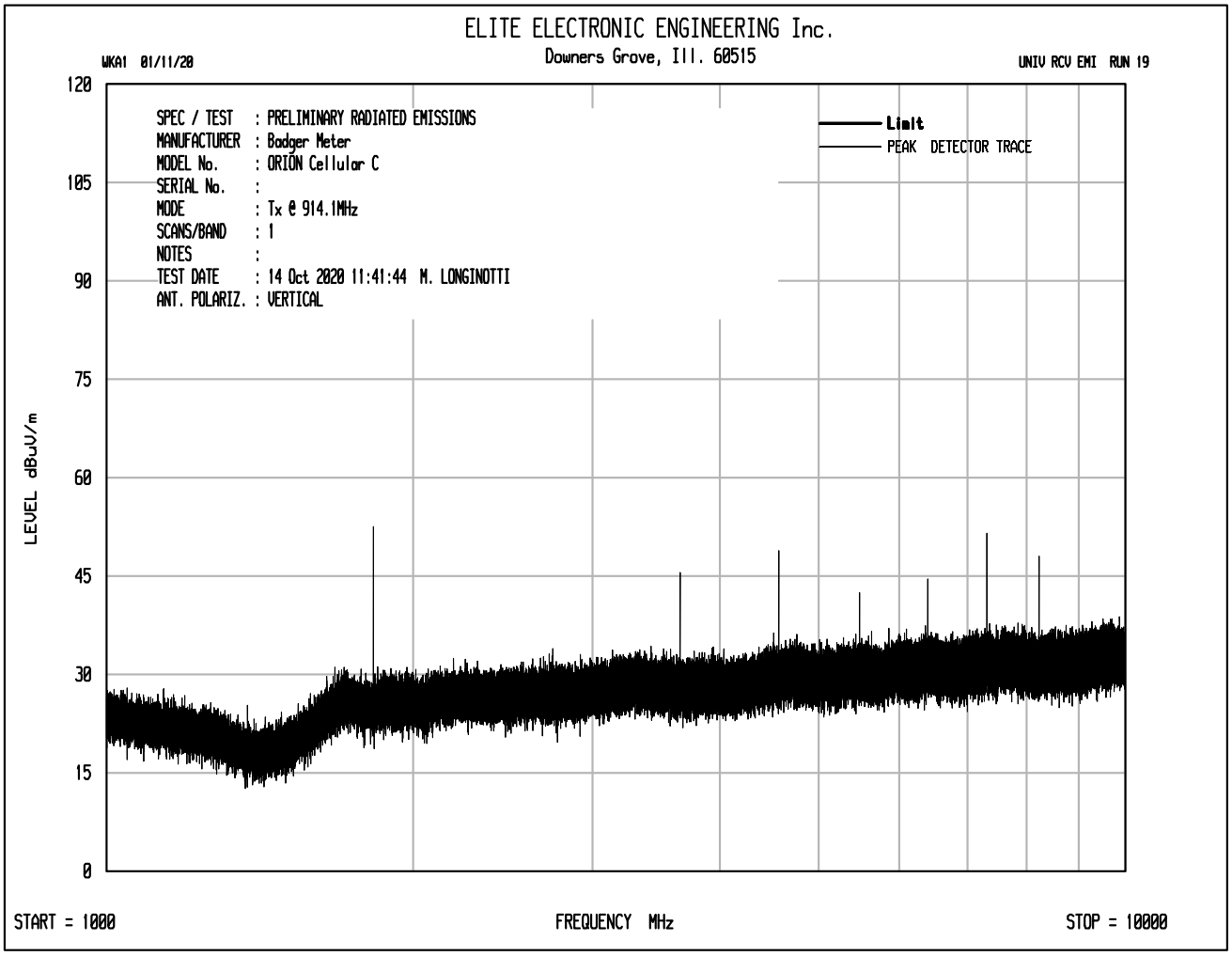
Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 904.94MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	None

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
904.94	H	71.3		2.0	26.2	0.0	99.5	94721.4		
904.94	V	81.3		2.0	26.2	0.0	109.5	299535.5		
1809.88	H	61.8		2.9	30.9	-40.1	55.5	598.0	29953.6	-34.0
1809.88	V	62.0		2.9	30.9	-40.1	55.7	611.9	29953.6	-33.8
6334.58	H	50.3		5.6	35.5	-39.6	51.9	392.3	29953.6	-37.7
6334.58	V	47.3		5.6	35.5	-39.6	48.9	277.7	29953.6	-40.7
7239.52	H	60.8		6.1	35.7	-39.7	63.0	1404.9	29953.6	-26.6
7239.52	V	57.1		6.1	35.7	-39.7	59.3	917.6	29953.6	-30.3


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 12
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 914.1MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 07:58:07 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 914.1MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 08:01:37 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 18
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 914.1MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 11:28:09 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 19
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 914.1MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 11:41:44 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 914.1MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	None

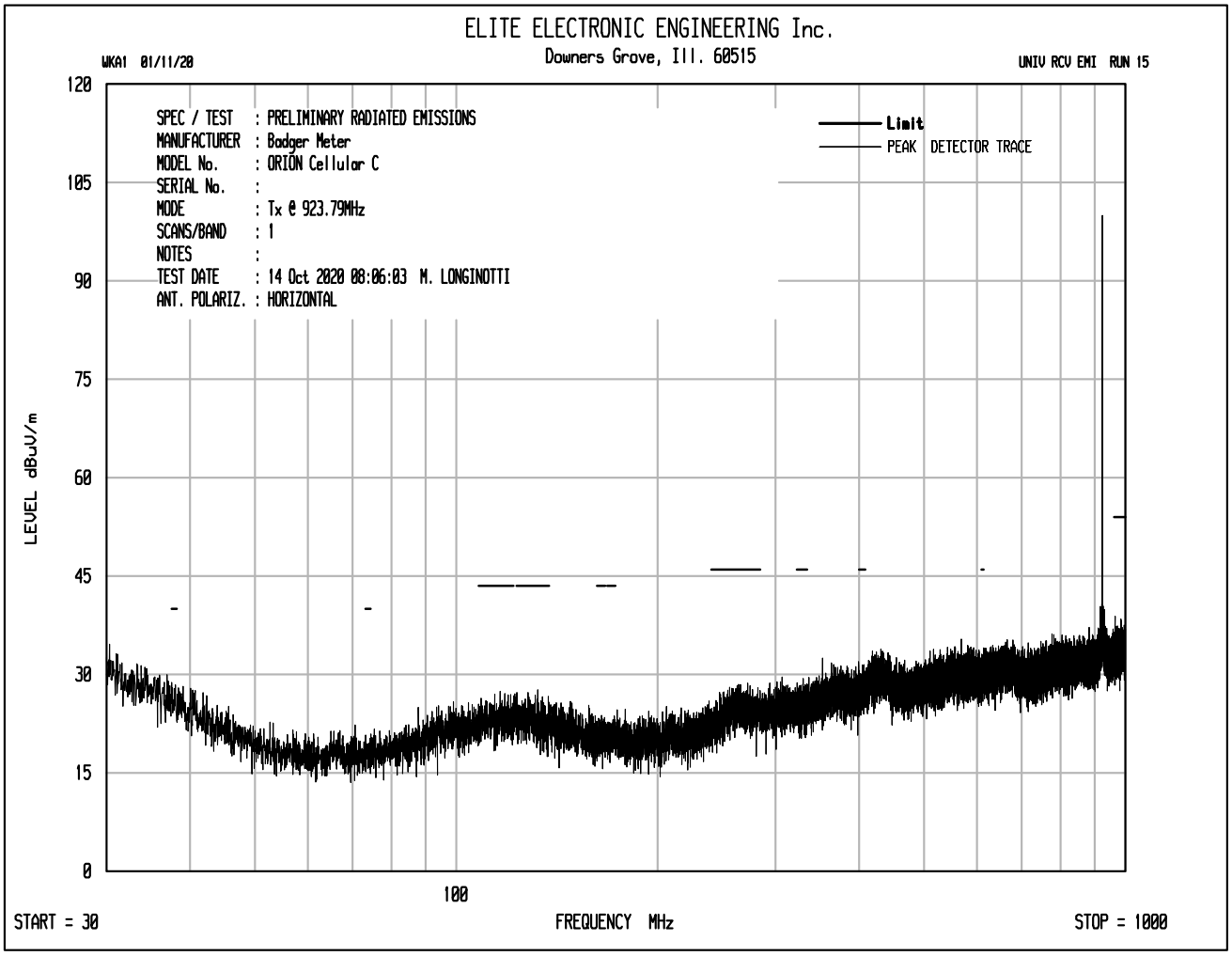
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2742.30	H	55.7		3.7	32.6	-40.2	51.8	390.1	5000.0	-22.2
2742.30	V	52.4		3.7	32.6	-40.2	48.5	266.8	5000.0	-25.5
3656.40	H	58.5		4.3	33.2	-39.6	56.4	662.8	5000.0	-17.6
3656.40	V	56.3		4.3	33.2	-39.6	54.2	514.5	5000.0	-19.8
4570.50	H	65.5		4.7	34.3	-39.7	64.8	1746.9	5000.0	-9.1
4570.50	V	63.5		4.7	34.3	-39.7	62.8	1387.6	5000.0	-11.1
7312.80	H	58.9		6.2	35.7	-39.6	61.1	1138.7	5000.0	-12.9
7312.80	V	59.2		6.2	35.7	-39.6	61.4	1178.7	5000.0	-12.6
8226.90	H	53.5		6.5	35.9	-39.5	56.4	657.1	5000.0	-17.6
8226.90	V	54.3		6.5	35.9	-39.5	57.2	720.5	5000.0	-16.8
9141.00	H	51.1		6.6	36.3	-39.4	54.6	537.3	5000.0	-19.4
9141.00	V	51.3		6.6	36.3	-39.4	54.8	549.8	5000.0	-19.2

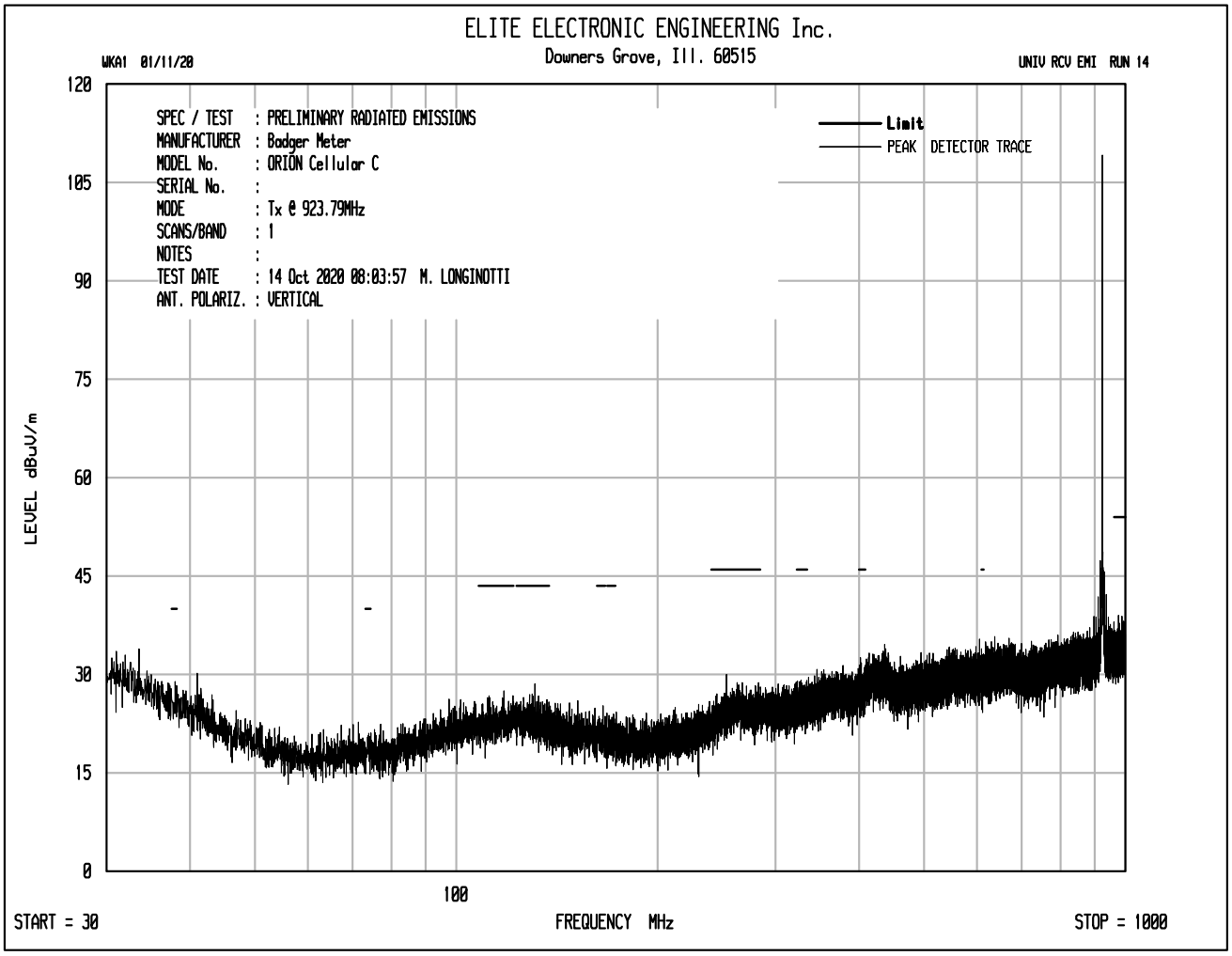
Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 914.1MHz
Parameters	Average Measurements in the Restricted Bands
Notes	None

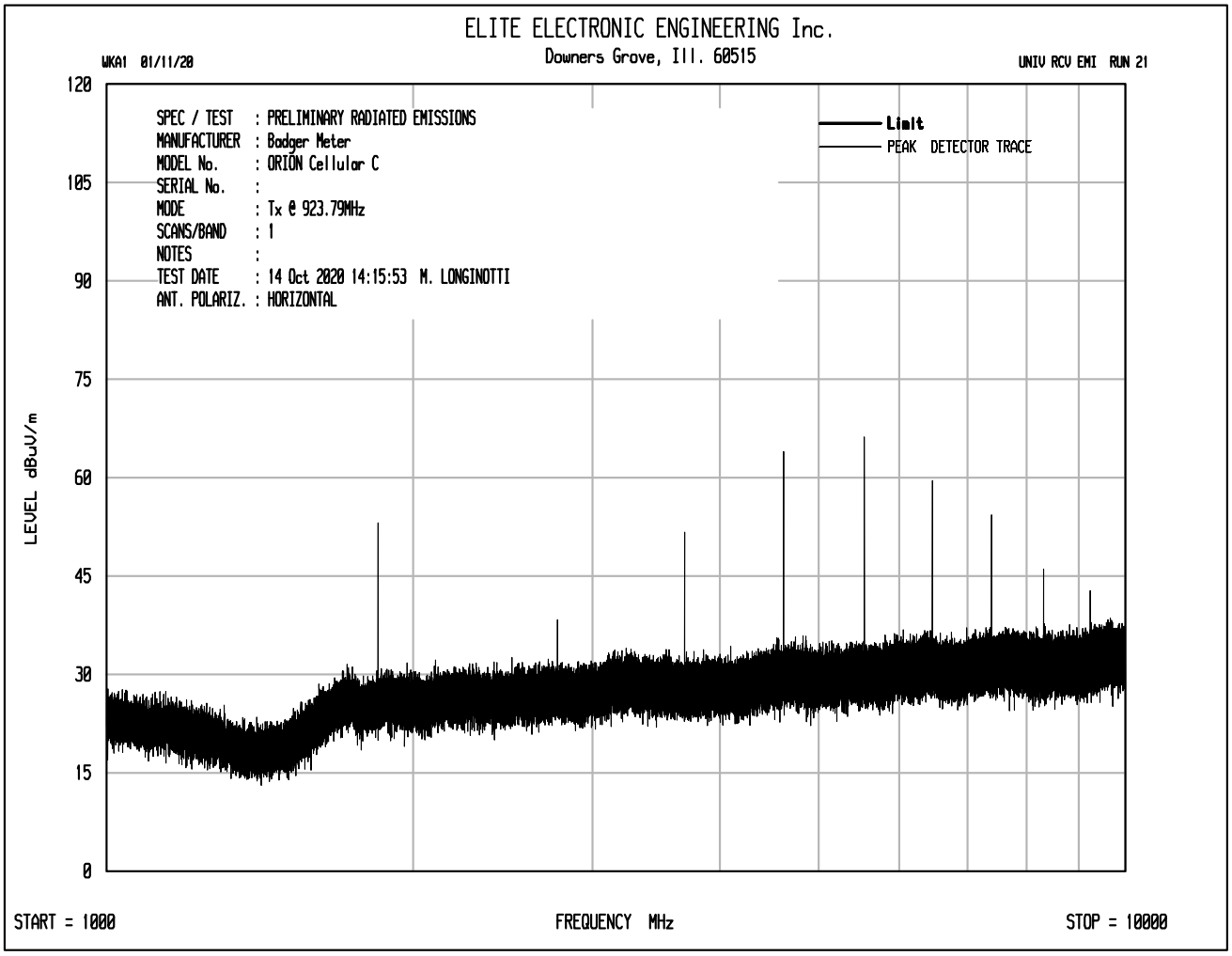
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2742.30	H	55.70		3.7	32.6	-40.2	-28.1	23.8	15.4	500.0	-30.2
2742.30	V	52.4		3.7	32.6	-40.2	-28.1	20.5	10.5	500.0	-33.5
3656.40	H	58.5		4.3	33.2	-39.6	-28.1	28.4	26.2	500.0	-25.6
3656.40	V	56.3		4.3	33.2	-39.6	-28.1	26.2	20.3	500.0	-27.8
4570.50	H	65.5		4.7	34.3	-39.7	-28.1	36.8	69.1	500.0	-17.2
4570.50	V	63.5		4.7	34.3	-39.7	-28.1	34.8	54.9	500.0	-19.2
7312.80	H	58.9		6.2	35.7	-39.6	-28.1	33.1	45.0	500.0	-20.9
7312.80	V	59.2		6.2	35.7	-39.6	-28.1	33.4	46.6	500.0	-20.6
8226.90	H	53.5		6.5	35.9	-39.5	-28.1	28.3	26.0	500.0	-25.7
8226.90	V	54.3		6.5	35.9	-39.5	-28.1	29.1	28.5	500.0	-24.9
9141.00	H	51.1		6.6	36.3	-39.4	-28.1	26.5	21.2	500.0	-27.4
9141.00	V	51.3		6.6	36.3	-39.4	-28.1	26.7	21.7	500.0	-27.2

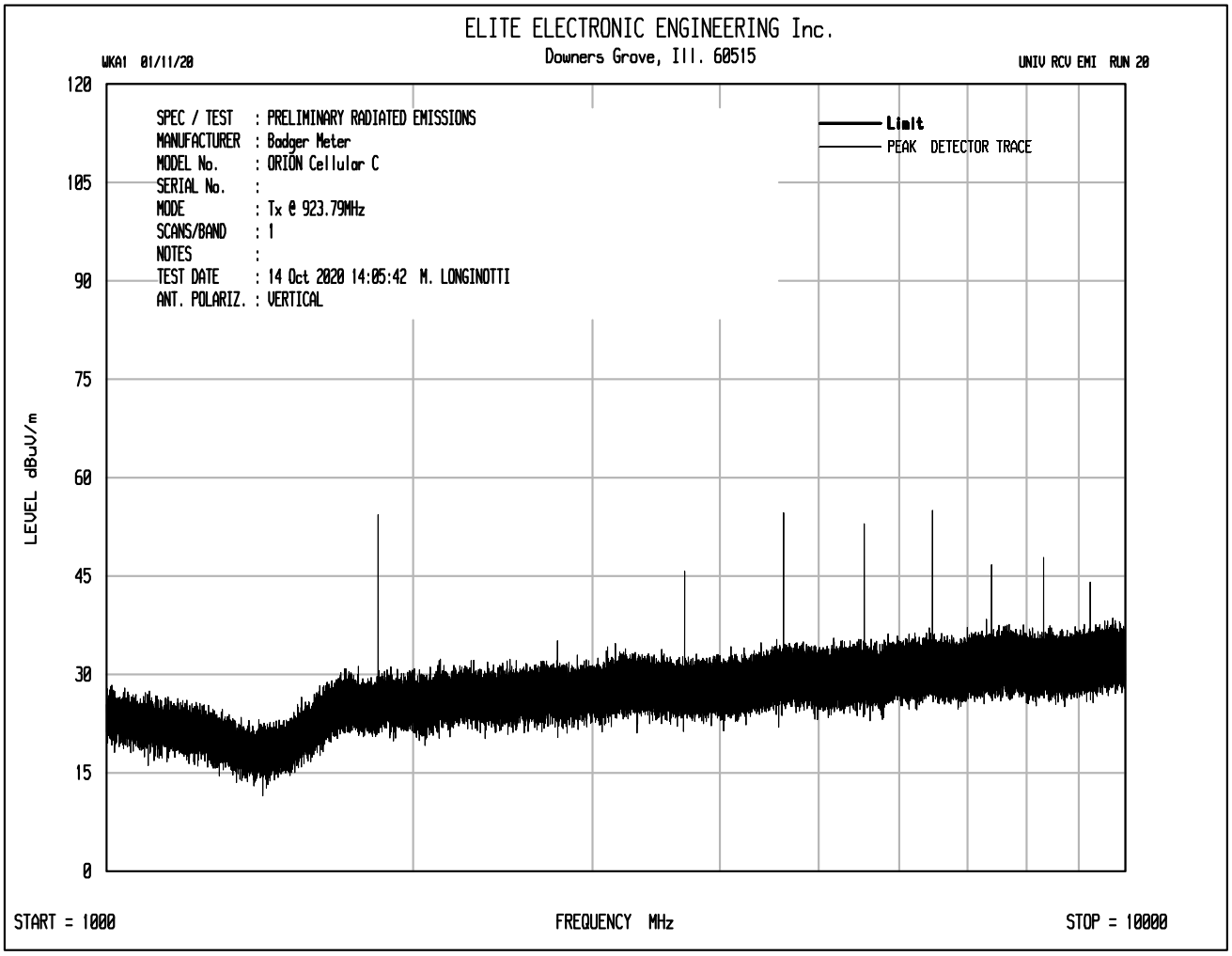
Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 914.1MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	None

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
914.10	H	69.1		2.1	26.3	0.0	97.5	74861.5		
914.10	V	81.9		2.1	26.3	0.0	110.3	326782.4		
1828.20	H	61.9		2.9	30.9	-40.1	55.7	607.7	32678.2	-34.6
1828.20	V	60.1		2.9	30.9	-40.1	53.9	494.0	32678.2	-36.4
5484.60	H	73.5		5.2	35.0	-39.4	74.2	5153.0	32678.2	-16.0
5484.60	V	67.3		5.2	35.0	-39.4	68.0	2523.8	32678.2	-22.2
6398.70	H	60.1		5.7	35.5	-39.5	61.8	1226.9	32678.2	-28.5
6398.70	V	55.5		5.7	35.5	-39.5	57.2	722.5	32678.2	-33.1


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 15
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 923.79MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 08:06:03 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 14
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 923.79MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 08:03:57 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 21
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 923.79MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 14:15:53 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 01/11/20
UNIV RCV EMI RUN 20
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : Badger Meter
MODEL No. : ORION Cellular C
SERIAL No. :
MODE : Tx @ 923.79MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Oct 2020 14:05:42 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 923.79MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	None

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2771.37	H	56.9		3.7	32.5	-40.1	53.0	448.1	5000.0	-21.0
2771.37	V	57.0		3.7	32.5	-40.1	53.1	453.3	5000.0	-20.9
3695.16	H	58.8		4.3	33.2	-39.5	56.8	693.8	5000.0	-17.2
3695.16	V	60.3		4.3	33.2	-39.5	58.3	824.6	5000.0	-15.7
4618.95	H	64.9		4.8	34.4	-39.7	64.4	1662.5	5000.0	-9.6
4618.95	V	62.8		4.8	34.4	-39.7	62.3	1305.5	5000.0	-11.7
7390.32	H	59.5		6.2	35.7	-39.6	61.8	1227.0	5000.0	-12.2
7390.32	V	57.8		6.2	35.7	-39.6	60.1	1008.9	5000.0	-13.9
8314.11	H	54.6		6.5	35.9	-39.5	57.5	753.1	5000.0	-16.4
8314.11	V	54.7		6.5	35.9	-39.5	57.6	761.8	5000.0	-16.3

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 923.79MHz
Parameters	Average Measurements in the Restricted Bands
Notes	None

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2771.37	H	56.90		3.7	32.5	-40.1	-28.1	25.0	17.7	500.0	-29.0
2771.37	V	57.0		3.7	32.5	-40.1	-28.1	25.1	17.9	500.0	-28.9
3695.16	H	58.8		4.3	33.2	-39.5	-28.1	28.8	27.4	500.0	-25.2
3695.16	V	60.3		4.3	33.2	-39.5	-28.1	30.3	32.6	500.0	-23.7
4618.95	H	64.9		4.8	34.4	-39.7	-28.1	36.4	65.7	500.0	-17.6
4618.95	V	62.8		4.8	34.4	-39.7	-28.1	34.3	51.6	500.0	-19.7
7390.32	H	59.5		6.2	35.7	-39.6	-28.1	33.7	48.5	500.0	-20.3
7390.32	V	57.8		6.2	35.7	-39.6	-28.1	32.0	39.9	500.0	-22.0
8314.11	H	54.6		6.5	35.9	-39.5	-28.1	29.5	29.8	500.0	-24.5
8314.11	V	54.7		6.5	35.9	-39.5	-28.1	29.6	30.1	500.0	-24.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000006
Mode	Transmit at 923.79MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	None

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
923.79	H	73.7		2.1	26.4	0.0	102.2	128960.3		
923.79	V	81.1		2.1	26.4	0.0	109.6	302312.5		
1847.58	H	60.6		3.0	31.0	-40.1	54.4	525.7	30231.2	-35.2
1847.58	V	63.1		3.0	31.0	-40.1	56.9	701.1	30231.2	-32.7
5542.74	H	73.2		5.2	35.0	-39.4	73.9	4971.2	30231.2	-15.7
5542.74	V	67.9		5.2	35.0	-39.4	68.6	2700.6	30231.2	-21.0
6466.53	H	62.8		5.7	35.6	-39.5	64.5	1687.0	30231.2	-25.1
6466.53	V	56.8		5.7	35.6	-39.5	58.5	845.5	30231.2	-31.1
9237.90	H	45.0		6.6	36.3	-39.4	48.6	268.7	30231.2	-41.0
9237.90	V	45.6		6.6	36.3	-39.4	49.2	287.9	30231.2	-40.4

30. Band-Edge Compliance

Test Information	
Manufacturer	Badger Meter
Product	Water Meter Transceiver
Model	ORION Cellular C
Serial No	130000005
Mode	Transmit at 904.94MHz, Transmit at 923.79MHz, Hopping Enabled

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Notes	None

Procedures

Low Band Edge

1) The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation.
2) The EUT was set to transmit continuously at the channel closest to the low band-edge, hopping function disabled.
3) To determine the band edge compliance, the following spectrum analyzer settings were used:

   a. Center frequency = low band-edge frequency.
   b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
   c. Resolution bandwidth (RBW) = 100kHz.
   d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
   e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)
   f. The analyzer's display was plotted using a 'screen dump' utility.

4) Step 3) was repeated with the frequency hopping function enabled.

High Band Edge

1) The antenna port of the EUT was connected to the spectrum analyzer through 40dB of attenuation.
2) The EUT was set to transmit continuously at the channel closest to the high band-edge, hopping function disabled.
3) To determine the band edge compliance, the following spectrum analyzer settings were used:

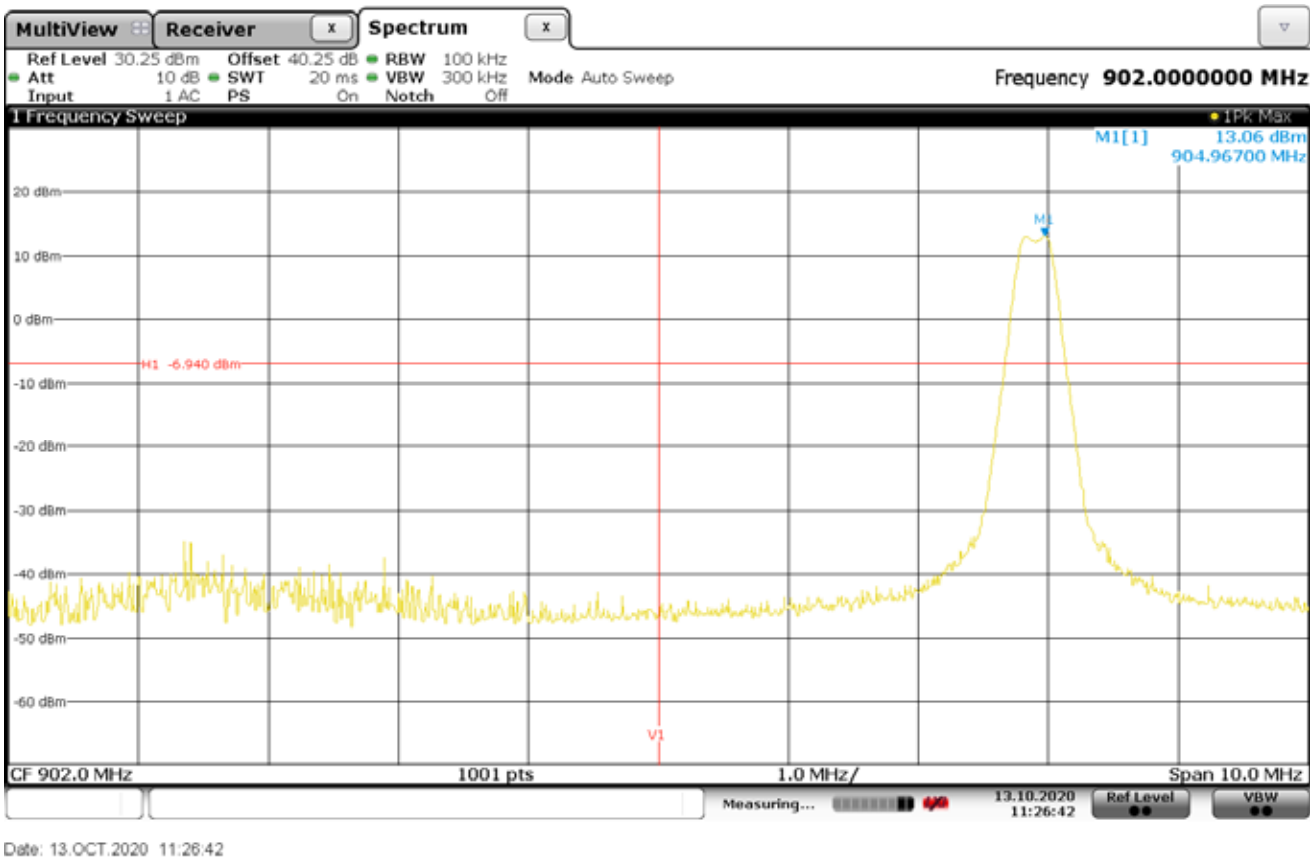
   a. Center frequency = high band-edge frequency.
   b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.

c. Resolution bandwidth (RBW) ≥ 1% of the span.
d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the right of the center frequency (band-edge) must be below the display line.)
f. The analyzer's display was plotted using a 'screen dump' utility.

4) Step 3) was repeated with the frequency hopping function enabled.

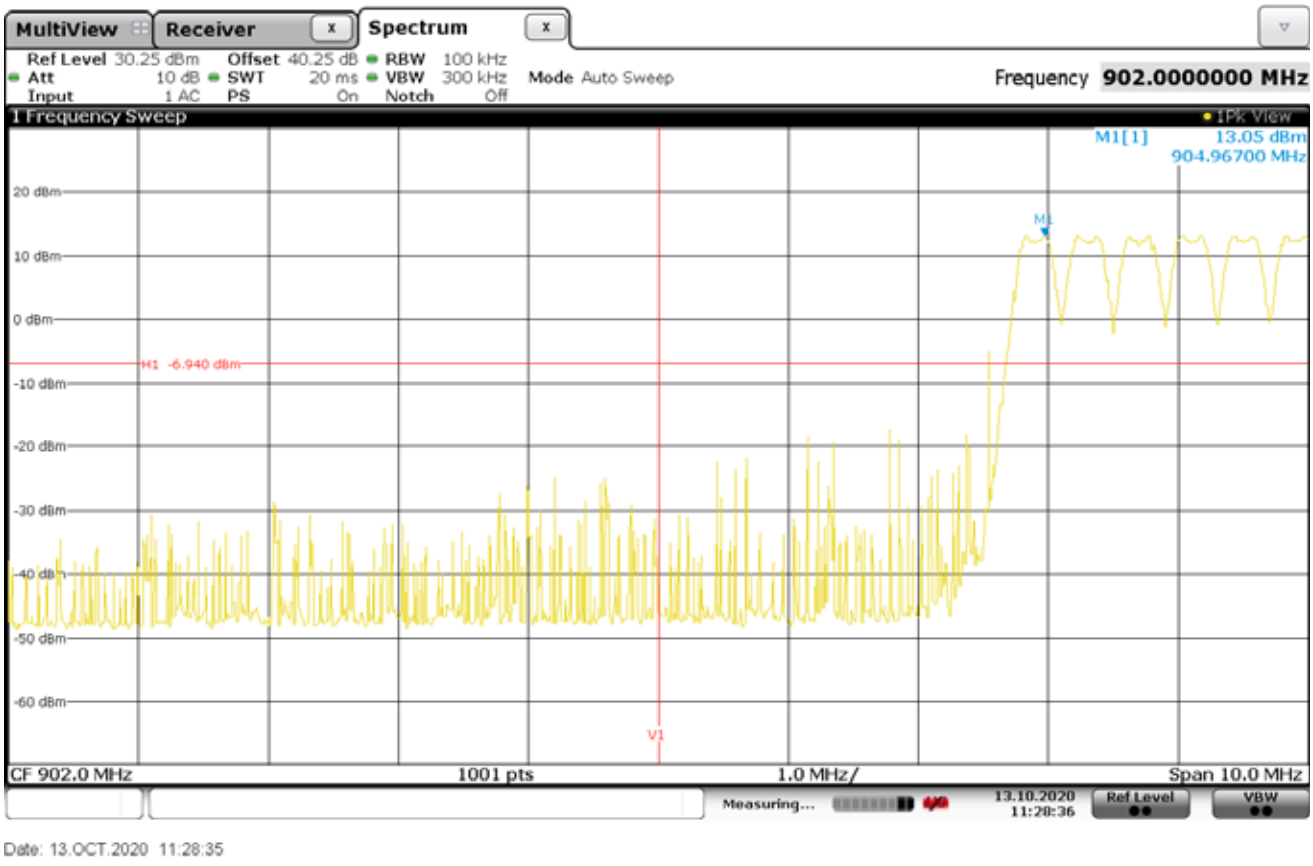
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 904.94MHz
Parameters	Low Band-Edge
Notes	Vertical Line V1 represents the low band edge frequency of 902MHz. Horizontal Line H1 represents the level 20dB down from the highest level of the in-band emissions in a 100 kHz bandwidth.



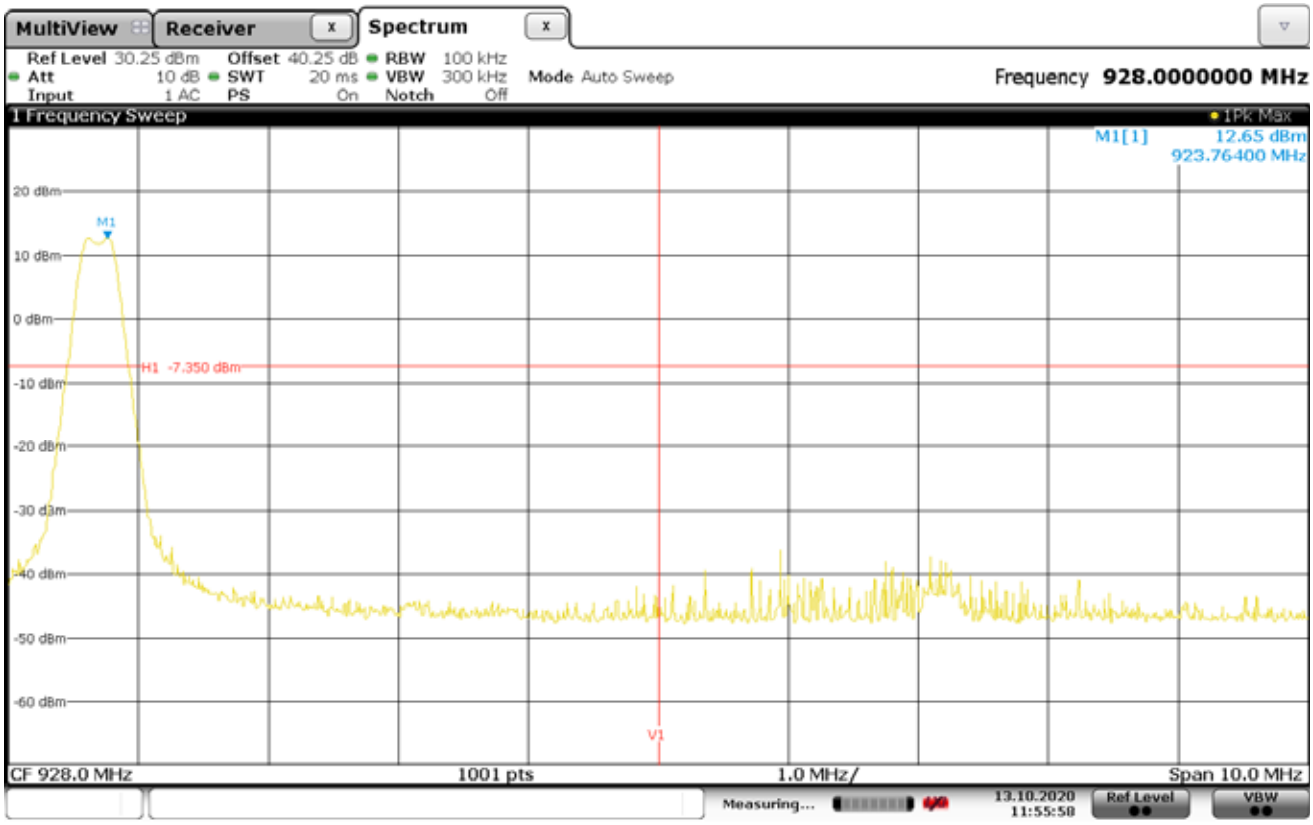
Date: 13.OCT.2020 11:26:42

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Hopping Enabled
Parameters	Low Band-Edge
Notes	Vertical Line V1 represents the low band edge frequency of 902MHz. Horizontal Line H1 represents the level 20dB down from the highest level of the in-band emissions in a 100 kHz bandwidth.

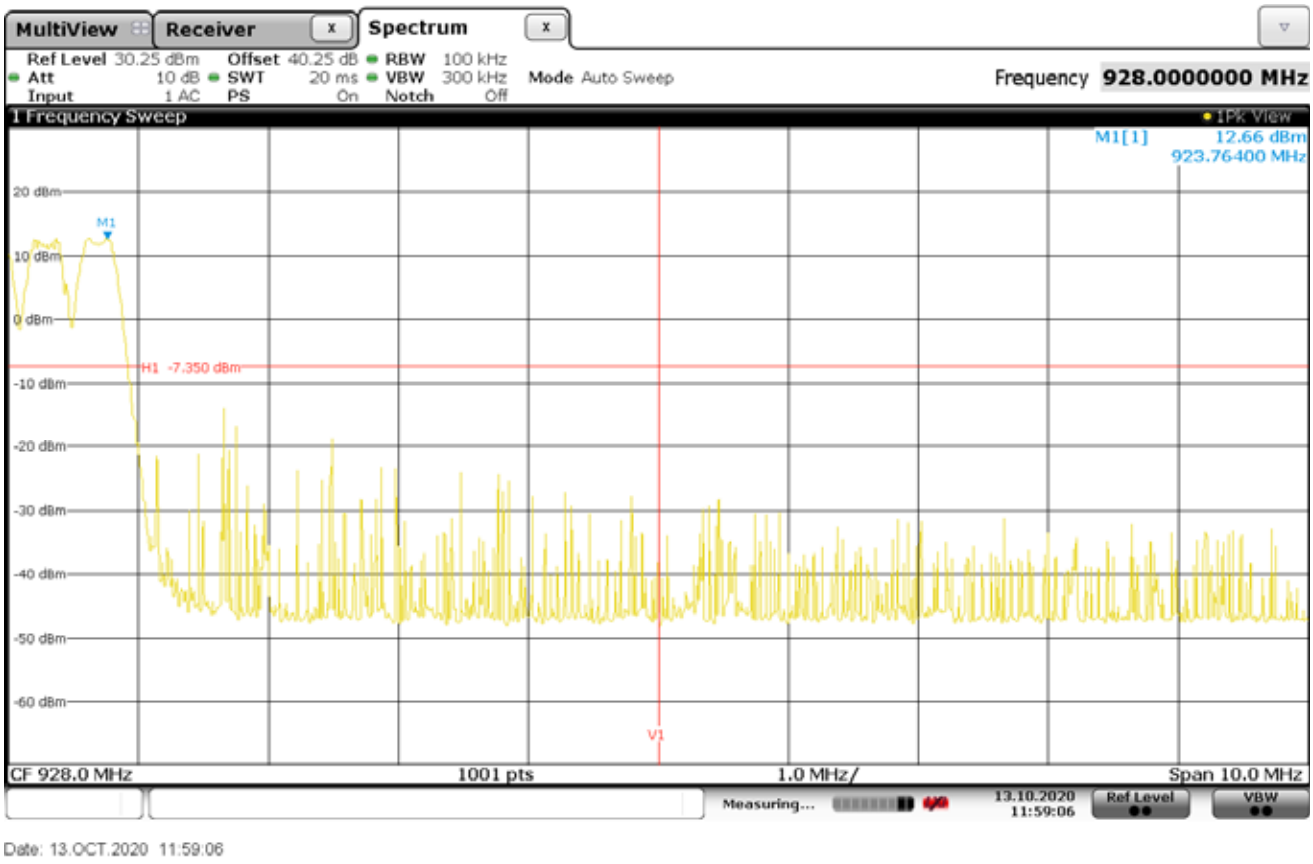


Date: 13.OCT.2020 11:28:35

Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Transmit at 923.79MHz
Parameters	High Band-Edge
Notes	Vertical Line V1 represents the high band edge frequency of 928MHz. Horizontal Line H1 represents the level 20dB down from the highest level of the in-band emissions in a 100 kHz bandwidth.



Test Details	
Manufacturer	Badger Meter
Model	ORION Cellular C
S/N	130000005
Mode	Hopping Enabled
Parameters	High Band-Edge
Notes	Vertical Line V1 represents the high band edge frequency of 928MHz. Horizontal Line H1 represents the level 20dB down from the highest level of the in-band emissions in a 100 kHz bandwidth.



31. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELITE ELECTRONIC ENGINEERING, INC.
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Downers Grove, IL 60515
Robert Bugielski (QA Manager) Phone: 630 495 9770 ext. 168
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Email: cfanning@elitetest.com
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ELECTRICAL

Valid to: June 30, 2021 Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:	Test Method(s)[1]:
Transient Immunity	ISO 7637-2 (including emissions); ISO 7637-3; ISO 16750-2:2012, Sections 4.6.3 and 4.6.4; CS-11979, Section 6.4; CS.00054, Section 5.9; EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222); GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12
Electrostatic Discharge (ESD)	ISO 10605 (2001, 2008); CS-11979 Section 7.0; CS.00054, Section 5.10; EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13; GMW 3097 Section 3.6
Conducted Emissions	CISPR 25 (2002, 2008), Sections 6.2 and 6.3; CISPR 25 (2016), Sections 6.3 and 6.4; CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2; GMW 3097, Section 3.3.2; EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421)
Radiated Emissions Anechoic	CISPR 25 (2002, 2008), Section 6.4; CISPR 25 (2016), Section 6.5; CS-11979, Section 5.3; CS.00054, Section 5.6.3; GMW 3097, Section 3.3.1; EMC-CS-2009.1 (RE 310); FMC1278 (RE310)
Vehicle Radiated Emissions	CISPR 12; ICES-002

Test Technology:	Test Method(s)[1]:
Bulk Current Injection (BCI)	ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1; GMW 3097, Section 3.4.1; SAE J1113-4; EMC-CS-2009.1 (RI112); FMC1278 (RI112)
Bulk Current Injections (BCI) *(Closed Loop Method)*	ISO 11452-4; SAE J1113-4
Radiated Immunity Anechoic *(Including Radar Pulse)*	ISO 11452-2; ISO 11452-5; CS-11979, Section 6.2; CS.00054, Section 5.8.2; GMW 3097, Section 3.4.2; EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21
Radiated Immunity Magnetic Field	ISO 11452-8
Radiated Immunity Reverb	ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMC1278 (RI114); ISO 11452-11
Radiated Immunity *(Portable Transmitters)*	ISO 11452-9; EMC-CS-2009.1 (RI115); FMC1278 (RI115)
Vehicle Radiated Immunity (ALSE)	ISO 11451-2
Electrical Loads	ISO 16750-2, Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.11, and 4.12
Dielectric Withstand Voltage	MIL-STD-202, Method 301; EIA-364-20D
Insulation Resistance	MIL-STD-202, Method 302; SAE/USCAR-2, Revision 6, Section 5.5.1; EIA-364-21D
Contact Resistance	MIL-STD-202, Method 307; SAE/USCAR-2, Revision 6, Section 5.3.1; EIA/ECA-364-23C; USCAR21-3 Section 4.5.3
DC Resistance	MIL-STD-202, Method 303
Contact Chatter	MIL-STD-202, Method 310; SAE/USCAR-2, Revision 6, Section 5.1.9
Voltage Drop	SAE/USCAR-2, Revision 6, Section 5.3.2; USCAR21-3 Section 4.5.6

Test Technology:	Test Method(s)[1]:
Emissions	
Radiated and Conducted (3m Semi-anechoic chamber, up to 40 GHz)	47 CFR, FCC Part 15 B (using ANSI C63.4:2014); 47 CFR, FCC Part 18 (using FCC MP-5:1986); ICES-001; ICES-003; ICES-005; IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004); IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010); KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008); CISPR 11; EN 55011; KN 11; CNS 13803 (1997, 2003); CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1; KN 14-1; IEC/CISPR 22 (1997); EN 55022 (1998) + A1(2000); EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006); IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004); AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz); CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz); CISPR 32; EN 55032; KN 32
Current Harmonics	IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2
Flicker and Fluctuations	IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3
Immunity	
Electrostatic Discharge	IEC 61000-4-2, Ed. 1.2 (2001); IEC 61000-4-2 (1995) + A1(1998) + A2(2000); EN 61000-4-2 (1995); EN 61000-4-2 (2009-05); KN 61000-4-2 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2; IEEE C37.90.3 2001
Radiated Immunity	IEC 61000-4-3 (1995) + A1(1998) + A2(2000); IEC 61000-4-3, Ed. 3.0 (2006-02); IEC 61000-4-3, Ed. 3.2 (2010); KN 61000-4-3 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3; IEEE C37.90.2 2004
Electrical Fast Transient/Burst	IEC 61000-4-4, Ed. 2.0 (2004-07); IEC 61000-4-4, Ed. 2.1 (2011); IEC 61000-4-4 (1995) + A1(2000) + A2(2001); KN 61000-4-4 (2008-5); RRL Notice No. 2008-5 (May 20, 2008); IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4
Surge	IEC 61000-4-5 (1995) + A1(2000); IEC 61000-4-5, Ed 1.1 (2005-11); EN 61000-4-5 (1995) + A1(2001); KN 61000-4-5 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5; IEEE C37.90.1 2012

Test Technology:	Test Method(s)[1]:
Immunity (cont'd)	
Conducted Immunity	IEC 61000-4-6 (1996) + A1(2000); IEC 61000-4-6, Ed 2.0 (2006-05); IEC 61000-4-6 Ed. 3.0 (2008); KN 61000-4-6 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6; EN 61000-4-6; KN 61000-4-6
Power Frequency Magnetic Field Immunity	IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009); EN 61000-4-8 (1994) + A1(2000); KN 61000-4-8 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8
Voltage Dips, Short Interrupts, and Line Voltage Variations	IEC 61000-4-11, Ed. 2 (2004-03); KN 61000-4-11 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11
Ring Wave	IEC 61000-4-12, Ed. 2 (2006-09); EN 61000-4-12:2006; IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12
Generic and Product Specific EMC Standards	IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2; KN 61000-6-2; IEC/EN 61000-6-3; AS/NZS 61000-6-3; KN 61000-6-3; IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4; EN 50130-4; IEC 61326-1; IEC/CISPR 14-2; EN 55014-2; AS/NZS CISPR 14.2; KN 14-2; IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24; IEC 60601-1-2; JIS T0601-1-2
TxRx EMC Requirements	EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17; EN 301 489-19; EN 301 489-52;
European Radio Test Standards	ETSI EN 300 086-1; ETSI EN 300 086-2; ETSI EN 300 113-1; ETSI EN 300 113-2; ETSI EN 300 220-1; ETSI EN 300 220-2; ETSI EN 300 330-1; ETSI EN 300 330-2; ETSI EN 300 440-1; ETSI EN 300 440-2; ETSI EN 300 422-1; ETSI EN 300 422-2; ETSI EN 300 328; ETSI EN 301 893; ETSI EN 301 511; ETSI EN 301 908-1; ETSI EN 908-2; ETSI EN 908-13; ETSI EN 301 413; ETSI EN 302 502

Test Technology:	Test Method(s)[1]:
Canadian Radio Tests	RSS-102 (RF Exposure Evaluation only); RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-246; RSS-247; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN
Mexico Radio Tests	IFT-008; NOM-208-SCFI
Japan Radio Tests	Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18
Taiwan Radio Tests	LP-0002
Australia/New Zealand Radio Tests	AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)
Hong Kong Radio Tests	HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073
Korean Radio Test Standards	KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52
Unlicensed Radio Frequency Devices *(3 Meter Semi-Anechoic Room)*	47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))
Licensed Radio Service Equipment	47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101; ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015;
OTA (Over the Air) Performance GSM, GPRS, EGPRS UMTS (W-CDMA) LTE including CAT M1 A-GPS for UMTS/GSM LTS A-GPS, A-GLONASS, SIB8/SIB16 Large Device/Laptop/Tablet Testing Integrated Device Testing WiFi 802.11 a/b/g/n/ac	CTIA Test Plan for Wireless Device Over-the-Air Performance (Method for Measurement for Radiated Power and Receiver Performance) V3.8.2; CTIA Test Plan for RF Performance Evaluation of WiFi Mobile Converged Devices V2.1.0

Test Technology:	Test Method(s)[1]:
Electrical Measurements and Simulation	
AC Voltage / Current	FAA AC 150/5345-10H
(1mV to 5kV) 60 Hz	FAA AC 150/5345-43J
(0.1V to 250V) up to 500 MHz	FAA AC 150/5345-44K
(1µA to 150A) 60 Hz	FAA AC 150/5345-46E
DC Voltage / Current	FAA AC 150/5345-47C
(1mV to 15-kV) / (1µA to 10A)	FAA EB 67D
Power Factor / Efficiency / Crest Factor	
(Power to 30kW)	
Resistance	
(1mΩ to 4000MΩ)	
Surge	
(Up to 10 kV / 5 kA) (Combination Wave and Ring Wave)	

On the following products and materials:
Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

[1] When the date, revision or edition of a test method standard is not identified on the scope of accreditation, the laboratory is expected to be using the current version within one year of the date of publication, per part C., Section 1 of A2LA *R101 - General Requirements - Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Unintentional Radiators Part 15B	ANSI C63.4:2014	40000
Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	40000
Intentional Radiators Part 15C	ANSI C63.10:2013	40000
Unlicensed Personal Communication Systems Devices Part 15D	ANSI C63.17:2013	40000

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
U-NII without DFS Intentional Radiators Part 15E	ANSI C63.10:2013	40000
U-NII with DFS Intentional Radiators Part 15E	FCC KDB 905462 D02 (v02)	40000
UWB Intentional Radiators Part 15F	ANSI C63.10:2013	40000
BPL Intentional Radiators Part 15G	ANSI C63.10:2013	40000
White Space Device Intentional Radiators Part 15H	ANSI C63.10:2013	40000
Commercial Mobile Services (FCC Licensed Radio Service Equipment) Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
General Mobile Radio Services (FCC Licensed Radio Service Equipment) Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment) Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Maritime and Aviation Radio Services Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
Microwave and Millimeter Bands Radio Services Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Broadcast Radio Services Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Signal Boosters Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

[2]Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (https://apps.fcc.gov/oetcf/eas/) for a listing of FCC approved laboratories.

Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 8th day of August 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.