

RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES

REPORT NUMBER: M2112041-5 V1.0

STANDARD: FCC KDB 447498 D01

**CLIENT: MINELAB ELECTRONICS
PTY LTD**

**DEVICE: TORMENTOR METAL
DETECTOR**

MODEL: X-TERRA PRO

DATE OF ISSUE: 5 JULY 2022

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, inferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.

REVISION TABLE

Version	Sec/Para Changed	Change Made	Date
0		Initial issue of document	26/06/2022
1		TCB Comments	05/07/2022



Except for the Certificate of Compliance, this document must only be reproduced in full.

CONTENTS

1	Introduction.....	5
1.1	Laboratory Overview.....	5
1.2	Test Laboratory/Accreditations.....	5
2	Device Details.....	5
3	SAR TEST EXCLUSION THRESHOLD FOR 100MHz to 6GHz and $\leq 50\text{mm}$	6
4	LIMITS for Low Power Consumer Wireless Power Transfer Application.....	8
5	MEASUREMENT METHOD	8
5.1	Table 1: Test Equipment List.....	8
5.2	Measurement Procedures	8
6	Uncertainty	8
7	MEASUREMENT RESULTS.....	9
7.1	Results	9
7.2	Bluetooth Module Results.....	9
8	Conclusion.....	9
9	Appendix A – Probe Datasheet.....	12
10	APPENDIX B – Measurement Plots	13
11	APPENDIX C – Supplied Information.....	21
12	APPENDIX D – Photos.....	22

RADIOFREQUENCY RADIATION EXPOSURE EVALUATION REPORT - MPE

Device: Tormentor Metal Detector
Model Number: X-Terra Pro
Serial Number: 73790867765 / 40866572870 (coil)

Manufacturer: Minelab Electronics Pty Ltd

Inspected for: Minelab Electronics Pty Ltd
Address: 2 Second Avenue, Mawson Lakes, SA 5095
Phone Number: 0434481762
Contact: Charles Edwards
Email: charles.edwards@codan.com.au

Standards: **447498 D01 General RF Exposure Guidance v06**
RF exposure procedures and equipment authorization policies for mobile and portable devices.

Result: Based on an assessment of the documentation provided the Tormentor Metal Detector, model X-Terra Pro complies with the RF exposure requirements of 447498 D01. Refer to Report M2112041-5 V1.0 for full details

Assessment Date: 19 April 2022

Assessment Engineers:  Deborah Olaleye  Emad Mansour

Authorised Signatory:  Emad Mansour
EMR/On-Site Project Manager
EMC Technologies Pty Ltd

Issued by: EMC Technologies Pty. Ltd.,
176 Harrick Road, Keilor Park, VIC, 3042, Australia.
Phone: +61 3 9365 1000

E-mail: emc-general@emctech.com.au

Web: www.emctech.com.au



Accreditation No.5292

Except for the Certificate of Compliance, this document must only be reproduced in full.

1 INTRODUCTION

This report is intended to demonstrate compliance of the Tormentor Metal Detector model X-Terra Pro with the RF exposure requirements of KDB 447498 D01-v06. Evaluation was performed in accordance with KDB 680106-v03 as per TCP enquiry (Tracking Number 781827)

The test sample was provided by the Client. The conclusion herein is based on the information provided by the client.

1.1 Laboratory Overview

EMC Technologies Pty. Ltd. is an independently owned Australian company that is NATA accredited to ISO 17025 for both testing and calibration and ISO 17020 for Inspection. – **Accreditation Number 5292.**

1.2 Test Laboratory/Accreditations

Inspection was performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

Table 1-1: Accreditations for Conformity Assessment

Country/Region	Body	
Australia/New Zealand	NATA	Accreditation Number: 5292
Europe	European Union	Notified Body Number: 0819
USA	FCC	Designation Number: AU0001 (Melb)
Canada	ISED Canada	Company Number: 3569B(Melb)
Japan	VCCI	Company Number: 785
Taiwan	BSMI	Lab Code SL2-IN-E-5001R

2 DEVICE DETAILS

(Information supplied by the Client)

The X-TERRA PRO is designed as a high-performance coin & treasure metal detector. The product is designed to detect metal targets buried at varying depths in the ground. The metal detector supports a low-latency wireless audio connection for use with wireless headphones.

Manufacturer: Minelab Electronics Pty Ltd
Inspected Sample: Tormentor Metal Detector
Model Number: X-Terra Pro
Serial Number: Control Unit: 73790867765
Coil: 40866572870

Transmit parameters were provided by the customer and are shown below:

Table 2-1: Transmitter Parameters

Transmitter #1	
Radio:	Bluetooth Low Energy (Nordic nRF5340)
Operating Frequency:	2400 – 2483.5 MHz
Output Power:	3 dBm
Antenna:	PCB Trace Antenna TEXAS INSTRUMENTS 2.4-GHz Inverted F Antenna (TI AP #SWRU120D)
Antenna gain:	3.3 dBi
Transmitter #2	
EUT Modulation Type:	Transceiver
Operating Frequency Range:	4kHz to 50kHz

3 SAR TEST EXCLUSION THRESHOLD FOR 100MHZ TO 6GHZ AND ≤50MM

Table1: SAR test exclusion threshold 100 MHz- 6GHz

Frequency (MHz)	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
435	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	
Frequency (MHz)	30	35	40	45	50	mm
150	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	164	192	219	246	274	
450	134	157	179	201	224	
435	98	115	131	148	164	
900	95	111	126	142	158	
1500	73	86	98	110	122	
1900	65	76	87	98	109	
2450	57	67	77	86	96	
3600	47	55	63	71	79	
5200	39	46	53	59	66	
5400	39	45	52	58	65	
5800	37	44	50	56	62	

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$\frac{\text{max. power of channel, including tune – up tolerance (mW)}}{\text{min. test separation distance (mm)}} * \sqrt{f(\text{GHz})} \leq 3.0$$

Where:

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

- The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz.

4 LIMITS FOR LOW POWER CONSUMER WIRELESS POWER TRANSFER APPLICATION

The limit as per “680106 D01 RF Exposure Wireless Charging App v03r01”

- 83 V/m for the electric field
- 90 A/m for the magnetic field.

5 MEASUREMENT METHOD

5.1 Table 1: Test Equipment List

Equipment Type	Make, Model and Serial Number	Calibration due	Calibrated by
EM Field Meter	Asset Number: P-199-1 Manufacturer: Wavecontrol Model Number: SMP2 S/N: 18WP100446/18SN0901	03/2024	Wavecontrol (Manufacturer)
E-Field/ H-Field Probe	Asset Number: P-199-2 Manufacturer: Wavecontrol Model Number: WP400* Freq: 1 Hz to 400 kHz Measurement Type: Selective/Broadband S/N: 18WP100466	03/2024	Wavecontrol (Manufacturer)

*The WP400 probe is a Realtime isotropic, 3-axis probe with 100 cm² sensor (diameter = 5.64 cm), the isotropy of this probe is 5% (0.42 dB).

The Uncertainty of the probe is 0.67 dB (Total, counting isotropy, temperature deviation, resolution, frequency response, linearity, repeatability).

Probe specification sheet attached in appendix.

5.2 Measurement Procedures

The measurements were performed at 100 Hz – 400 kHz frequency range; magnetic and electric flux measurements were taken using the WaveControl meter. The levels recorded were then compared against the limits in Section 8.

6 UNCERTAINTY

EMC Technologies has evaluated the tools and methods used to perform Radiated Electromagnetic Field predictions.

The Measurement Uncertainties for DC and ELF magnetic field measurements are derived from the manufacturer, Instruments’ stated uncertainty factors and calibration data.

Expanded Uncertainty:

Testing: DC to 400kHz ±2.3 dB

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

7 MEASUREMENT RESULTS

7.1 Results

Table 7-1: Magnetic Field Result

Survey point #	Measured Magnetic Field (A/m)	Limit (A/m)	% of General Public Limit
1	4.22	90	4.69%
2	2.70	90	3.00%
3	2.19	90	2.43%
4	3.04	90	3.37%
5	18.45	90	20.50%
6	3.64	90	4.05%
7	1.14	90	1.27%

Note: Measurement recorded in μT and converted to A/m

Table 7-2: E-Field Result

Survey point #	Measured Electric Field (V/m)	Limit (V/m)	% of General Public Limit
1	6.52	83	7.86%
2	12.67	83	15.27%
3	12.7	83	15.30%
4	2.52	83	3.04%
5	15.84	83	19.08%
6	3.03	83	3.65%
7	3.53	83	4.25%

Note 1: For survey point locations refer to appendix D

Note 2: Measurements performed at 0mm spacing (worst case)

An E-Field and H-Field Spatial Averaging measurement performed at survey point # 8, the recorded E-field was 7.24 V/m and 0.085 μT (0.68 A/m) for magnetic field.

7.2 Bluetooth Module Results

The separation distance between the Bluetooth antenna and the user at least 30mm, and the output power 3 dBm (2mW).

The standalone transmitter is exempted from SAR if the below condition satisfied in conjunction with threshold power condition in table 1

$$\frac{\text{max. power of channel, including tune – up tolerance (mW)}}{\text{min. test separation distance (mm)}} * \sqrt{f(\text{GHz})} \leq 3.0$$

Where

Minimum test separation distance (30mm):

The minimum test separation distance is determined by the smallest distance from the antenna (radiating structures) to the outer surface of the device

Maximum power of channel (mW):

Time-averaged maximum conducted output power

$$\frac{\text{max. power of channel, including tune – up tolerance (mW)}}{\text{min. test separation distance (mm)}} * \sqrt{f(\text{GHz})} = \frac{2\text{mW}}{30\text{mm}} * \sqrt{2.45 \text{ GHz}}$$
$$= 0.1 \leq 3.0$$

As the transmitted power is 3 dBm (2 mW) less than 57 mW indicated in table (1) and the result of the above condition is 0.1 (less than 3), hence this transmitter excepted from SAR evaluation

8 CONCLUSION

Based on an assessment of the documentation provided the Tormentor Metal Detector, model X-Terra Pro complies with the RF exposure requirements of 447498 D01



Accreditation No.5292



Except for the Certificate of Compliance, this document must only be reproduced in full.

9 APPENDIX A – PROBE DATASHEET

Probe data sheet



WP400_Datasheet_
EN.pdf



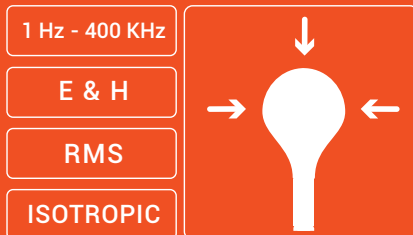
Except for the Certificate of Compliance, this document must only be reproduced in full.

WP400 Probe

1 Hz - 400 kHz



- Electric & Magnetic field measurement
- Isotropic & True RMS measurement
- Spectrum analysis probe
- Measurements in accordance with International Standards
- 100 cm² sensor



Power grid

Measurement of the exposure to EM fields at transformer stations and high-voltage lines.



Railway

Measurement of EM fields in trains and in the railway environment with respect to human exposure.



Industry

Assessment of workers' exposure to EM fields in all kind of manufacturing facilities.



Technical Specifications

	Electric Field	Magnetic Field
Sensor type	Isotropic patented electrodes	
Frequency range	1 Hz – 400 kHz	1 Hz – 400 kHz
Field Strength Mode		
Measurement range	1 V/m to 100 kV/m	50 nT – 10 mT (100 Hz - 10 kHz) · Upper range increases linearly with decreasing frequency below 100 Hz. · Upper range decreases linearly with increasing frequency above 10 kHz.
Graphical display	RMS, Axis Values, AVG, MAX, MIN, PEAK, RMS time graph	
Peak value	digital realtime	digital realtime
Resolution	< 0.4 mV/m above 8 Hz	< 0.1 nT (at 50 Hz) and < 0.05 nT above 100 Hz
Noise level	< 1 V/m (10 Hz - 400 kHz)	< 50 nT (10 Hz – 400 kHz)
Weighted Peak Method mode		
Measurement range	200 % (min)	200 % (min)
Graphical display	PEAK (%), AXIS VALUES (%), AVG (%), MAX (%), MIN (%), RMS (%), Time graph	
Standards/Limits	EU Directive 2013/35/EU, FCC/IEEE, ICNIRP, BGV B11. Easy software update to future modifications and to other limits.	



WP400_EN_1904_v2.2

WP400 Probe

1 Hz - 400 kHz



Technical Specifications

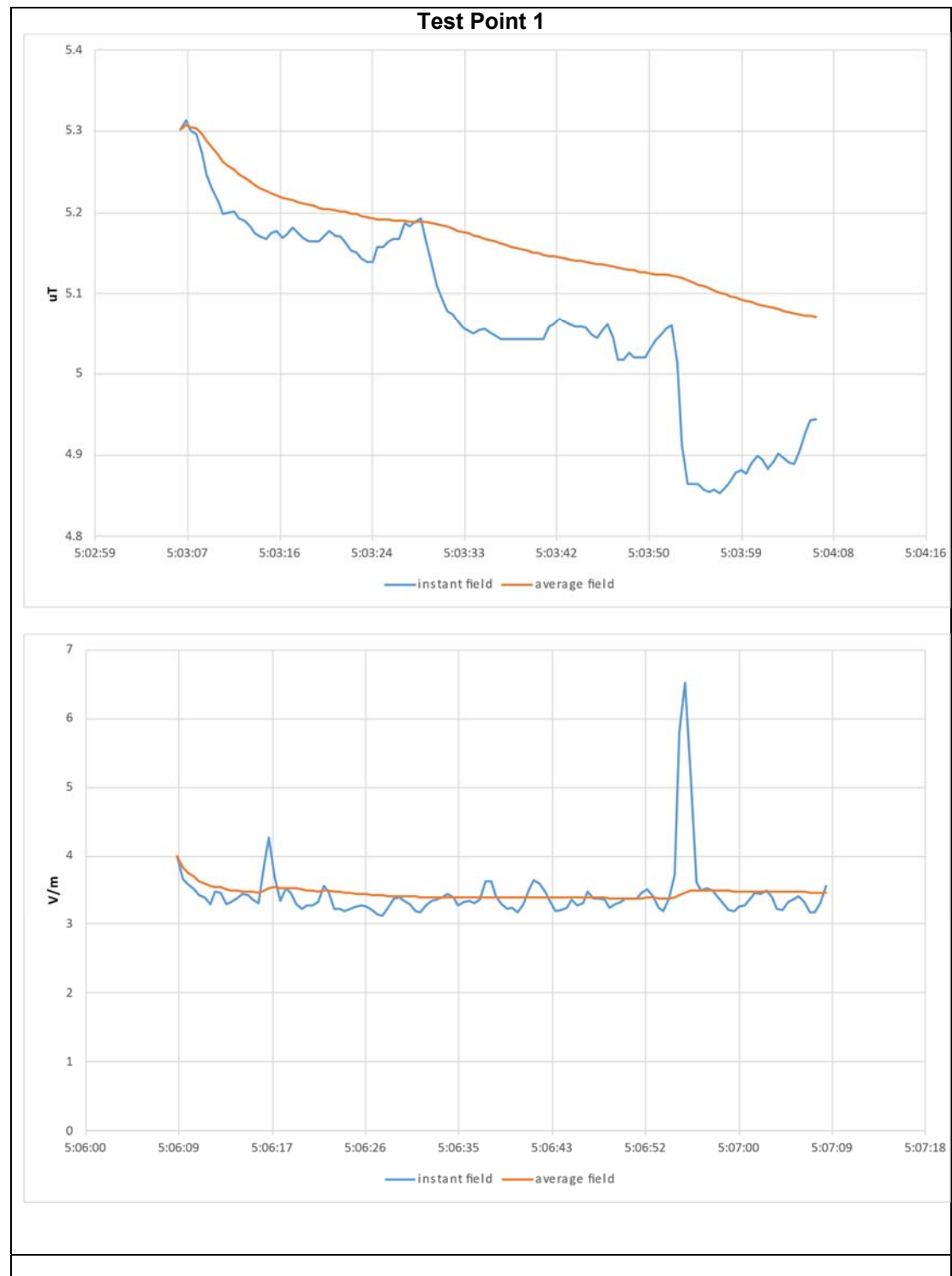
	Electric Field	Magnetic Field
FFT Mode		
Measurement range	4 mV/m – 100 kV/m	0.5 nT - 10 mT (100 Hz - 10 kHz) · Upper range increases linearly with decreasing frequency below 100 Hz. · Upper range decreases linearly with increasing frequency above 10 kHz.
Graphical display	Frequency analysis, total field and axis	
SPAN (Resolution)	400 Hz (1 Hz) - 4 kHz (10 Hz) - 40 kHz (100 Hz) - 400 kHz (1 kHz)	
Noise level	< 4 mV/m	< 0.5 nT
FFT	1024 point FFT	
General Specifications		
Isotropy	± 5 %	± 4 %
Typical Uncertainty (1)	0.67 dB	0.60 dB
Temperature deviation [typ. at 60 Hz] (referred to 25 °C, 50 % relative humidity)	- 0.005 dB/°C (- 15 °C to 40 °C)	- 0.003 dB/°C (- 15 °C to 25 °C) + 0.003 dB/°C (25 °C to 40 °C)
Damage level	> 200 kV/m	> 2000 mT up to 60 Hz Damage level decreases linearly with increasing frequency above 60 Hz
Linearity	± 1 % (typ.) ± 2 % (max.)	
Weight	220 g	
Probe size	280 mm x 128 mm Ø	

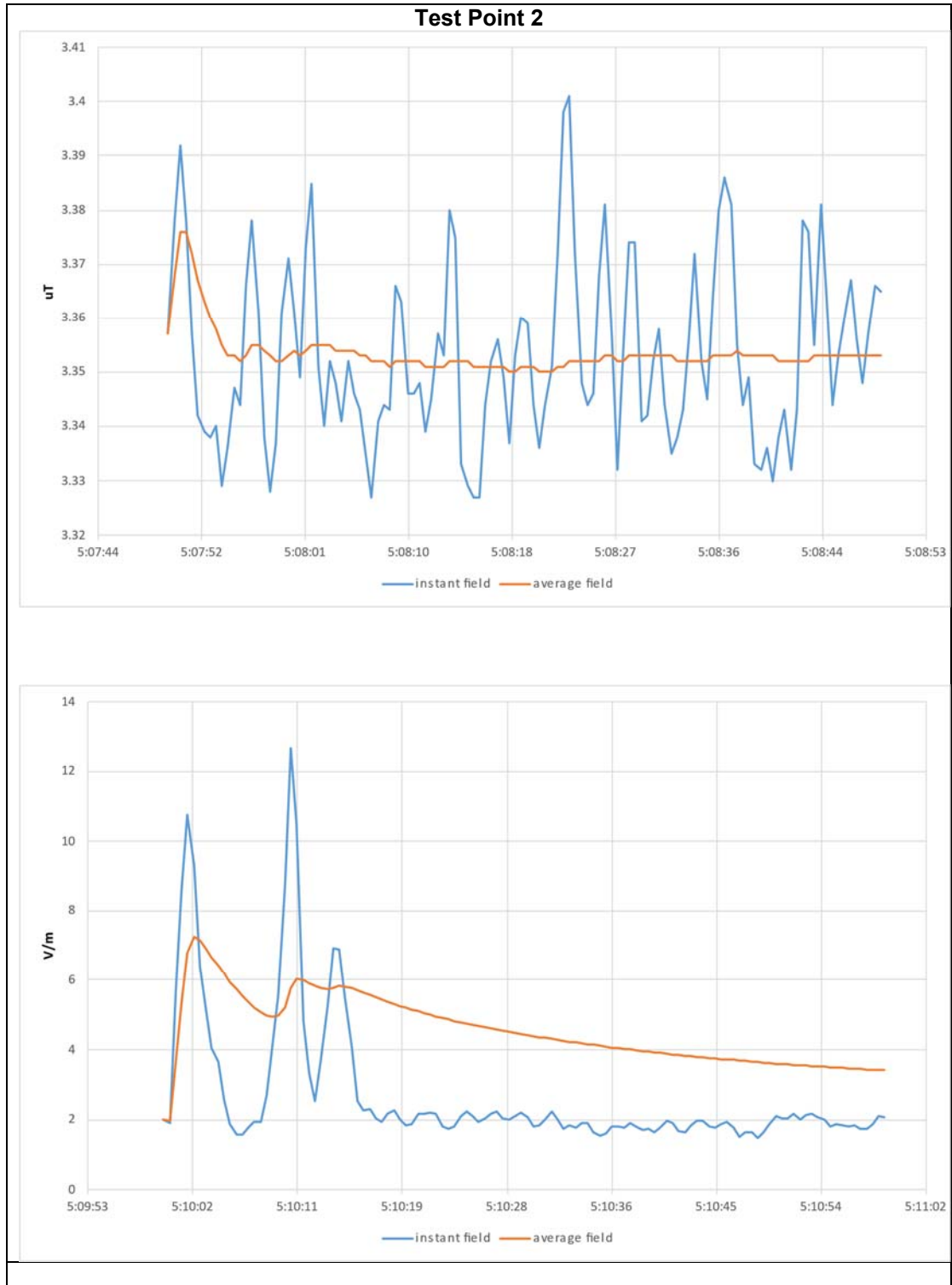
(1) Total, counting isotropy, temperature deviation, resolution, frequency response, linearity, repeatability.

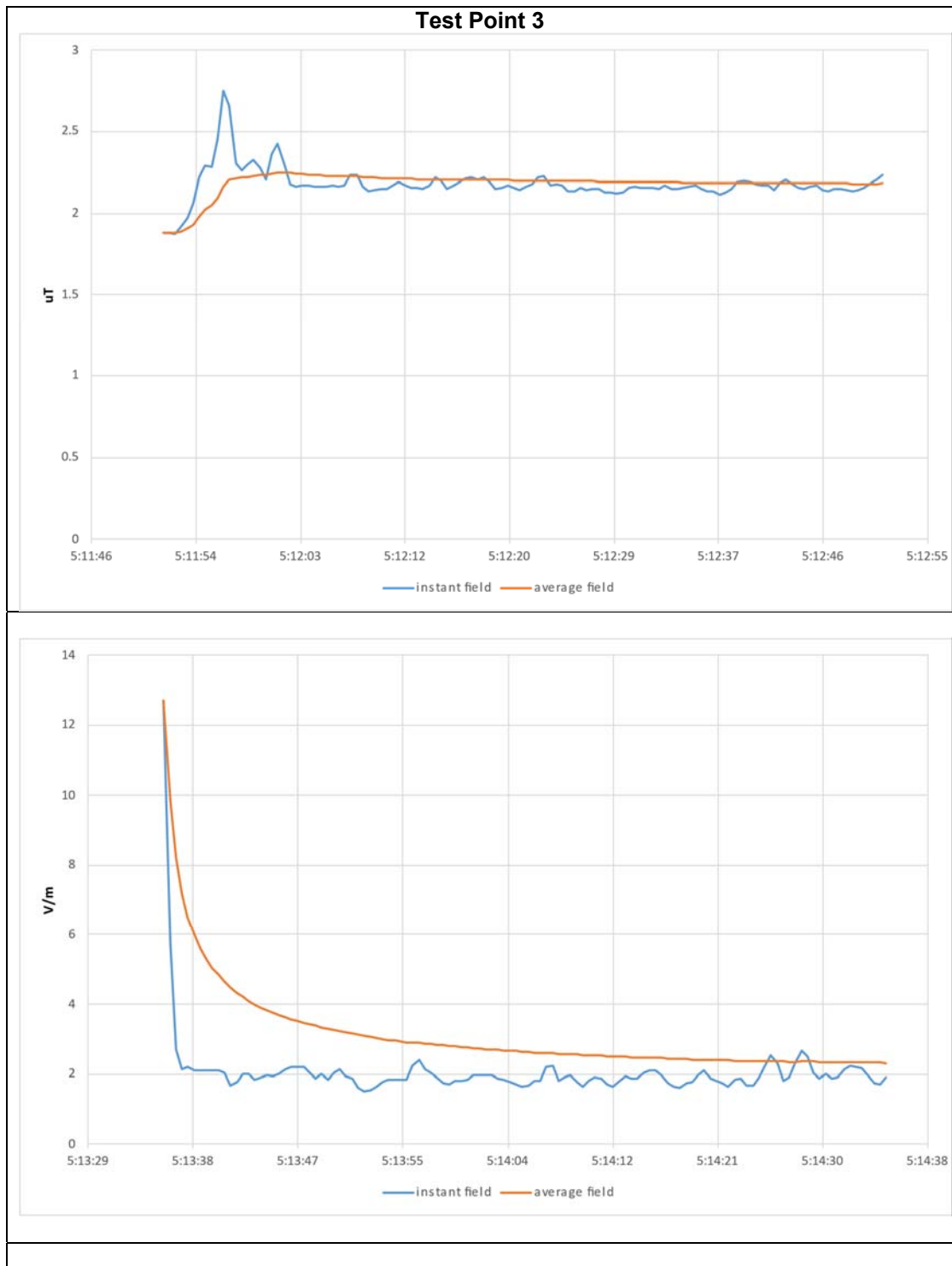


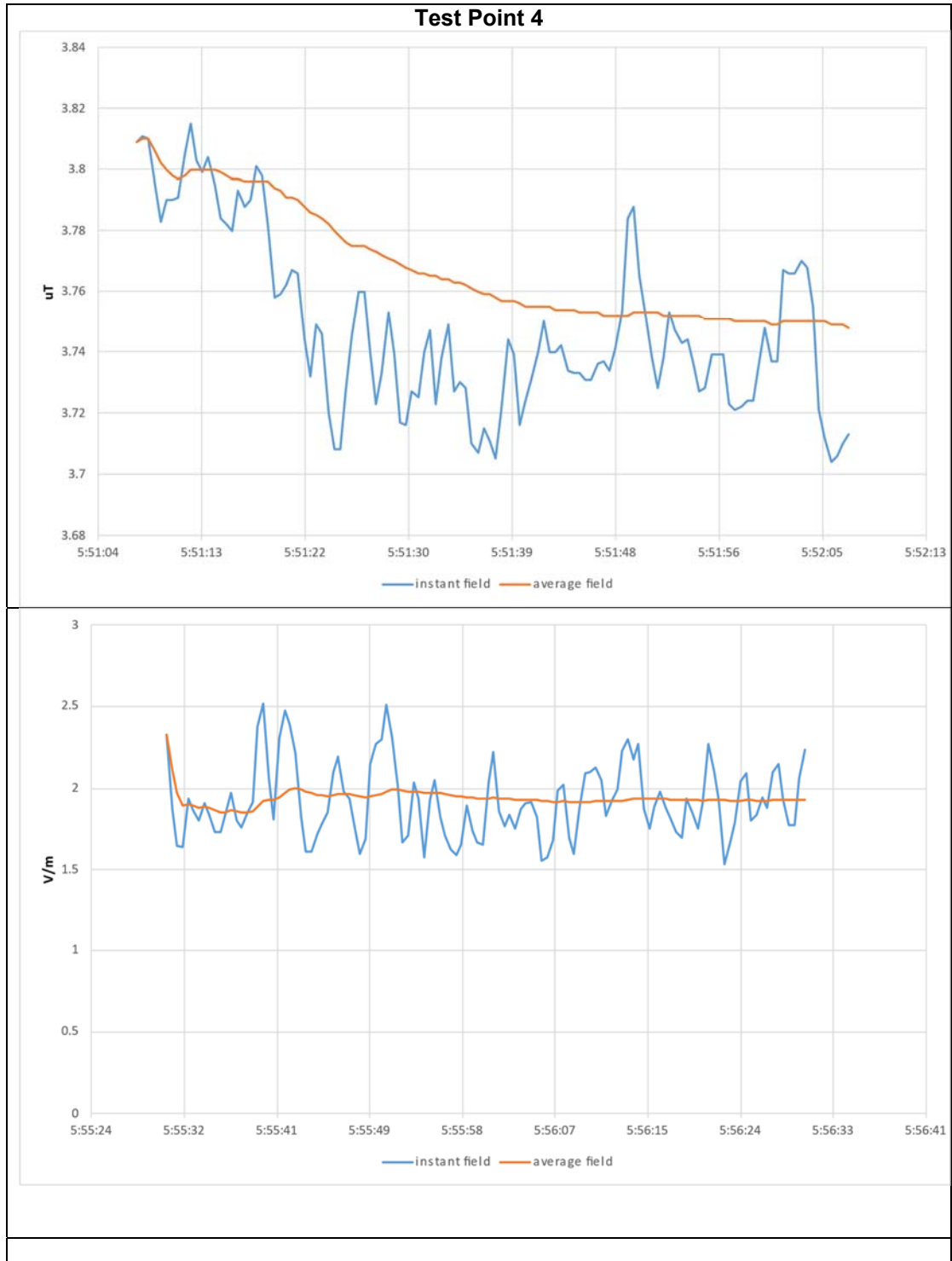
Product specifications and descriptions in this document subject to change without notice

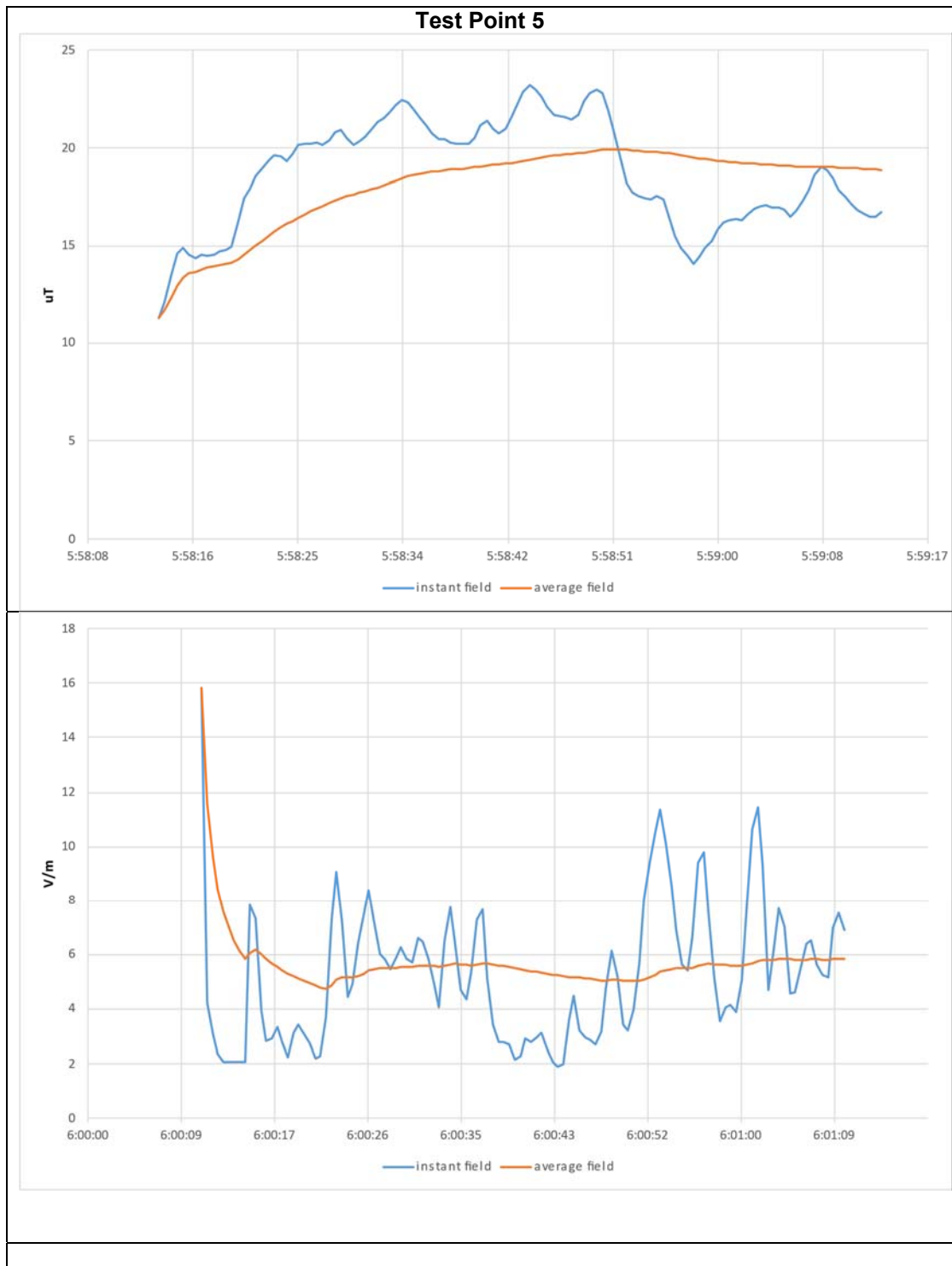
10 APPENDIX B – MEASUREMENT PLOTS



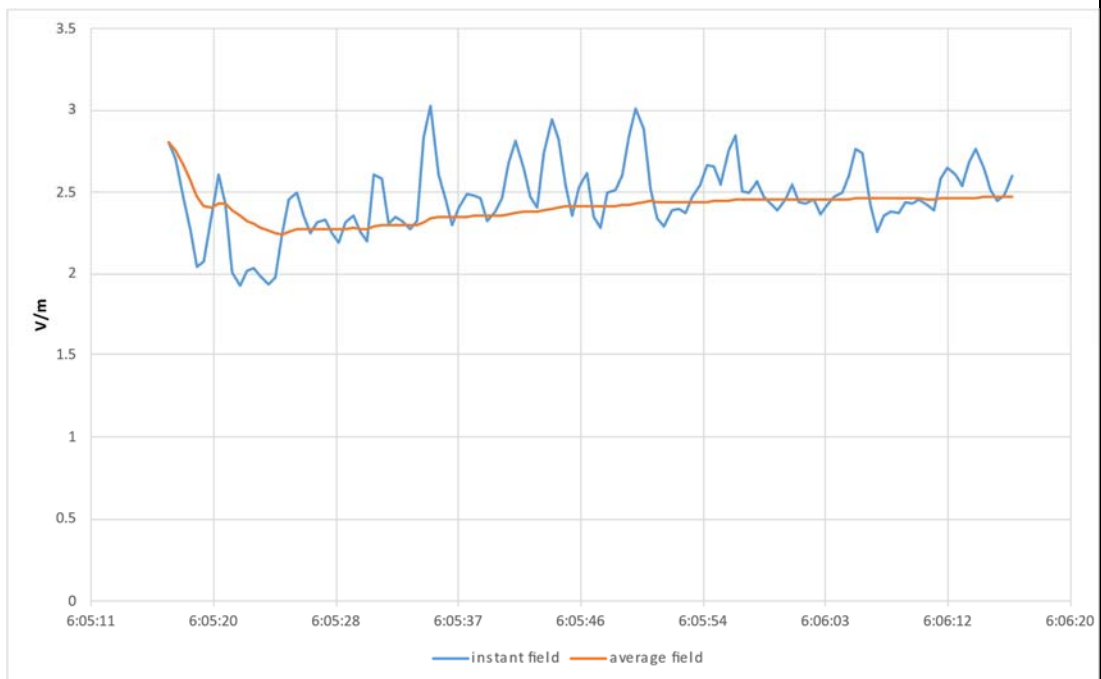
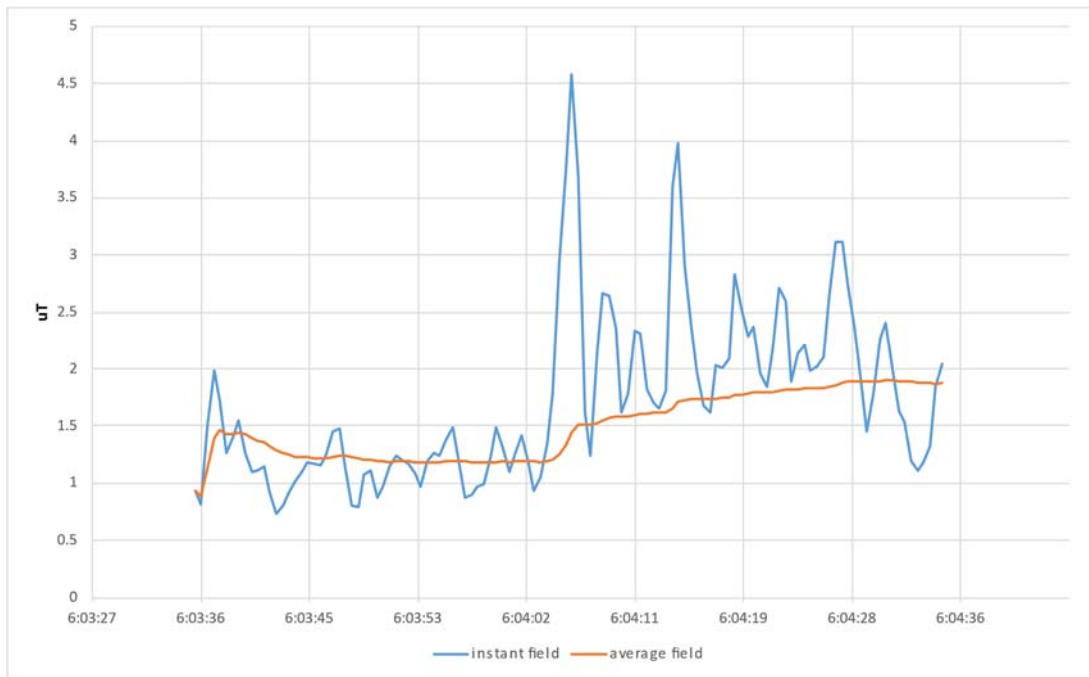




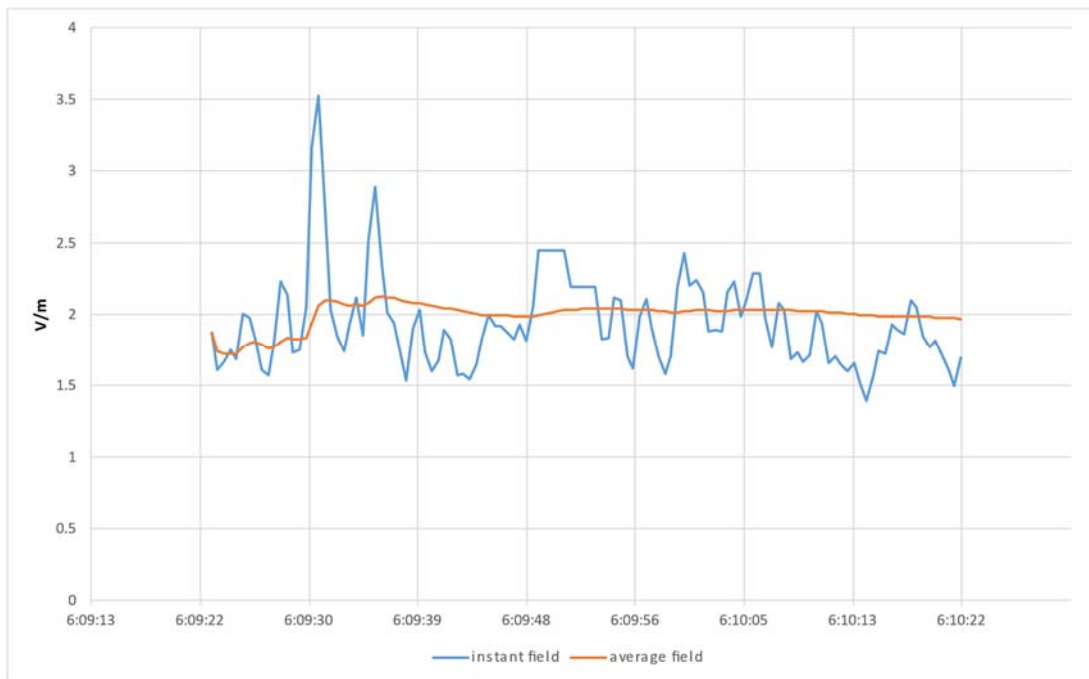
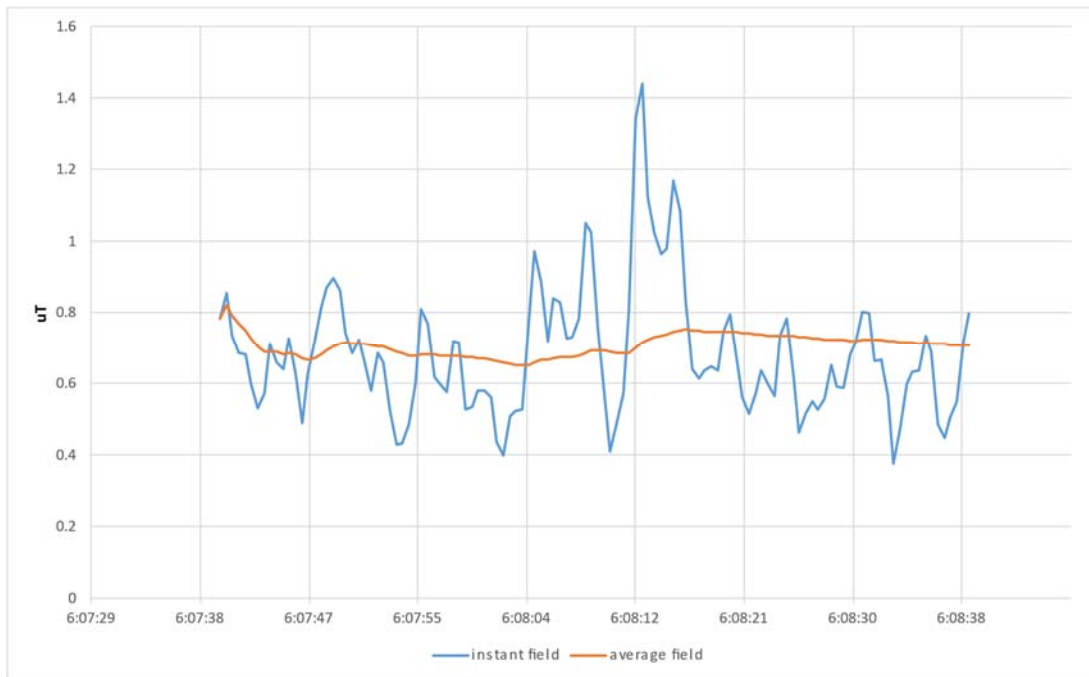


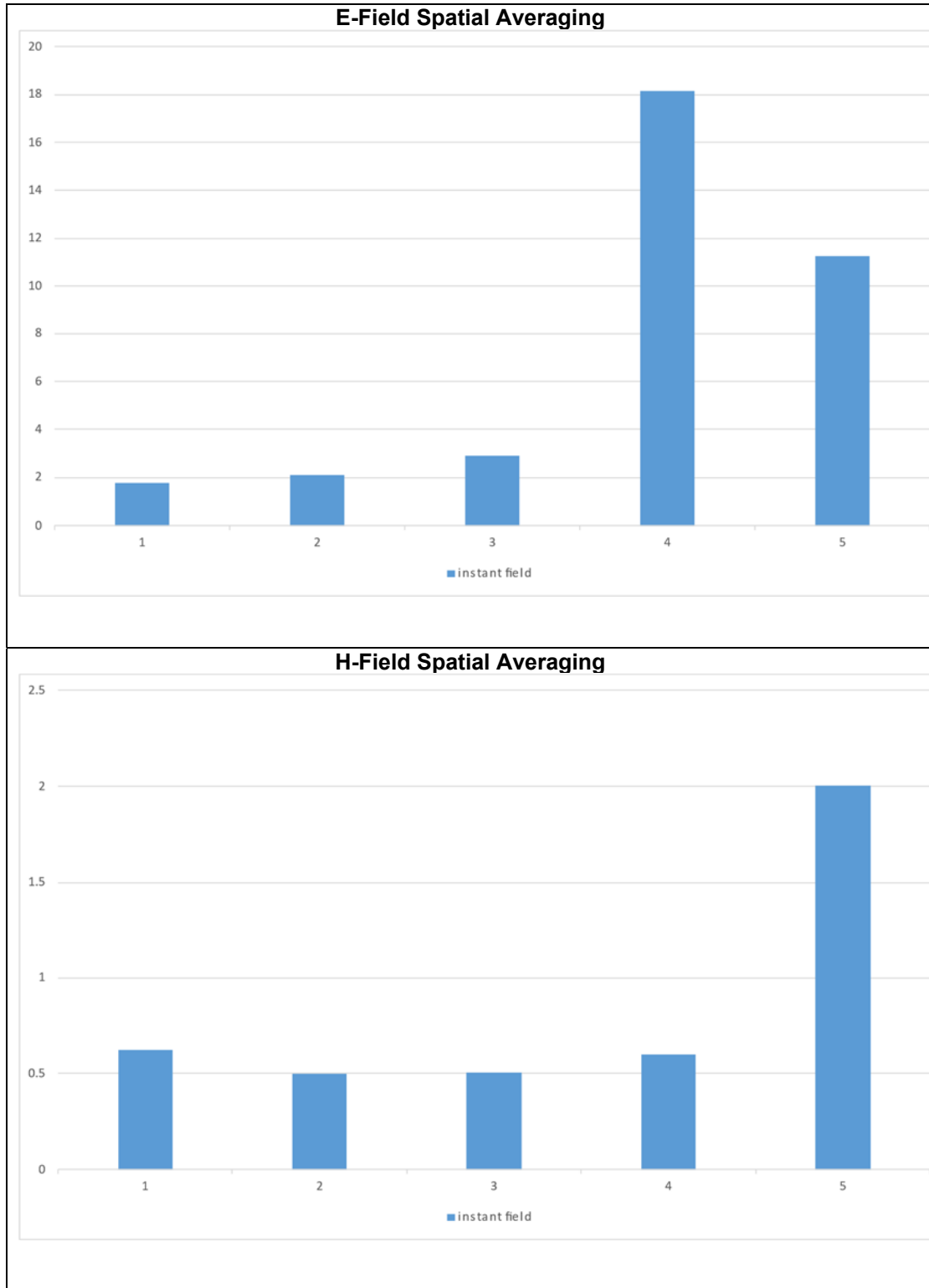


Test Point 6



Test Point 7





11 APPENDIX C – SUPPLIED INFORMATION

Referenced Documents

Document	Comments
Tormentor_Form 005 Customer and EUT Information2-20211222	EUT and Transmitter details
SWRU120D	Antenna details
nRF5340_OPS_v0.5.1	Bluetooth Chip Specification