EMC TEST REPORT

For

Tire Pressure Monitoring System

Test Model: TM515, RP03, SE

Additional Model No.: Please Refer to Page 6

Prepared for	:	
Address	:	Hong Kong
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	July 29, 2022
Number of tested samples	:	2
Serial number	:	Prototype
Date of Test	:	July 29, 2022 ~ August 05, 2022
Date of Report	:	August 08, 2022

CE

EMC TEST REPORT
ETSI EN 301 489-1 V2.2.3 (2019-11) & Draft ETSI EN 301 489-3 V2.3.0 (2022-07)

Report Reference No.	:	**LCSA072722077EA**
Date Of Issue.....	:	August 08, 2022
Testing Laboratory Name.....	:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	Room 101, 201, Building A and Room 301, Building C, Juji Industrial Park, Yabianxueziwei, Shajing Street, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure....	:	Full application of Harmonised standards■ Partial application of Harmonised standards□ Other standard testing method□
Applicant's Name.....	:	
Address.....	:	Hong Kong
Test Specification		
Standard.....	:	ETSI EN 301 489-1 V2.2.3 (2019-11) Draft ETSI EN 301 489-3 V2.3.0 (2022-07)
Test Report Form No.	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2017-06

Test Item Description.....	:	**Tire Pressure Monitoring System**
Trade Mark.....	:	N/A
Test Model.....	:	TM515, RP03, SE
Ratings.....	:	Please refer to page 6
Result	:	**Positive**

Compiled by:	Supervised by:	Approved by:
Diamond Lu/ Administrator	Cary Luo/ Technique principal	Gavin Liang/ Manager

EMC -- TEST REPORT

Test Report No. : LCSA072722077EA	August 08, 2022 Date of issue

Test Model.....	: TM515, RP03, SE
EUT.....	: Tire Pressure Monitoring System
Applicant.....	:
Address.....	:
Telephone.....	:
Fax.....	:
Manufacturer.....	:
Address.....	:
Telephone.....	:
Fax.....	:
Factory.....	:
Address.....	:
Telephone.....	:
Fax.....	:

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Report Version	Issue Date	Revision Content	Revised By
000	August 08, 2022	Initial Issue	--

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Product Description for Equipment Under Test (EUT)

EUT	:	Tire Pressure Monitoring System
Test Model	:	TM515, RP03, SE
Additional Model No.	:	Receiver: TM508, T1, T2, T3, T4, EK215, TM516, TM518, TM527C, TM521, TC02, TC04, TC08, TC09, TC10, TC11, RP02U, RP03U, RP08U, M7, M12, M12C, M5, MB-7, MB-8, CL201, CL203, CL205, CL206, CL208, T100, T100B, TM100, T800, T800B, G206, NB206 Repeater: RP02, RP05, 030892, RP06, RP07, RP09, RP12, RP22, RP23 Sensor: SP, SH, ST, SC, SI, SR, SL, SN, SO, SU, E01, E06, E07, E09, E22, E47, E40, E51, E64, E74, E80, E90, E81, E82, E83, E84, E85
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	:	Receiver: Input: 5-24VDC, 300mA DC 3.7V by Rechargeable Li-ion Battery, 850mAh Repeater: Input: DC 5-24V Sensor: DC 3.0V By CR2032 Battery
Hardware Version	:	V1.0
Software Version	:	V1.0
Receiver		
Frequency Range	:	433.92MHz
Channel Number	:	1 channels
Modulation Type	:	ASK
Antenna Description	:	Spring antenna, 1.0dBi(Max)
Repeater		
Frequency Range	:	433.92MHz
Channel Number	:	1 channels
Modulation Type	:	ASK
Antenna Description	:	Spring antenna, 1.5dBi(Max)
Sensor		
Frequency Range	:	433.92MHz
Channel Number	:	1 channels
Modulation Type	:	ASK
Antenna Description	:	Copper plate antenna, 0.5dBi(Max)

1.2. Objective

ETSI EN 301 489-1	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility
ETSI EN 301 489-3	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard for ElectroMagnetic Compatibility

The objective is to determine compliance with ETSI EN 301 489-1 V2.2.3 (2019-11), Draft ETSI EN 301 489-3 V2.3.0 (2022-07).

1.3. Related Submittal(s)/Grant(s)

No Related Submittals.

1.4. Test Methodology

All measurements contained in this report were conducted with ETSI EN 301 489-1 V2.2.3 (2019-11), Draft ETSI EN 301 489-3 V2.3.0 (2022-07).

1.5. Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

1.6. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
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1.7. External I/O

I/O Port Description	Quantity	Cable
--	--	--

1.8. Measurement Uncertainty

Item	MU	Remark
Uncertainty for Power point Conducted Emissions Test	2.42dB	
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.54dB	Polarize: V
	4.1dB	Polarize: H
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	2.08dB	Polarize: H
	2.56dB	Polarize: V
Uncertainty for radio frequency	0.01ppm	
Uncertainty for conducted RF Power	0.65dB	
Uncertainty for temperature	0.2℃	
Uncertainty for humidity	1%	
Uncertainty for DC and low frequency voltages	0.06%	

1.9. Description of Test Modes

There was 2 test Modes TM1 to TM2 were shown below:
TM1 : Operate in 433 SRD mode;
TM2 : Idle mode

***Note:
1. All test modes were tested, but we only recorded the worst case in this report.

2. SUMMARY OF TEST RESULTS

Rule	Description of Test Items	Result
§7.1	Reference to clause 8.4 of ETSI EN 301 489-1 Conducted Emission (AC mains input/output port)	N/A*
§7.1	Reference to clause 8.3 of ETSI EN 301 489-1 Conducted Emission (DC power input/output port)	N/A*
§7.1	Reference to clause 8.7 of ETSI EN 301 489-1 Conducted Emission (Wired network port)	N/A*
§7.1	Reference to clause 8.2 of ETSI EN 301 489-1 Radiated Emission (Enclosure of ancillary equipment)	Compliant
§7.1	Reference to clause 8.5 of ETSI EN 301 489-1 Harmonic current emissions (AC mains input port)	N/A*
§7.1	Reference to clause 8.6 of ETSI EN 301 489-1 Voltage fluctuations and flicker (AC mains input port)	N/A*
§7.2	Reference to clause 9.3 of ETSI EN 301 489-1 Electrostatic discharge (Enclosure port) (EN 61000-4-2)	Compliant
§7.2	Reference to clause 9.2 of ETSI EN 301 489-1 RF electromagnetic field (80MHz to 6000MHz) (Enclosure port) (EN 61000-4-3)	Compliant
§7.2	Reference to clause 9.4 of ETSI EN 301 489-1 Fast transients common mode (signal, wired network and control ports, DC and AC power ports) (EN 61000-4-4)	N/A*
§7.2	Reference to clause 9.8 of ETSI EN 301 489-1 Surges, line to line and line to ground (AC mains power input ports, wired network ports) (EN 61000-4-5)	N/A*
§7.2	Reference to clause 9.5 of ETSI EN 301 489-1 RF common mode 0.15MHz to 80MHz (signal, wired network and control ports, DC and AC power ports) (EN 61000-4-6)	N/A*
§7.2	Reference to clause 9.6 of ETSI EN 301 489-1 Transients and surges in the vehicular environment (ISO 7637-2)	N/A*
§7.2	Reference to clause 9.7 of ETSI EN 301 489-1 Voltage dips and interruptions (AC mains power input ports) (EN 61000-4-11)	N/A*

3. TEST RESULTS

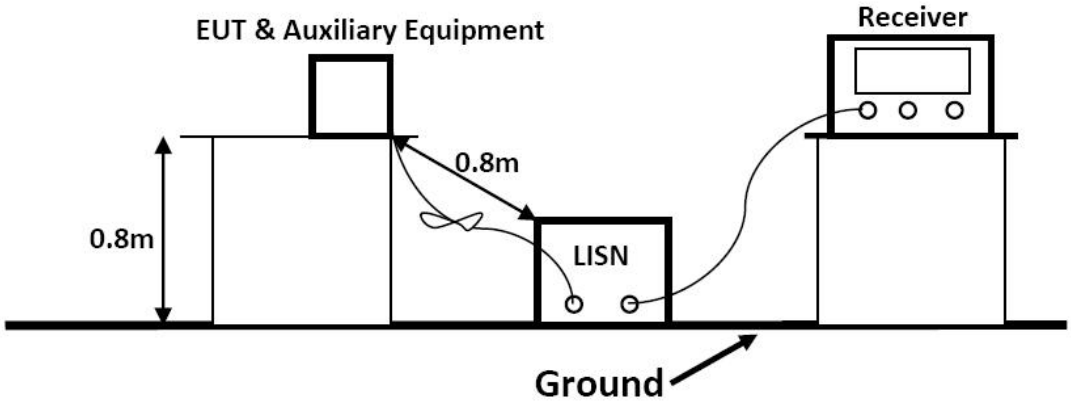
3.1. Line Conducted Emission

3.1.1 Conducted Emission Limit

Relevant Standard(s): ETSI EN 301 489-1 V2.2.3 (2019-11) / EN 55032:2015/A11:2020 Class B

Limits for Line Conducted Emission		
Frequency (MHz)	Limit (dBμV)	
	Quasi-peak Level	Average Level
0.15 ~ 0.50	66.0 ~ 56.0 *	56.0 ~ 46.0 *
0.50 ~ 5.00	56.0	46.0
5.00 ~ 30.00	60.0	50.0
NOTE1-The lower limit shall apply at the transition frequencies. NOTE2-The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.		

3.1.2 Test Configuration



The setup of EUT is according with per ETSI EN 301 489-1 measurement procedure. The specification used was with the ETSI EN 301 489-1 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

The EUT received charging power from the charger which received power through a LISN supplying power of AC 230V/50Hz.

3.1.3 EMI Test Receiver Setup

During the conducted emission test, the EMI test receiver was set with the following configurations:

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	150KHz ~ 30MHz
(IF)RBW	9kHz

All data was recorded in the Quasi-peak and average detection mode.

3.1.4 Test Procedure

Power on the EUT, the EUT begins to work. Make sure the EUT operates normally during the test.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

3.1.5 Test Results

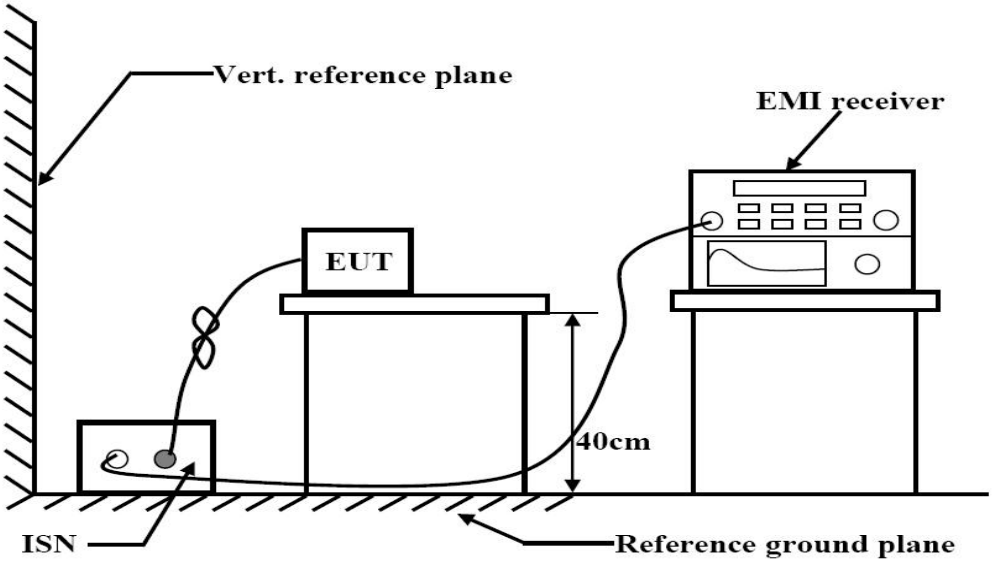
Not applicable.

3.2. Conducted Emission (Wired Network Port)

3.2.1 Conducted Emission Limit(Wired Network Port)

Limits for asymmetric mode conducted emissions				
Frequency (MHz)	Class B voltage limits (dBμV)		Class B current limits (dBμA)	
	Quasi-peak Level	Average Level	Quasi-peak Level	Average Level
0.15 ~ 0.50	84.0~74.0	74.0~64.0	40.0~30.0	30.0~20.0
0.50 ~ 30.00	74.0	64.0	30.0	20.0
NOTE 1-The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz. NOTE 2-The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150Ω to the telecommunication port under test (conversion factor is 20 log10 150 / 1 = 44 dB).				

3.2.2 Test Configuration



3.2.3 EMI Test Receiver Setup

During the conducted emission test, the EMI test receiver was set with the following configurations:

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	150KHz ~ 30MHz
(IF)RBW	9kHz

All data was recorded in the Quasi-peak and average detection mode.

3.2.4 Test Procedure

Please refer to ETSI EN 301 489-1 Clause 8.7.2 and EN 55032 Clause 6 for the measurement methods.

3.2.5 Test Results

Not applicable.

3.3. Radiated Disturbance

3.3.1 Radiated Emission Limit

Relevant Standard(s): ETSI EN 301 489-1 V2.2.3 (2019-11) / EN 55032:2015/A11:2020 Class B

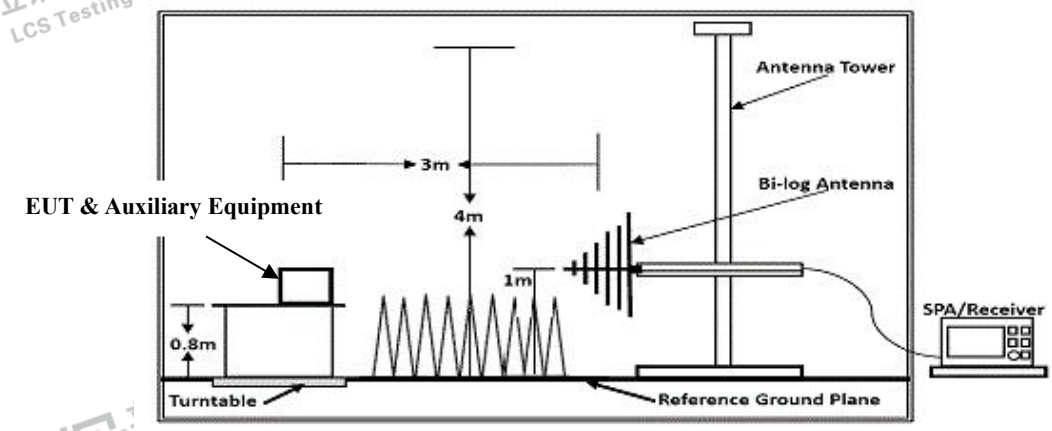
Limits for Radiated Disturbance Below 1GHz			
Frequency (MHz)	Facility	Distance (Meters)	Field Strengths Limit (dBμV/m)
30 ~ 230	FAR	3	42-35
230 ~ 1000	FAR	3	42
***Note: (1) The smaller limit shall apply at the combination point between two frequency bands. (2) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the EUT.			

Limits for Radiated Disturbance Above 1GHz			
Frequency (MHz)	Distance (Meters)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)
1000 ~ 3000	3	70	50
3000 ~ 6000	3	74	54
***Note: The lower limit applies at the transition frequency.			

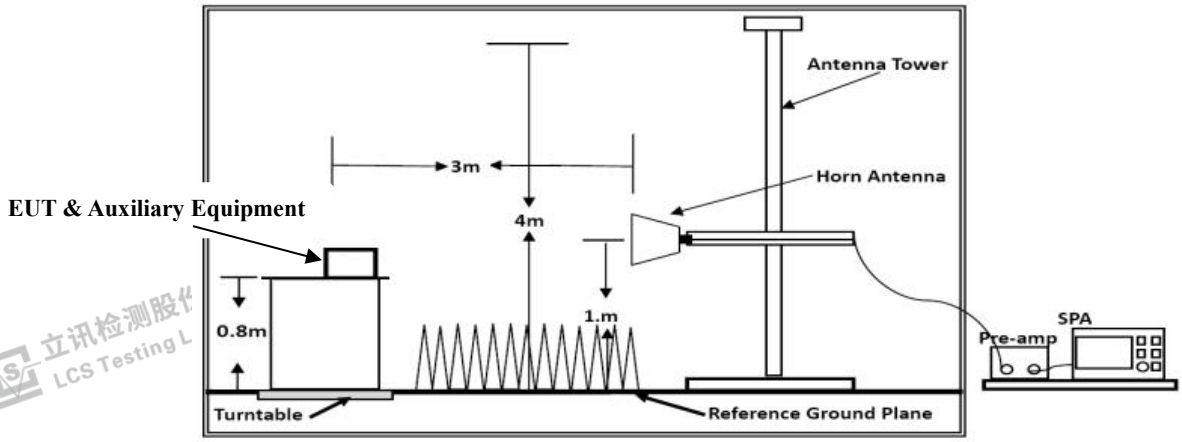
Limits for Radiated Disturbance Below 1GHz (For FM Receivers)			
Frequency (MHz)	Distance (Meters)	Class B Limit (dBμV/m)	
		Fundamental	Harmonics
30 ~ 230	3	60	52
230 ~ 300	3		52
300 ~ 1000	3		56
***Note: These relaxed limits apply only to emissions at the fundamental and harmonic frequencies of the LO. Signals at all other frequencies shall be compliant with the limits given in above Table.			

Limits for Radiated Disturbance Above 1GHz (For FM Receivers)			
1000 ~ 3000	3	70	50
3000 ~ 6000	3	74	54
***Note: The lower limit applies at the transition frequency.			

3.3.2 Test Configuration



Below 1GHz



Above 1GHz

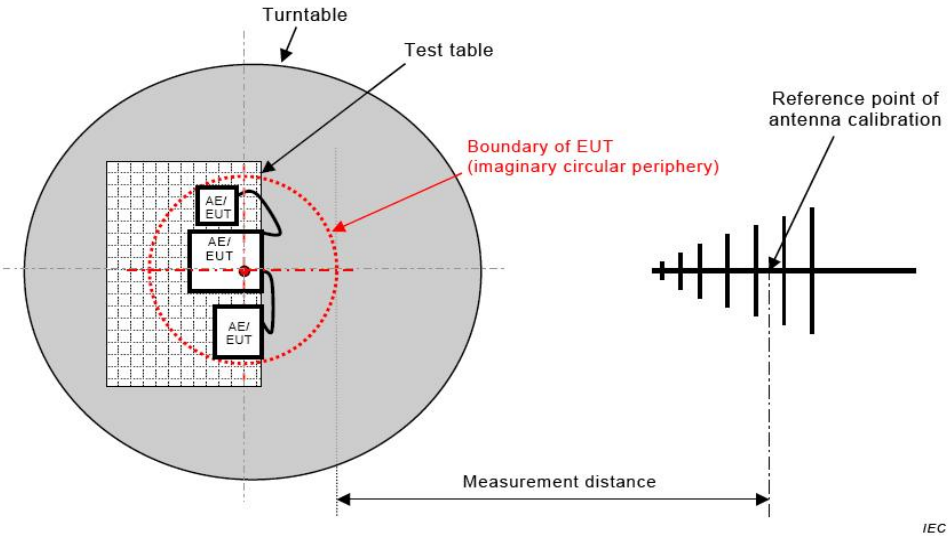


Figure C.1 – Measurement distance

Test Setup for FM Receiver

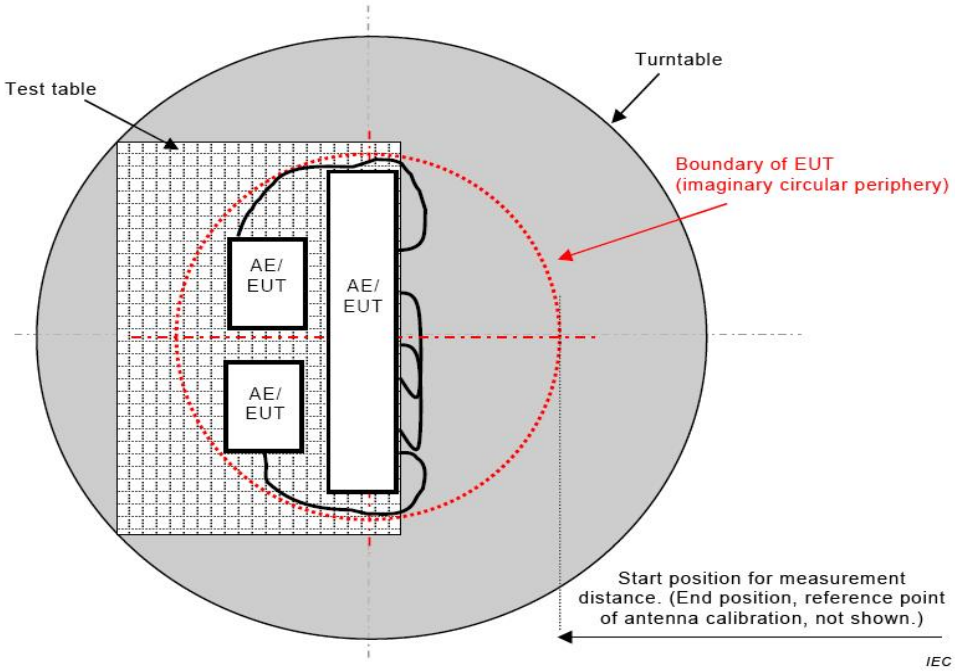


Figure C.2 – Boundary of EUT, Local AE and associated cabling

Test Setup for FM Receiver

3.3.3 Test Procedure

The test method shall be in accordance with CENELEC EN 55032 [1], annex A.1

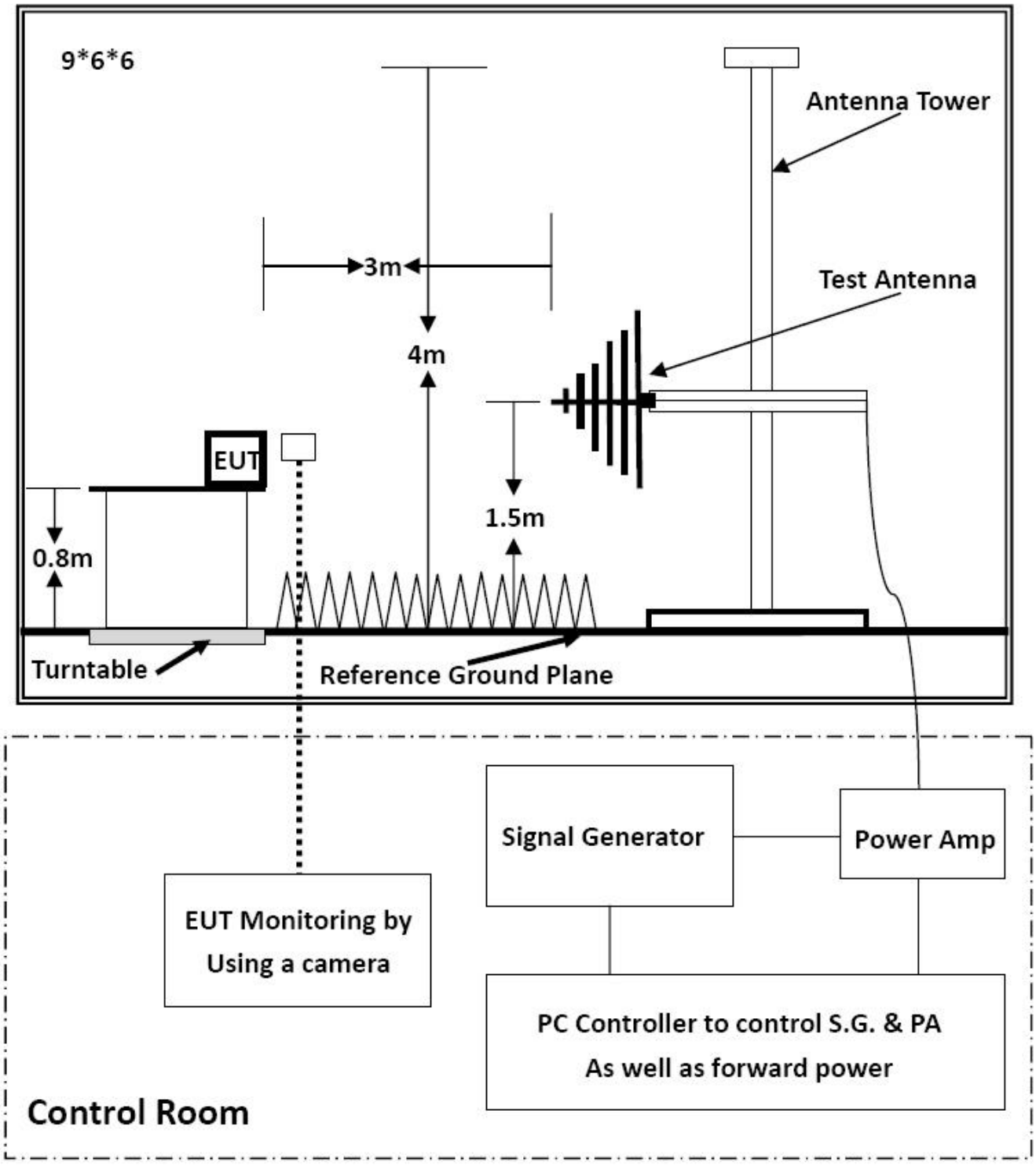
3.3.4 Test Results

PASS

The worst test mode of the EUT was TM1, and its test data please refer to Appendix A.1 for Emission and Immunity test results.

3.4. RF Electromagnetic Field (80 MHz - 6000 MHz)

3.4.1 Test Configuration



3.4.2 Test Standard

ETSI EN 301 489-1, ETSI EN 301 489-3 (EN 61000-4-3: 2006+A2: 2010)

Test level 2 at 3V/m.

3.4.3 Severity Level

Level	Field Strength (V/m)
1	1
2	3
3	10
X	Special
Performance Criterion: **A**	

3.4.4 Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. EUT is set 3 meter away from the transmitting antenna which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna are set on test. Each of the four sides of EUT must be faced this transmitting antenna and measured individually. In order to judge the EUT performance, a CCD camera is used to monitor EUT screen. All the scanning conditions are as follows:

Condition of Test	Remark
Fielded Strength	3 V/m (Severity Level 2)
Radiated Signal	Unmodulated
Scanning Frequency	80-6000MHz
Dwell time of radiated	0.0015 decade/s
Waiting Time	3 Sec.

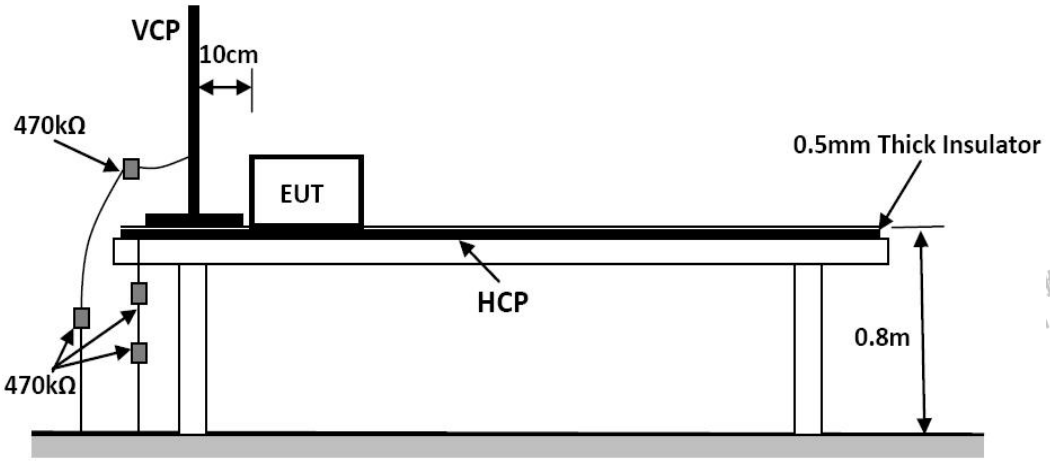
3.4.5 Test Results

PASS

Please refer to Appendix A.2 for Emission and Immunity test results.

3.5. Electrostatic Discharge

3.5.1 Test Configuration



EN 61000-4-2 specifies that a tabletop EUT shall be placed on a non-conducting table which is 80 centimeters above a ground reference plane and that floor mounted equipment shall be placed on a insulating support approximately 10 centimeters above a ground plane. During the tests, the EUT is positioned over a ground reference plane in conformance with this requirement.

For tabletop equipment, a 1.5 by 1.0-meter metal sheet (HCP) is placed on the table and connected to the ground plane via a metal strap with two 470 k Ohms resistors in series. The EUT and attached cables are isolated from this metal sheet by 0.5-millimeter thick insulating material. A Vertical Coupling Plane (VCP) grounded on the ground plane through the same configuration as in the HCP is used.

3.5.2 Test Procedure

ETSI EN 301 489-1 V2.2.3 (2019-11) / EN 61000-4-2: 2009
Test level 3 for Air Discharge at ±8 kV
Test level 2 for Contact Discharge at ±4 kV

3.5.2.1 Air Discharge

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the EUT. After each discharge, the discharge electrode shall be removed from the EUT. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed.

3.5.2.2 Contact Discharge

All the procedure shall be same as Section 3.5.2.1. except that the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

3.5.2.3 Indirect Discharge For Horizontal Coupling Plane

At least 10 single discharges (in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit (if applicable) of the EUT and 0.1m from the front of the EUT. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

3.5.2.4 Indirect Discharge For Vertical Coupling Plane

At least 10 single discharges (in the most sensitive polarity) shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated.

3.5.3 Test Results

PASS

Please refer to Appendix A.3 for Emission and Immunity test results.

4. GENERAL PERFORMANCE CRITERIA FOR IMMUNITY TEST

4.1. Performance criteria for Continuous phenomena applied to Transmitter (CT)

For equipment of type II or type III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence. Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

4.2. Performance criteria for Transient phenomena applied to Transmitter (TT)

For equipment of type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence. Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

4.3. Performance criteria for Continuous phenomena applied to Receiver (CR)

For equipment of type II or III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence. Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

4.4. Performance criteria for Transient phenomena applied to Receiver (TR)

For equipment of type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence. Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

Performance criteria for Draft ETSI EN 301 489-3 V2.3.0 (2022-07)

1) Introduction

The performance criteria are used to make an assessment whether a radio equipment passes or fails immunity tests.

Only the performance criteria specified in the present document or in ETSI EN 301 489-1 [1] where referenced shall apply.

The provisions of ETSI EN 301 489-1 [1], clause 6, shall apply together with clauses 6.2 and 6.3.

2) Continuous and non-continuous operation

Latency is the time delay between the initiation and the completion of operation of the EUT. Correct functioning requires completing the relevant operation within the maximum latency time.

Where the maximum latency is specified in the applicable harmonised radio standard (in the wanted performance criterion, or an acknowledge requirement), that value shall be used.

Where this is not the case, then the maximum latency is that required by the intended use of the EUT.

3) Operating modes

Where the EUT has more than one mode of operation (see clause 4.4.1), an unplanned transition from one mode to another is considered as an unintentional response. The EUT shall be tested in all modes to confirm there are no such unintentional responses.

5. LIST OF MEASURING EQUIPMENT

RADIATED DISTURBANCE

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	EMI Test Software	Farad	EZ	/	N/A	N/A
2	3m Full Anechoic Chamber	MRDIANZI	FAC-3M	MR009	2021-09-25	2022-09-24
3	Positioning Controller	Max-Full	MF7802BS	MF780208586	N/A	N/A
4	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2021-09-12	2024-09-11
5	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2021-09-05	2024-09-04
6	EMI Test Receiver	R&S	ESPI	101940	2021-08-19	2022-08-18
7	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2021-11-16	2022-11-15
8	Broadband Preamplifier	/	BP-01M18G	P190501	2022-06-16	2023-06-15
9	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2022-06-16	2023-06-15

RF ELECTROMAGNETIC FIELD

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	RS Test Software	Tonscend	/	/	N/A	N/A
2	MXG Vector Signal Generator	Agilent	E4438C	MY42081396(6G)	2022-06-16	2023-06-15
3	3m Full Anechoic Chamber	MRDIANZI	FAC-3M	MR009	2021-09-25	2022-09-24
4	RF POWER AMPLIFIER	OPHIR	5225R	1052	2022-06-16	2023-06-15
5	RF POWER AMPLIFIER	OPHIR	5273F	1019	2022-06-16	2023-06-15
6	RF POWER AMPLIFIER	SKET	HAP_0306G-50W	/	2022-06-16	2023-06-15
7	Stacked Broadband Log Periodic Antenna	SCHWARZBECK	STLP 9128	9128ES-145	NCR	NCR
8	Stacked Mikrowellen Log.-Per Antenna	SCHWARZBECK	STLP 9149	9149-482	NCR	NCR
9	RS Electric field probe	narda	EP 601	611WX80208	2022-06-16	2023-06-15
10	Sound Level meter	BK Precision	735	7350087310010020	2022-06-16	2023-06-15
11	Audio Analyzer	R&S	UPV	1146.2003K02-101721-UW	2021-11-15	2022-11-14
12	Mouse Simulation	Bruel & Kjaer	4227	A0304216	2022-06-16	2023-06-15
13	Ear Simulation and supply	Bruel & Kjaer	2669.4182.5935	A0305284	2022-06-16	2023-06-15
14	Acoustical Calibrators	Bruel & Kjaer	4231	A0304215	2022-06-16	2023-06-15
15	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2022-06-16	2023-06-15

Note: NCR means no calibration requirement

ELECTROSTATIC DISCHARGE

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	ESD Simulator	SCHLODER	SESD 230	604035	2022-07-18	2023-07-17
2	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2022-06-16	2023-06-15

6. PHOTOGRAPHS OF TEST SETUP

Please refer to separated files Appendix B for Photographs of Test Setup_EMC

7. PHOTOGRAPHS OF THE EUT

Please refer to separated files Appendix C for Photographs of The EUT.

----------THE END OF REPORT----------