

Test Report No.: Prüfbericht-Nr.:	US21YWD5.002 Rev.: 02 Part 3	Order No.: Auftrags-Nr.:	P00230111 234174286	Page 1 of 21 Seite 1 von 21
Client Reference No.: Kunden-Referenz-Nr.:	2229228	Order date: Auftragsdatum:	3/26/2021	
Client: Auftraggeber:	Satellite Tracking of People, LLC 5353 W Sam Houston Parkway N, Suite 190 Houston, Texas, 77041			
Test item: Prüfgegenstand:	BLUrepeater			
Identification/ Type No.: Bezeichnung / Typ-Nr.	BLUrepeater V1			
Order content: Auftrags-Inhalt:	Radio Compliance Test Report			
Test specification: Prüfgrundlage:	FCC 47 CFR Part 15.247:2021, RSS-247:2020			
Date of sample receipt: Wareneingangsdatum:	7/1/2021	See Test Setup Exhibit for Photos		
Test sample No.: Prüfmuster-Nr.:	0001, 0002			
Testing period: Prüfzeitraum:	7/6/2021- 7/13/2021			
Testing laboratory: Prüflaboratorium:	TUV Rheinland of North America 710 Resende Road, Building 199 Webster, NY 14580			
Test result*: Prüfergebnis*:	Pass			
tested by: Alexander Sowinski geprüft von:	authorized by: Richard Decker genehmigt von:			
Date: 12/8/2021 Datum:	Issue Date: 12/8/2021 Ausstellungsdatum:			
Position / Stellung:	Expert	Position / Stellung:	Expert	
Others / Sonstiges:				
Condition of the test item at delivery: Zustand des Prüfgegenstandes bei Anlieferung:		Test sample complete and undamaged		
* Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested * Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet				
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.				

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 2 of 21
Seite 2 von 21

Prüfbericht-Nr.:

Remarks
Anmerkungen

1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. <i>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i>
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3	Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report. <i>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</i>
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5	Radio Compliance Test Report. The above product was found to be Compliant to the above test standard(s).

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 3 of 21
Seite 3 von 21

Prüfbericht-Nr.:

Product description
Produktbeschreibung

1	Product details: <i>Produktdetails:</i>	BLUrepeater is a small, lightweight RF signal range extender. Designed to work with accessories to extend the LoRa/FSK signal.
2	Dimensions / Weight: <i>Maße / Gewicht:</i>	3.62 cm x 6.35 cm x 6.35 cm / 0.091 kg
3	Operating elements: <i>Bedienelemente:</i>	Battery Powered 3.7 VDC. AC Mains 85-264 VAC, 50/60Hz. Transmit band 902-928 MHz
4	Equipment / Accessories: <i>Ausstattung / Zubehör:</i>	None.
5	Used materials: <i>Verwendete Materialien:</i>	None.
6	Other: <i>Sonstiges:</i>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
7	Test sample obtaining: <i>Prüfmusterbereitstellung:</i>	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 4 of 21
Seite 4 von 21

Prüfbericht-Nr.:

Revisions

Date mm/dd/yy	Name	Page Number of Change	Describe Change
07/23/2021	Rev.:01	N/A	Original Document
12/08/2021	Rev.:02	All	Updated FCC ID, Operating Frequency Band.

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 5 of 21
Seite 5 von 21

Prüfbericht-Nr.:

TABLE OF CONTENTS

1	General Information	6
1.1	Scope	6
1.2	Purpose	6
1.3	Summary of Test Results	7
2	Laboratory Information	8
2.1	Accreditations & Endorsements	8
2.2	Test Software	8
2.3	Measurement Uncertainty	9
2.4	Calibration Traceability	10
2.5	Measurement Equipment Identification	11
3	Product Information	12
3.1	Test Plan	12
4	Transmitter Requirements	13
4.1	AC Line Conducted Emissions	13
Appendix A		17
5	Test Plan	17
5.1	General Information	17
5.2	Model(s) Name	17
5.3	Type of Product	17
5.4	Equipment Under Test (EUT) Description	18
5.5	Wireless Information	18
5.6	Testing Preparation	18
5.7	General Product Information	18
5.8	Modifications	18
5.9	EUT Electrical Power Information	19
5.10	EUT Modes of Operation during Testing	19
5.11	EUT Clock/Oscillator Frequencies	19
5.12	Electrical Support Equipment	19
5.13	Non - Electrical Support Equipment	20
5.14	EUT Equipment/Cabling Information	20
5.15	EUT Configuration	20
5.16	Block Diagram	20

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 6 of 21
Seite 6 von 21

Prüfbericht-Nr.:

1 General Information

1.1 Scope

This report is intended to document the status of conformance based on the results of testing performed on the BLUrepeater, Model Number: BLUrepeater V1, manufactured by Satellite Tracking of People, LLC. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components.

1.2 Purpose

Testing was performed to evaluate the Radio performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 7 of 21
Seite 7 von 21

Prüfbericht-Nr.:

1.3 Summary of Test Results

Applicant:	Satellite Tracking of People, LLC 5353 W Sam Houston Parkway N, Suite 190 Houston, Texas, 77041	Tel:	713-354-9393	Contact:	Mark Kirincic
		Fax:	--	e-mail:	mkirincic@securustechnologies.com
Description:	BLUrepeater	Test Voltage/Freq.:	Battery: 3.7 VDC, AC: 120VAC 60Hz		
Model Number:	BLUrepeater V1				
Serial Number:	0001, 0002	Test Engineer:	Alexander Sowinski		
Standards	Description	Severity Level or Limit		Criteria	Test Result
FCC 47 CFR Part 15.247:2021, RSS-247:2020 Radio Standard	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.	See Basic Sections Below		See Below	Complies
FCC 47 CFR Part 15.203, RSS-Gen (6.8)	Antenna Requirements	Per Standards		Report	Complies
FCC 47 CFR Part 15.247 (b.3), RSS-247 (5.4)	Transmitter Output Power	EIRP < 1 Watt (30 dBm)		Limit	Complies
FCC 47 CFR Part 15.247 (a.2), RSS-247 (5.2)	Occupied Bandwidth	6dB OBW > 500 kHz		Limit	Complies
FCC 47 CFR Part 15.247 (e), RSS-247 (5.2)	Power Spectral Density	PSD < 8dBm / 3kHz band		Limit	Complies
FCC 47 CFR Part 15.247 (d), RSS-247 (5.5)	Out of Band Emissions	< 20 dB / 100kHz band		Limit	Complies
FCC CFR 15.209, RSS-Gen (8.9)	Transmitter Spurious Emissions	Class B, 30 - 1000 MHz Class B, 1000 - 18000 MHz		Limit	Complies
FCC CFR 15.207, RSS-Gen (8.8)	AC Line Conducted Emissions	Class B, 150 kHz – 30 MHz		Limit	Complies

2 Laboratory Information

2.1 Accreditations & Endorsements

TUV Rheinland of North America located at, 710 Resende Road Webster, NY 14580 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 5253). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.1 ILAC/A2LA

This is a program which is administered under the auspices of A2LA accredited. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2017 (Certificate Number: 3331.08). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.2 VCCI

VCCI Accredited test lab. Registration numbers A-0329.

2.1.3 Industry Canada

(Registration No.: 482B-1) The 10 meter Semi-Anechoic chamber has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2014.

2.1.4 BSMI

Registration No.: SL2-IN-E-1159R. The BSMI accreditation was obtained by NIST MRA with the BSMI.

2.1.5 Korea

(Designation No.: US0192). Recognized by National Radio Research Agency (RRA) as an accredited Conformity Assessment Body (CAB) under the terms for Korea Phase I of the APEC TEL.

2.2 Test Software

- 1) CIGUI 32 Version 1.4 for California Instruments AC power source
- 2) TILE version 4.1.B
- 3) TILE 7 version 7.1.3.24
- 4) Voltech PM 6000 Firmware 1.22.07RC6, Software IEC61000-3 for PM6000 Release 1.24.12
- 5) California Instruments AC power source MXHCL
- 6) Rohde & Schwarz EMI Measurement software EMC32 version 8.54.0
- 7) TEMA 3000 version 4.1.2
- 8) TILE version 3.4.k.28

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V/m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

$$25 \text{ dBuV/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dBuV/m}$$

2.3.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	Ulab	Ucisp
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	4.57 dB	5.2 dB
Radiated Disturbance @ 3m		
1.0 GHz – 6.0 GHz	5.18 dB	5.2 dB
6.0 GHz – 18.0 GHz	5.48 dB	5.5 dB
18.0 GHz – 26.5 GHz	5.21 dB	
26.5 GHz – 40.0 GHz	4.99 dB	
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.62 dB	3.6 dB
Disturbance Power		

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 10 of 21
Seite 10 von 21

Prüfbericht-Nr.:

30 MHz – 300 MHz	3.88 dB	4.5 dB
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Measurement Uncertainty Emissions

The estimated combined standard uncertainty for radiated emissions measurements is ± 4.57 dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 1 GHz to 6 GHz is ± 5.18 dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 6 GHz to 18 GHz is ± 5.48 dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for conducted emissions measurements is ± 2.62 dB.	Per CISPR16-4-2 Method

Expanded measurement uncertainty numbers are shown in the tables above. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard ISO IEC 17025:2017. Equipment calibration records are kept on file at the test facility.

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 11 of 21
Seite 11 von 21

Prüfbericht-Nr.:

2.5 Measurement Equipment Identification

Equip.	Description	Model	Manufacturer	Page	1 of 1
				Last Date MM/DD/YYYY	Due Date MM/DD/YYYY
G1701077	SunAR JB6 Antenna	JB6	SunAR	04/30/2020	04/30/2022
G1701081	Fluke Multimeter 87 V 39760226	87 V	Fluke	04/09/2021	04/09/2022
G1701082	Temperature/Humidity/Barometer	68000-49	Control Company	02/12/2021	06/12/2023
G1701089	R&S EMI Receiver ESW44 101880	ESW44	Rohde & Schwarz	04/02/2021	04/02/2022
G1701233	EMCO Horn Antenna 3115 9812-5635	3115	EMCO	02/28/2020	03/28/2022
G1701365	EMCO Horn 3160-10 1180	3160-10	EMCO	08/11/2020	08/11/2022
G1701367	EMCO Horn 3160-09 6707	3160-09	EMCO	08/11/2020	08/11/2022
G1701385	R&S EMI Receiver ESU40 100274	ESU40	Rohde & Schwarz	02/09/2021	02/09/2022
G1701452	RF Path 30-1000MHz	RF Cable Path		05/12/2021	02/12/2023
G1701526	Tunable Notch Filter	240NFM	EAGLE	No Cal	No Cal

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 12 of 21
Seite 12 von 21

Prüfbericht-Nr.:

3 Product Information

3.1 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in appendix A of this report.

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 13 of 21
Seite 13 von 21

Prüfbericht-Nr.:

4 Transmitter Requirements

4.1 AC Line Conducted Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other nearby electronic equipment.

4.1.1 Over View of Test

Results	Complies (as tested per this report)					Date	07/08/2021	
Standard	FCC CFR 15.207, RSS-Gen (8.8)							
Product Model	BLUrepeater V1				Serial#	0001		
Configuration	See test plan for details.							
Test Set-up	Tested in shielded room, EUT placed on table. See test plans for details.							
EUT Powered By	120VAC 60Hz	Temp	24°C	Humidity	56%	Pressure	1005 mbar	
Frequency Range	150 kHz – 30 MHz							
Perf. Criteria	Class B (Below Limit)	Perf. Verification			Readings Under Limit for L1 & Neutral			
Mod. to EUT	None	Test Performed By			Alexander Sowinski			

4.1.2 Test Procedure

Conducted and emissions tests were performed using the procedures of FCC CFR 15.207, RSS-Gen (8.8) and/or ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration. Further conducted emission tests were performed per the procedures stated in the other emissions standards listed in this report.

The frequency range from 150 kHz – 30 MHz was investigated for conducted emissions.

Conducted Emissions measurements were performed in the shielded room using procedures specified in the test plan and standard.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the conducted emission test.

4.1.4 Final Test

All final conducted emissions measurements were below (in compliance) the limits.

Test report no.: US21YWD5.002 Rev.:02 Part 3

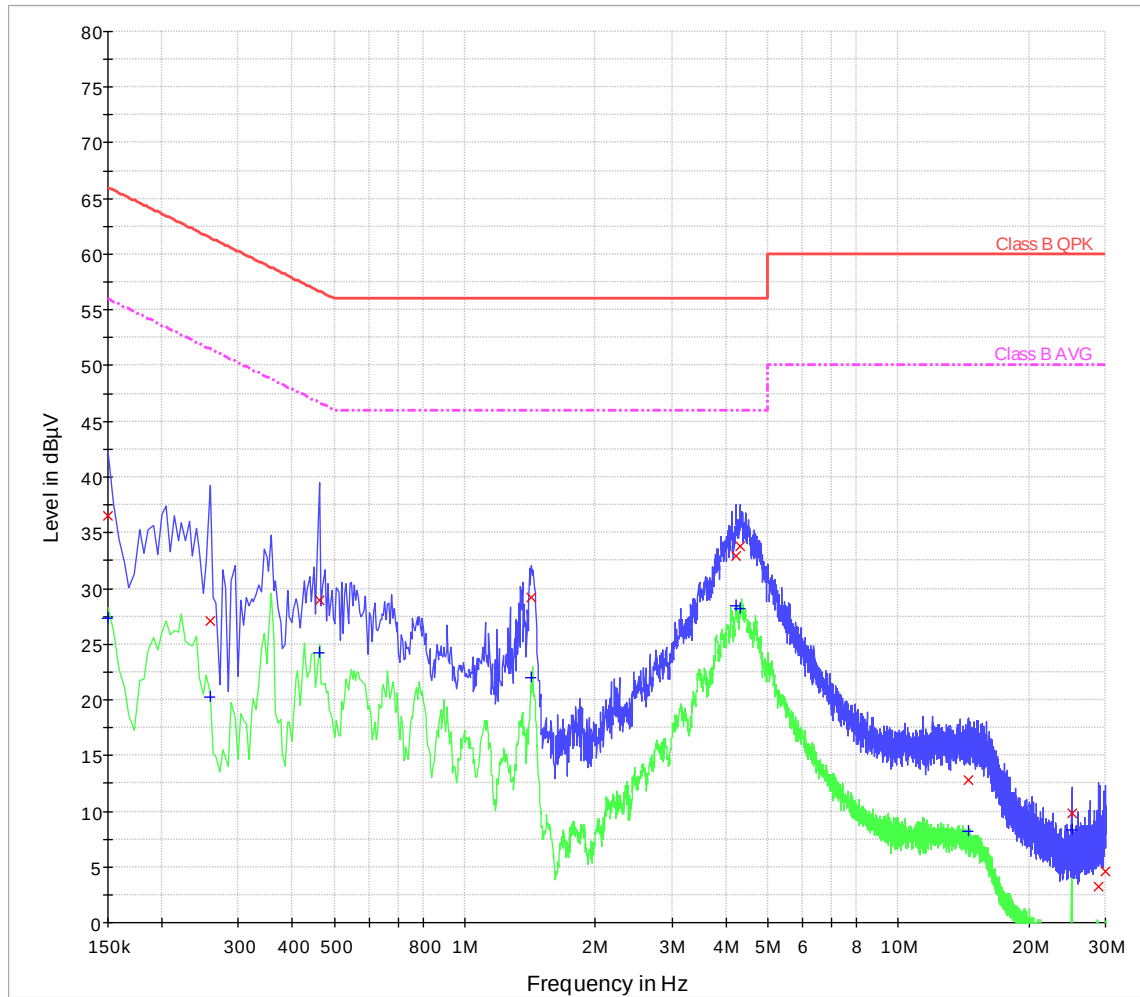
Page 14 of 21
Seite 14 von 21

Prüfbericht-Nr.:

4.1.5 Final Graphs

NOTES:

Conducted Emissions @ 120V/60Hz
Line



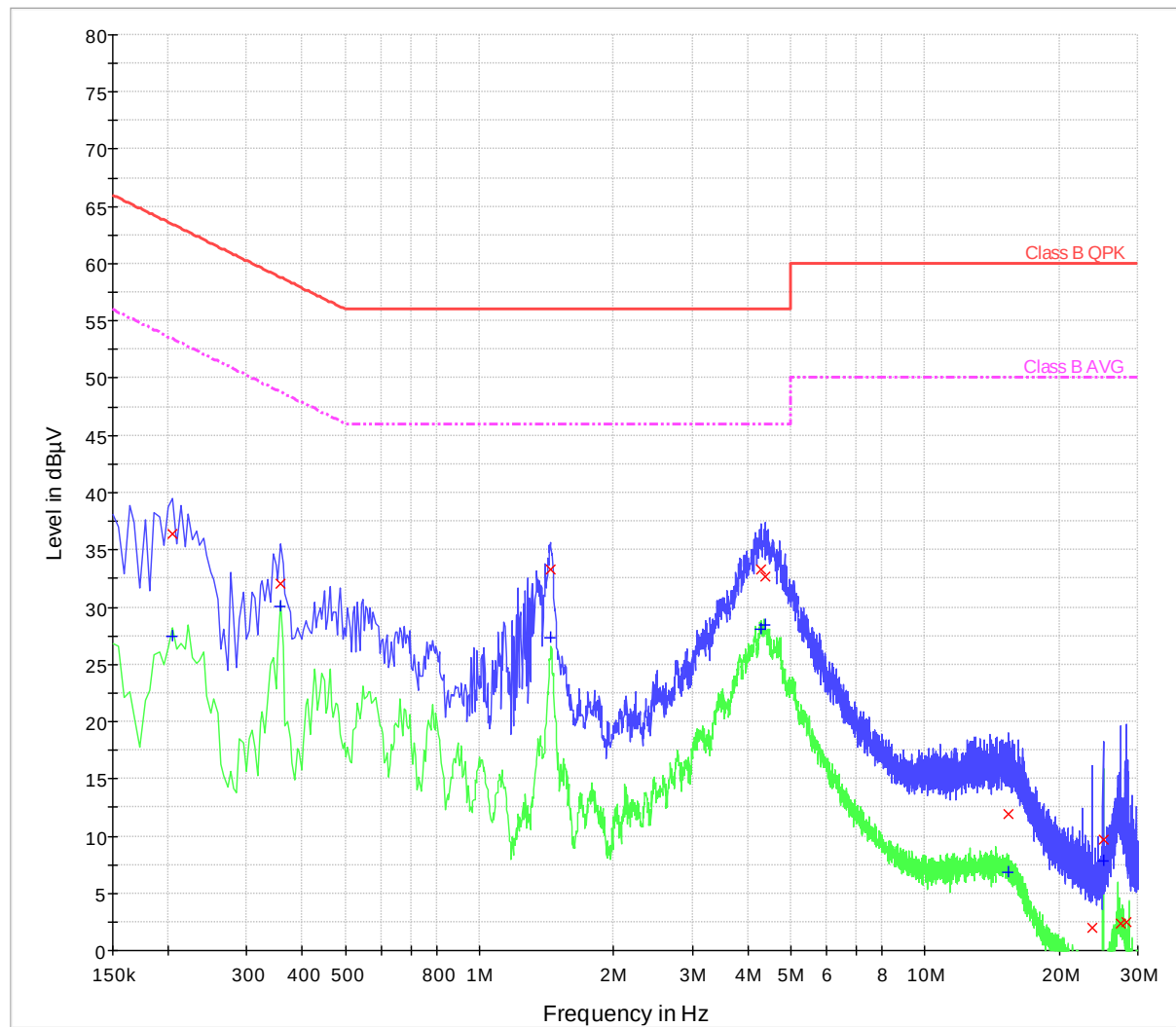
Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 15 of 21
Seite 15 von 21

Prüfbericht-Nr.:

NOTES:

**Conducted Emissions @ 120V/60Hz
Neutral**



Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 16 of 21
Seite 16 von 21

Prüfbericht-Nr.:

4.1.6 Final Tabulated Data at 120V/60Hz

Frequency MHz	QuasiPeak dBμV	Average dBμV	Line	Limit - QPK dBμV	Margin - QPK dB	Limit - AVG dBμV	Margin - AVG dB
0.1500	36.5	27.3	L1	66.0	-29.5	56.0	-28.7
0.2040	36.4	27.4	N	63.4	-27.0	53.4	-26.0
0.2580	27.1	20.2	L1	61.5	-34.4	51.5	-31.3
0.3570	32.0	30.0	N	58.8	-26.8	48.8	-18.8
0.4605	29.0	24.2	L1	56.7	-27.7	46.7	-22.5
1.4235	29.2	21.9	L1	56.0	-26.8	46.0	-24.1
1.4415	33.3	27.3	N	56.0	-22.7	46.0	-18.7
4.2225	32.9	28.5	L1	56.0	-23.1	46.0	-17.5
4.2765	33.3	28.1	N	56.0	-22.7	46.0	-17.9
4.3035	33.8	28.2	L1	56.0	-22.2	46.0	-17.8
4.3755	32.7	28.5	N	56.0	-23.3	46.0	-17.5
14.4420	12.8	8.2	L1	60.0	-47.2	50.0	-41.8
15.3735	12.0	6.9	N	60.0	-48.0	50.0	-43.1
23.7570	2.0	-2.6	N	60.0	-58.0	50.0	-52.6
25.0575	9.7	7.8	N	60.0	-50.3	50.0	-42.2
25.0575	9.9	8.3	L1	60.0	-50.1	50.0	-41.7
27.4920	2.3	-2.0	N	60.0	-57.7	50.0	-52.0
28.2165	2.5	-1.3	N	60.0	-57.5	50.0	-51.3
28.9815	3.3	-1.1	L1	60.0	-56.7	50.0	-51.1
29.9715	4.6	-0.6	L1	60.0	-55.4	50.0	-50.6

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 17 of 21
Seite 17 von 21

Prüfbericht-Nr.:

Appendix A

5 Test Plan

This test report is intended to follow the test plan outlined herein unless otherwise stated. The test plan provides product information, reference standards, and testing details. The product information below came via client, product manual, product itself and or the internet. Test procedure information will reference standards or internal TUV Rheinland NA procedures.

5.1 General Information

Client	Satellite Tracking of People, LLC
Address 1	5353 W Sam Houston Parkway N, Suite 190
Address 2	Houston, Texas, 77041
Contact Person	Mark Kirincic
Telephone	713-354-9393
Fax	--
e-mail	mkirincic@securustechnologies.com

5.2 Model(s) Name

BLUrepeater V1

5.3 Type of Product

BLUrepeater

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 18 of 21
Seite 18 von 21

Prüfbericht-Nr.:

5.4 Equipment Under Test (EUT) Description

BLUrepeater is our small, lightweight (RF) signal range extender. Designed to work with Accessories to extend the LoRa/FSK signal.

5.5 Wireless Information

EUT Specifications	
Environment:	Indoor
Operating Temperature Range °C:	-20°C - 50°C
Multiple Feeds:	No
FCC ID:	S5EBRP010321
IC ID:	9086A-BRP010321
Product Marketing Name (PMN):	BLUrepeater
Hardware Version Identification Number (HVIN):	BLUrepeater V1
Firmware Version Identification Number (FVIN):	1.0
RF Software Version:	1.0
Operating Modes:	LoRa, FSK
Transmitter Frequency Band:	903 - 927 MHz
Power @ Operating Channel (dBm):	+14 dBm
Antenna Type	Stamp metal embedded SMT
Antenna Gain (dBi)	+1.0 dBi
Modulation:	CSS, FSK
Data Rate	LoRa CSS : 23.810 kbps FSK : 21.875 kbps
TX/RX Chain (s):	Single
Type of Equipment:	LoRa/FSK signal range extender
*All EUT specifications are provided by the manufacturer or the TUV direct customer	
Note: Information supplied by the customer and can affect the validity of results	

5.6 Testing Preparation

Four units were provided by the client. One (0002) was used for radiated measurements, while the other (0001) was used for antenna port conducted measurements. The remaining units were spares.

5.7 General Product Information

Size		H	3.62 cm	W	6.35 cm	L	6.35 cm
Weight		0.091 kg		Fork-Lift Needed		No	
Notes							

5.8 Modifications

Custom software was used to place the device in assorted transmit modes for the purpose of testing. These settings would not be available to the end user.

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 19 of 21
Seite 19 von 21

Prüfbericht-Nr.:

5.9 EUT Electrical Power Information

5.9.1 Electrical Power Type

☒	AC	☐	DC	☒	Batteries	☐	Host -
-------------------------------------	----	--------------------------	----	-------------------------------------	-----------	--------------------------	--------

5.9.2 Electrical Power Information

Name	Type	Voltage		Frequency	Current	Notes
		min	max			
Internal Li-Ion Battery	DC	3.7	3.7	DC	< 1 mA	
AC Mains	AC	85	264	AC	< 1 mA	
Notes	Battery is installed in device and is not accessible to end user					

5.10 EUT Modes of Operation during Testing

The EUT can be operated in two active modes. The EUT can be operated using a standard LoRa scheme or a basic FSK scheme for the purpose of transmitting data. The transmitters cannot be operated independently of each other.

5.11 EUT Clock/Oscillator Frequencies

Please specify the maximum clock frequency used in the product – 32.768 MHz

In the table below, please specify other clock frequencies and sensitive operating frequencies in the product.

Clock Frequencies & Sensitive Frequencies
32 MHz
32.768 MHz

5.12 Electrical Support Equipment

Type	Manufacturer	Model	Connected To
Laptop	Lenovo	T470	USB Serial Connection

Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 20 of 21
Seite 20 von 21

Prüfbericht-Nr.:

5.13 Non - Electrical Support Equipment

Item	Notes
Gas	None.
Water	None.
Air	None.

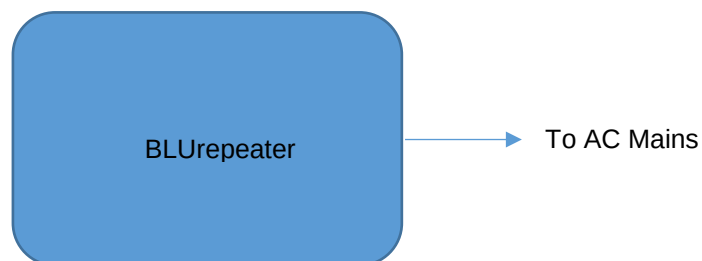
5.14 EUT Equipment/Cabling Information

EUT Port	Connected To	Location	Length	Shielded / Unshielded
None.				

5.15 EUT Configuration

Configuration	Description
Radiated	EUT is configured to transmit radiated at a desired channel
Conducted	EUT is configured to transmit along temporary SMA connection at a desired channel
Notes	All configurations are the same except as noted above

5.16 Block Diagram



Test report no.: US21YWD5.002 Rev.:02 Part 3

Page 21 of 21
Seite 21 von 21

Prüfbericht-Nr.:

--- Ende des Prüfberichts / End of Test Report ---