Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15 Subpart B: 2020, ICES-003: 2016

On

September 16th, 2020

Prepared for:

Actall Corporation
2017 Curtis St.
Denver, CO 80205 U.S.A

Prepared by:

TUV Rheinland of North America, Inc.
5015 Brandin Ct. Fremont CA 94538 USA

Revisions

Revision No.	Date	Reason for Change	Author
0	07/10/2020	Original Document	RK

Note: Latest revision report will replace all previous reports.

ATTESTATION OF TEST RESULTS

Client:	Actall Corporation 2017 Curtis St. Denver, CO 80205 USA	Isaac Devenport Tel. 303-859-5773	
Model Name:	PMT (HDT)	***Serial Number:***	N/A
Model Numbers:	PMT (HDT)	***Date(s) Tested:***	September 16, 2019
Test Location:	TUV Rheinland of North America Inc. 1279 Quarry Lane, Ste. A, Pleasanton, California 94566, U.S.A.		
Test Specifications:	Emissions:	FCC Part15 Subpart B:2020, ICES-003: 2016	
	Immunity:	N/A	
Test Result:	**The above product was found to be Compliant to the above test standard(s)**		

Prepared by: **Rachana Khanduri**	***Reviewed by:*** **Osvaldo Casorla**
07/10/2020 	07/10/2020 
Date Name Signature	***Date Name Signature***

Other aspects:	**None**

FREMONT

US1131	**Testing Cert #3331.02**	**INDUSTRY CANADA 2932D**	**1097 (A-0327)**

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the listed standards based on the results of testing performed on September 16, 2019 on the PMT (HDT) manufactured by Actall Corporation. 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. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC 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.

1.3 Summary of Test Results	
Applicant	Actall Corporation 2017 Curtis St. Denver, CO 80205 USA
Description	Personal Tracking Monitor
Model Name	PMT (HDT)
Model Number	PMT (HDT)
Serial Number	N/A
Input Power	3.0 VDC (Battery Operated)
Test Date(s)	September 16, 2019

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC Part15 Subpart B:2020, ICES-003: 2016	Radiated Emissions	Class B 30 MHz - 18 GHz	Limit	Complies
FCC Part15 Subpart B:2020, ICES-003: 2016	Conducted Emissions	Class B 150 kHz- 30 MHz	Limit	N/A, EUT is DC powered by 3.0 VDC (Battery) only.

Laboratory Information

1.4 Accreditations & Endorsements

1.4.1 US Federal Communications Commission

TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

1.4.2 A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

1.4.3 Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

1.4.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0326

VCCI Registration No. for Fremont: A-0327

1.5 Test Facilities and EMC Software

Test facilities are located at 1279 Quarry Lane, Ste. A, Pleasanton, California 94566, U.S.A. and 5015 Brandin Ct. Fremont CA 94538 USA (Fremont is the Pleasanton Annex).

1.5.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

1.5.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 3.7 m x 3.175 mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 10m semi-anechoic chamber with absorber added to floor.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9 m x 3.7 m x 3.175 mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

1.5.3 EMC Software - Fremont

Manufacturer	Name	Version	Test Type
Rohde & Schwarz	EMC32	10.50.00	Radiated & Conducted Emissions
EMISoft	Vasona	5.0	Radiated & Conducted Emissions
ETS-Lindgren	TILE	4.2.A	Radiated Emissions > 1 GHz
ETS-Lindgren	TILE	V.3.4.K.22	Radiated & Conducted Immunity
Haefely	WinFEAT	1.6.3	Surge
Thermo Electron - Keytek	CEWare32	3.0	EFT/Surge/Voltage Dips & Interrupt
Voltech	IEC61000-3	1.15.07RC	Harmonic & Flicker

1.5.4 EMC Software - Pleasanton

Manufacturer	Name	Version	Test Type
Rohde & Schwarz	EMC32	10.50.00	Radiated & Conducted Emissions
ETS-Lindgren	TILE	3.4.K.14 @ 4.0.A.5	Radiated & Conducted Emissions
EMISoft	Vasona	5.0	Radiated & Conducted Emissions
Agilent	Agilent MXE	A.11.02	Radiated & Conducted Emissions
ETS-Lindgren	TILE	3.4.K.14	Radiated & Conducted Immunity
Thermo Electron - Keytek	CEWare32	4.00	EFT/Surge/Voltage Dips & Interrupt
Voltech	IEC61000-3	1.21.07RC2	Harmonic & Flicker

1.6 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 measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

1.6.1 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:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

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

Sample radiated emissions calculation @ 30 MHz

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

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

1.6.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.	Per CISPR 16-4-2

1.6.3 Measurement Uncertainty Immunity

The estimated expanded uncertainty for ESD immunity measurements is ± 8.2%.	Per IEC 61000-4-2
The estimated expanded uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated expanded uncertainty for EFT fast transient immunity measurements is ± 5.84%.	Per IEC 61000-4-4
The estimated expanded uncertainty for surge immunity measurements is ± 5.84 %.	Per IEC 61000-4-4
The estimated expanded uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated expanded uncertainty for power frequency magnetic field immunity is ± 11.6%.	Per IEC 61000-4-8
The estimated expanded uncertainty for voltage variation and interruption measurements is ± 3.48%.	Per IEC 61000-4-11

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

1.7 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 17025:2017. Equipment calibration records are kept on file at the test facility.

1.8 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
EMI Receiver	Rohde & Schwarz	ESW44	101663-dv	07/18/2019	07/18/2021
Preamplifier, 9 kHz – 1 GHz	Sonoma	310N	213221	01/16/2019	01/16/2021
Bilog Antenna	Sunol Sciences	JB3	A061907	12/19/2018	12/19/2020
Amplifier	Miteq	TTA1800-30-HG	1842452	01/16/2019	01/16/2021
Horn Antenna	Sunol Sciences	DRH-118	A040806	03/05/2019	03/05/2021
Amplifier	HP	8449B	3008A01013	01/16/2019	01/16/2021

Note: CE=Conducted Emissions, CI=Conducted Immunity, DP=Disturbance Power, EFT=Electrical Fast Transients, ESD=Electrostatic Discharge, FLI=Flicker, HAR=Harmonics, MF=Magnetic Field Immunity, NCR=No Calibration Required, RE=Radiated Emissions, RI=Radiated Immunity, SI=Surge Immunity, VDSI=Voltage Dips and Short Interruptions

2 Product Information

2.1 Product Description

See Section 4.

2.2 Equipment Modifications

No modifications were needed to bring product into compliance.

2.3 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.

2.4 EUT External Photos

Figure 1 - External Photo (Top)

Figure 2- External Photo (Bottom)

Figure 3 - External Photo (Side 1)

Figure 4- External Photo (Side 2)

3 Emissions

3.1 Radiated Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

3.1.1 Overview of Test

Results	**Compliant** (as tested per this report)			**Test Date(s)**		September 16, 2019	
Standard	FCC Part15 Subpart B:2020, ICES-003: 2016						
Model Number	PMT (HDT)			**Serial #**	N/A		
Configuration	Unintentional Radiated Emissions - see test plan for details.						
Test Setup	Tested in the 5-meter Semi-Anechoic chamber, placed on table: see test plan for details.						
EUT Powered By	3.0 VDC						
Environmental Conditions	September 16, 2019	**Temp**	21.1º C	**Humidity**	38.8%	**Pressure**	1017 mbar
Frequency Range	30 MHz to 18 GHz						
Perf. Criteria	Class B		**Perf. Verification**		Readings under limit		
Mod. to EUT	None		**Test Performed By**		Donald Foster		

3.1.2 Test Procedure

Unintentional Radiated emissions tests were performed using the procedures of ANSI C63.4:2014 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 MHz to 18 GHz was investigated for radiated emissions.

3.1.3 Deviations

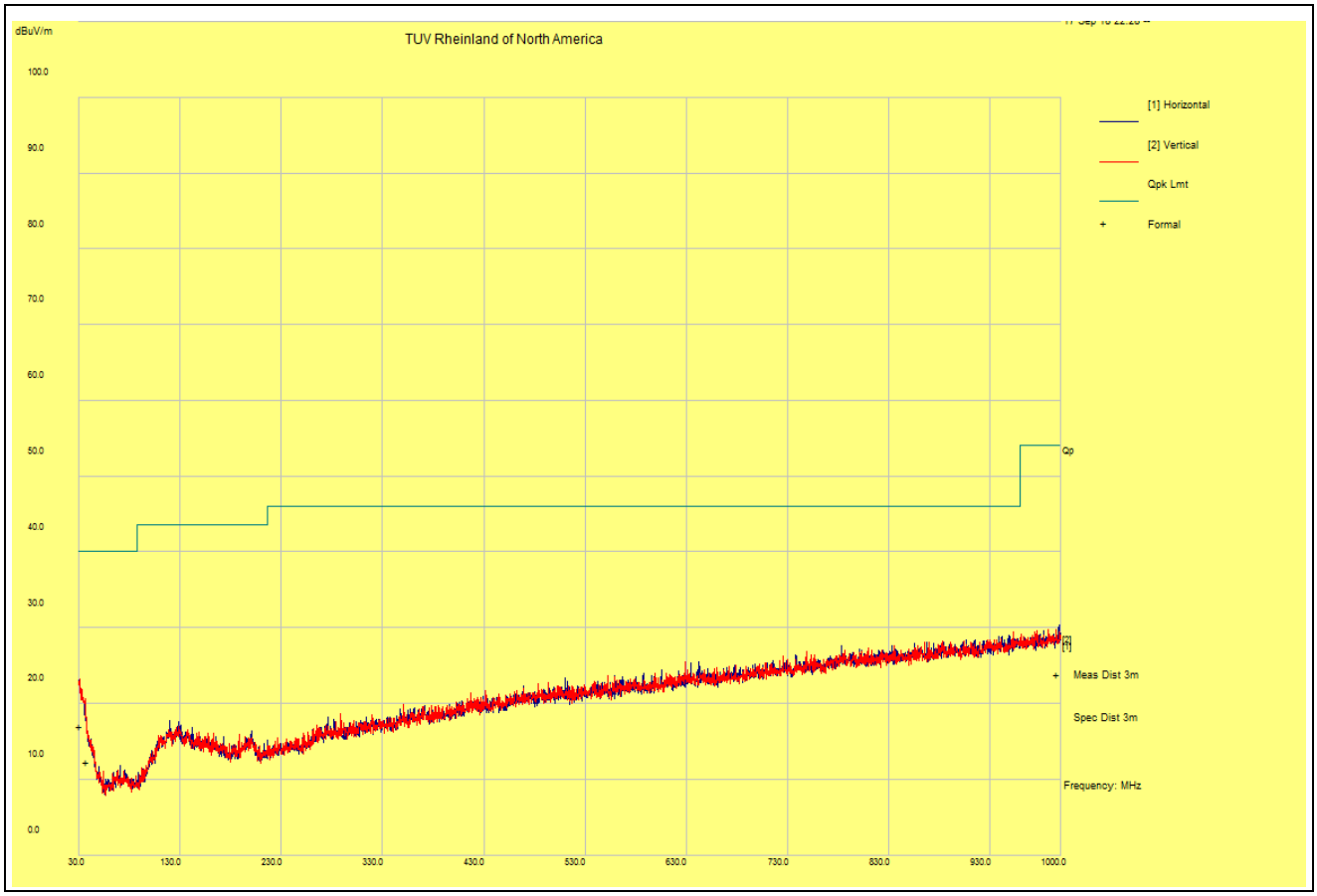
There were no deviations from the test methodology listed in the test plan for the radiated emission test.

3.1.4 Final Test

All final radiated emissions measurements were below the specification limits.

3.1.5 Plots

NOTES:	**Radiated Emissions Full Scan** **30 MHz – 1000 MHz** **Vertical / Horizontal**



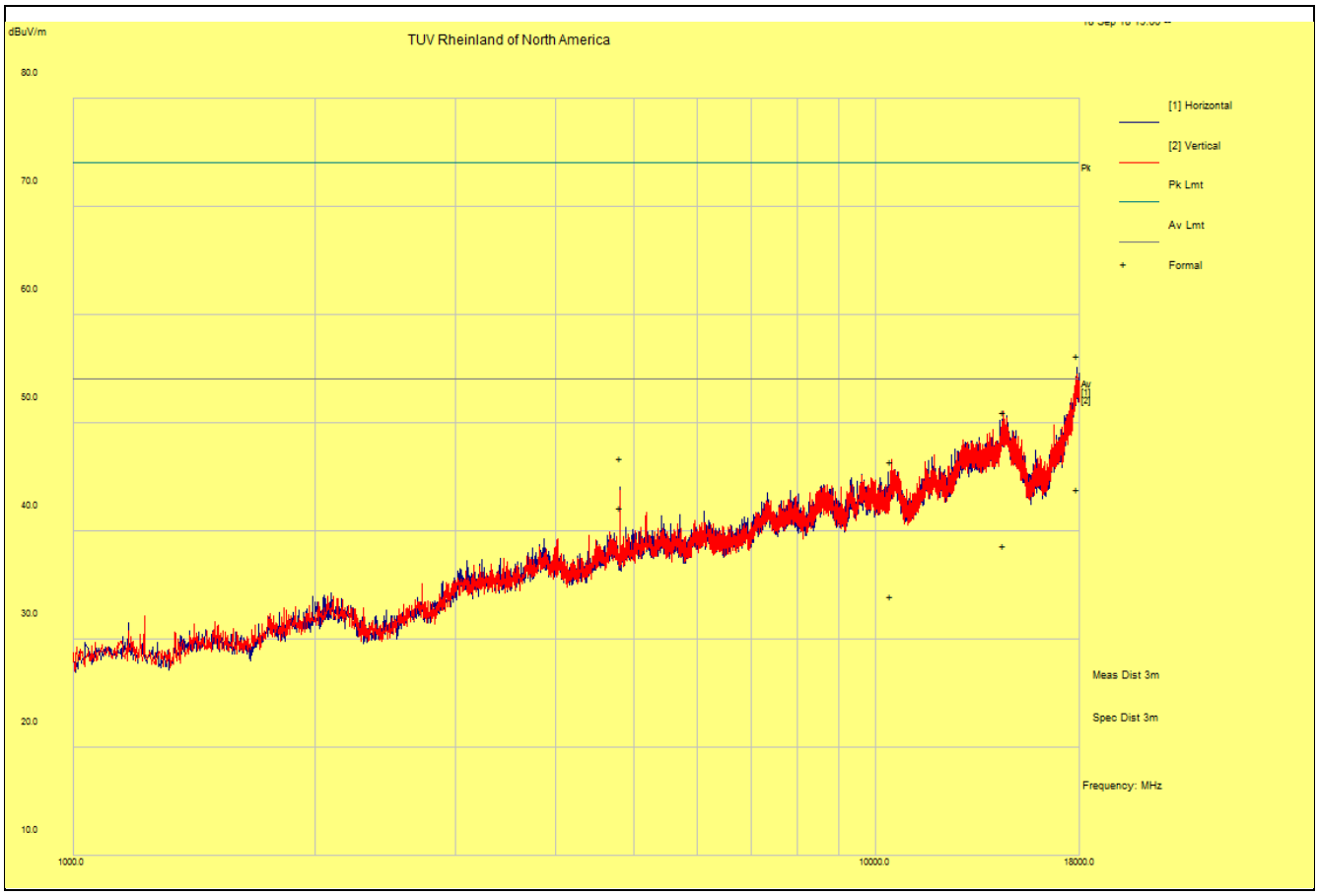
3.1.6 Final Tabulated Data

30 MHz – 1000 MHz

Frequency (MHz)	Raw (dBµV/m)	Cable Loss (dB)	AF (dB)	Level (dBµV/m)	Detector	Polarity (H/V)	Height (cm)	Azimuth (deg)	Limit (dBµV/m)	Margin (dB)	Result
37.91	22.40	2.54	-12.60	12.34	QP	H	220	16	40.00	-27.66	Pass
996.86	21.16	5.14	-2.49	23.82	QP	H	215	8	54.00	-30.18	Pass
31.66	22.05	2.49	-7.51	17.03	QP	V	384	172	40.00	-22.97	Pass

NOTES:

Radiated Emissions Full Scan
1000 MHz – 18,000 MHz
Vertical / Horizontal



3.1.1 Final Tabulated Data

1000 MHz – 18,000 MHz

Frequency (MHz)	Raw (dBµV/m)	Cable Loss (dB)	AF (dB)	Level (dBµV/m)	Detector	Polarity (H/V)	Height (cm)	Azimuth (deg)	Limit (dBµV/m)	Margin (dB)	Result
4811.62	44.91	2.12	-0.36	46.67	Peak Max	H	201	98	74.00	-27.33	Pass
4811.62	40.36	2.12	-0.36	42.12	Average Max	H	201	98	54.00	-11.88	Pass
17851.97	36.97	4.23	14.95	56.15	Peak Max	H	195	144	74.00	-17.85	Pass
17851.97	24.72	4.23	14.95	43.90	Average Max	H	195	144	54.00	-10.10	Pass
10472.81	36.53	3.22	6.62	46.37	Peak Max	V	155	236	74.00	-27.63	Pass
10472.81	24.06	3.22	6.62	33.90	Average Max	V	155	236	54.00	-20.10	Pass
14458.03	35.83	3.79	11.32	50.94	Peak Max	V	117	106	74.00	-23.06	Pass
14458.03	23.57	3.79	11.32	38.68	Average Max	V	117	106	54.00	-15.32	Pass

3.1.2 Photos

Figure 5 - Radiated Emissions Test Setup 30 - 1000 MHz – Front

Figure 6 - Radiated Emissions Test Setup 30 - 1000 MHz – Back

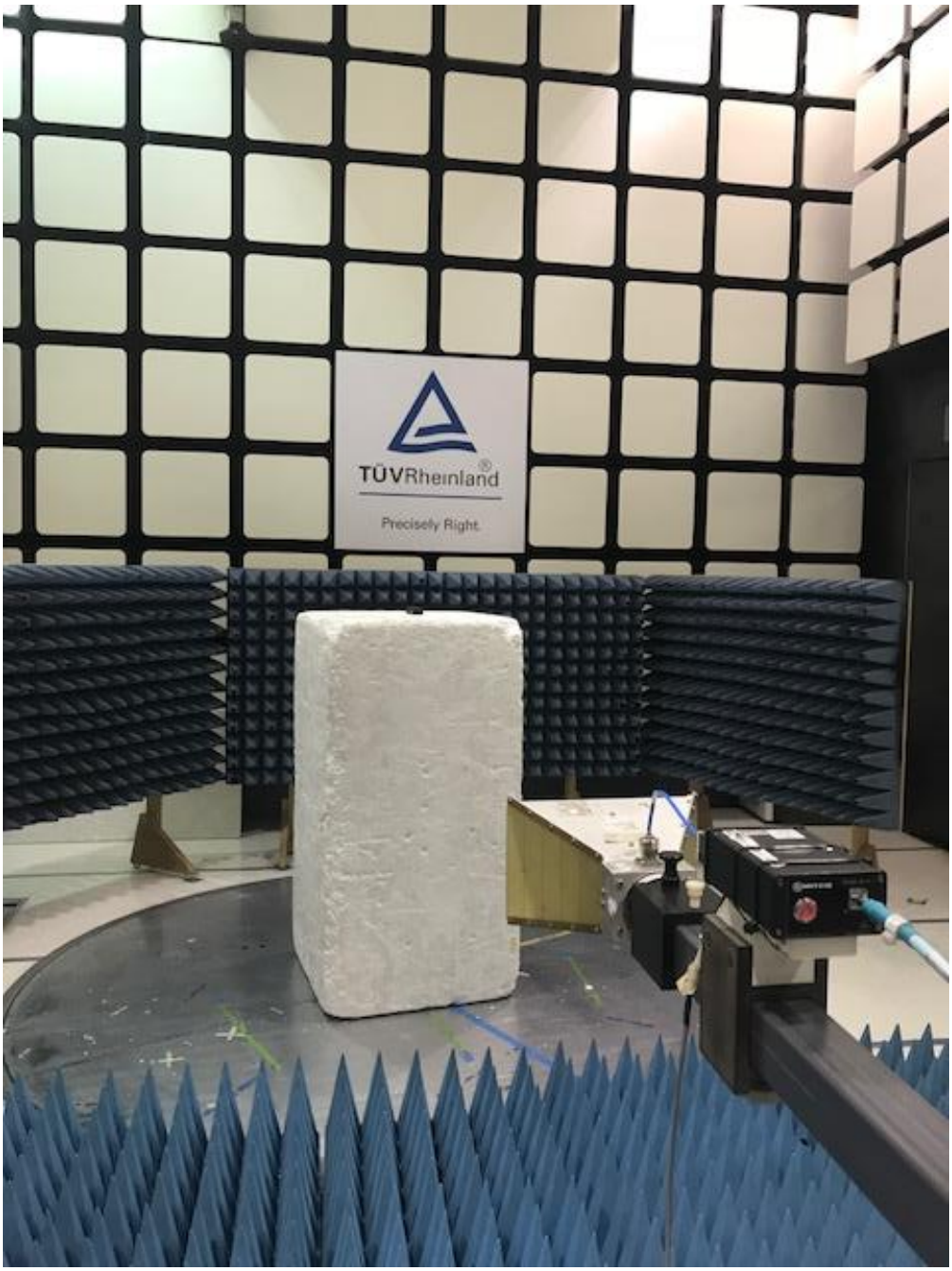


Figure 7 - Radiated Emissions Test Setup 1000 - 18000 MHz – Front

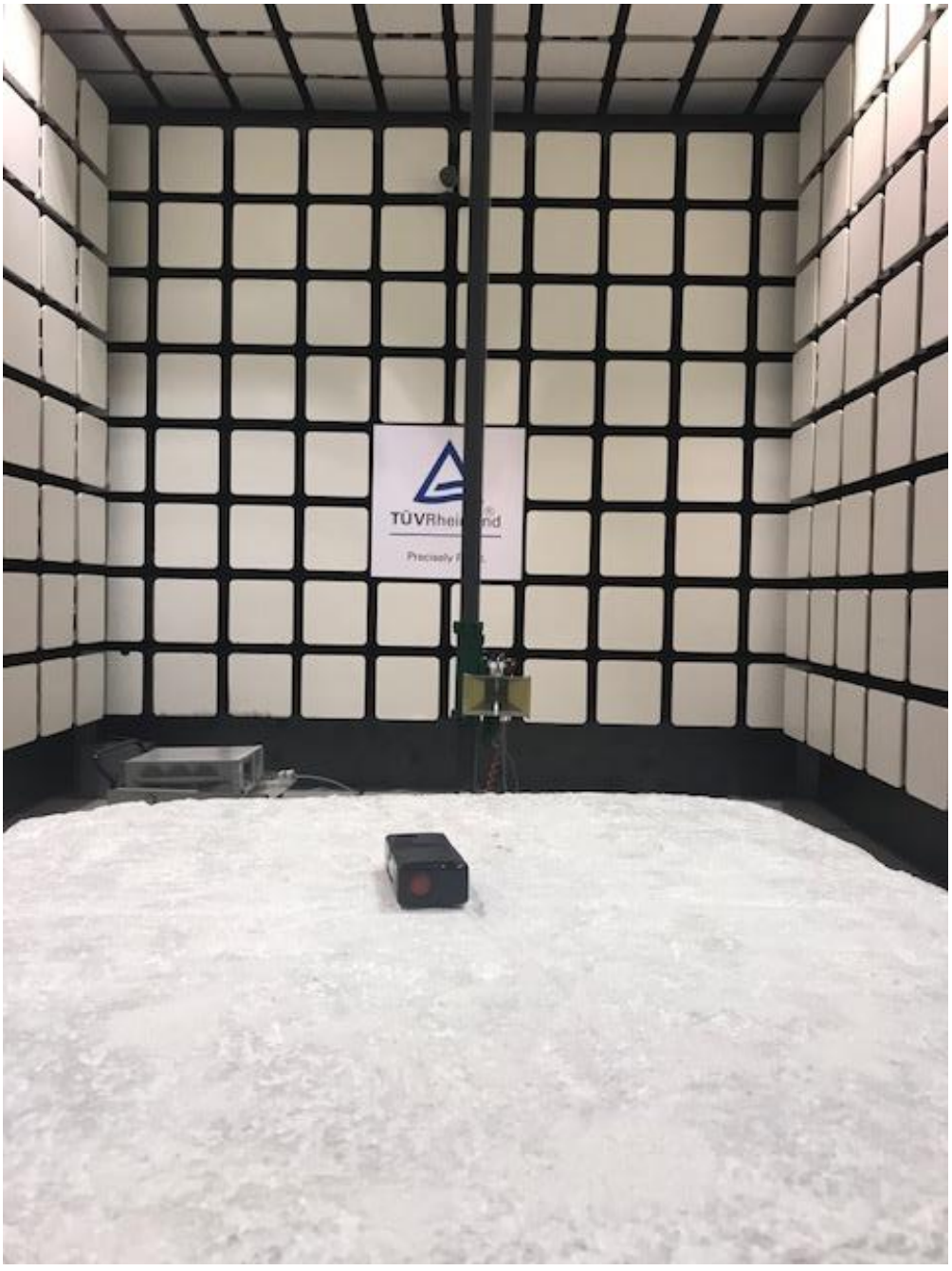


Figure 8 - Radiated Emissions Test Setup 1000 - 18000 MHz – Rear

Appendix A

4 Test Plan

This test report is intended to follow this test plan outlined here in unless otherwise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

4.1 General Information

Client	Actall Corporation
Address	2017 Curtis St.
	Denver CO 80205 USA

4.2 EUT Designation

Model Name	PMT (HDT)
Model Number(s)	PMT (HDT)

4.3 EUT Description

Configuration	Description
1	Personal Tracking Monitor
Notes	

4.4 Equipment Under Test (EUT) Description

The test subject is a personal monitoring tag. It runs in a closed system transmitting as an FHSS at 2400MHz band and also employs a 900MHz. LoRa radio.

4.5 Product Environment(s)

☒	**Domestic/Residential**	☐	**Hospital**
☐	**Light Industrial/Commercial**	☐	**Small Clinic**
☐	**Industrial**	☐	**Doctor's office**
☐	**Telecommunications Center**	☐	**Other than Telecommunications Center**
☐	**Other**		

*Check all that apply

4.6 Applicable Documents

Standards	Description
FCC Part15 Subpart B:2020, ICES-003: 2016	Radiated Emissions

4.7 EUT Electrical Power Information

Name	# of Phases	Type	Input Voltage		AC Voltage Frequency	Current Max.	Power
			Min	Max			
Battery	1 ☐ 3 ☐ None ☒	AC ☐ DC ☐ Host ☐ Batteries ☒	3.0VDC	3.0VDC	-	-	-
Notes	-						

4.8 EUT Clock/Oscillator Frequencies

Reference Designation	Speed (MHz)	Type
FHSS	2400	☐ Oscillator ☒ Transmitter
ISM	900	☐ Oscillator ☒ Transmitter

4.8.1 Radiated Emissions, Upper Frequency

☐	**Less than 108 MHz**	**Scan to 1 GHz**
☐	**Less than 500 MHz**	**Scan to 2 GHz**
☐	**Less than 1000 MHz**	**Scan to 5 GHz**
☒	**Greater than 1000 MHz**	**Scan to 5th Harmonic or 40 GHz (whichever is lower)**

4.9 Electrical Support Equipment

Reference Designation	Manufacturer	Model	Serial Number	BSMI #
N/A	N/A	N/A	N/A	N/A

4.10 Non - Electrical Support Equipment N/A

Reference Designation	Manufacturer	Model	Serial Number or Description (e.g., Type of Gas or Liquid)
N/A	N/A	N/A	N/A

4.11 EUT Equipment/Cabling Information N/A

EUT Port	Connected To	Cable Type				
		Length (Meters)	Shielded Yes / No		Bead Yes / No	
N/A	-	-	☐	☐	☐	☐

4.12 EUT Test Program

N/A

4.13 Monitoring of EUT during Testing

Once the device is activated, can check its status lights (LED).

4.14 EUT Configuration

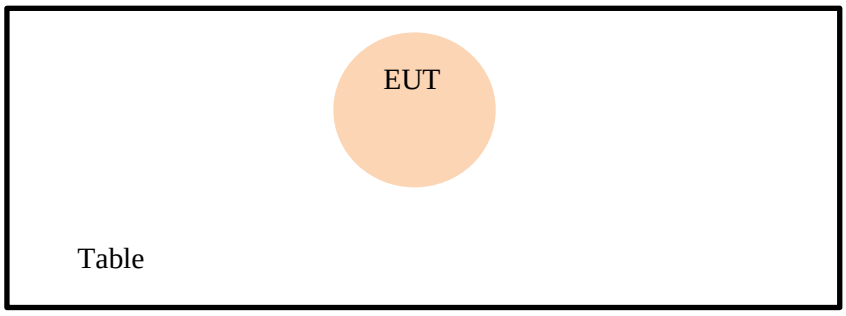
4.14.1 Description

Configuration	Description
1	EUT is powered by 3VDC battery.
Notes	

4.15 Subassemblies

Reference Designation	Manufacturer	Model No.	Revision	Serial No.	Description
N/A					

4.15.1 Block Diagram



4.16 Emissions

4.16.1 Radiated Emissions

4.16.1.1 Preliminary Radiated Emissions Test Setup

Standard	FCC Part15 Subpart B:2020, ICES-003: 2016			**Procedure**	ANSI C63.4
Limit	Class B	**Emissions Verification**		Emissions Under Limit	
Frequency Range	30 MHz – 18 GHz				
Scan #1	Final Scan 30 – 1000 MHz	**Antenna Distance**	3m	**Detector**	Peak Scan
Scan #2	Final Scan 1 – 18 GHz	**Antenna Distance**	3m	**Detector**	Peak Scan
Configuration	See Section 4.15				
Notes	None				

4.16.1.2 Final Radiated Emissions Test Setup

Standard	FCC Part15 Subpart B:2020, ICES-003: 2016			**Procedure**	ANSI C63.4
Limit	Class B	**Emissions Verification**		Emissions Under Limit	
Frequency Range	30 MHz – 18 GHz				
Scan #1	Final Scan 30 – 1000 MHz	**Antenna Distance**	3m	**Detector**	Quasi Peak
Scan #2	Final Scan 1 – 18 GHz	**Antenna Distance**	3m	**Detector**	Peak/Average
Configuration	See Section 4.15				
Notes	None				

Appendix B

5 Modification(s)

N/A

END OF REPORT