EMC TEST REPORT

TEST STANDARD(S)	:	EN 301 489-1: V2.1.1 EN 301 489-3: V2.1.1 EN 301 489-52: V1.1.0
CLIENT / APPLICANT	:	Digital Matter SA (Pty) Ltd.
CLIENT ADDRESS	:	Ground Floor, Buffalo building The Oval Cnr. Meadowbrook Lane and Sloane Street Bryanston 2021
TEST SAMPLE (EUT)	:	Falcon Cellular 2G
SERIAL NUMBER	:	553404
REPORT NUMBER	:	TRE00347-10/19
DATE ISSUED	:	16/05/2019
REVISION	:	2.0

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This test report was prepared by: ***Name:*** *CJ Deysel*
Title: *EMC Test Engineer*

This test report was approved by: ***Name:*** *R van den Berg*
Title: *Senior RF Engineer*

T0812

This test report is issued in accordance with SANAS accreditation requirements. SANAS is a signatory to the ILAC Mutual Recognition arrangement for the mutual recognition of the equivalence of testing and calibration reports

DOCUMENT CONTROL

Revision	Date	Author	Pages affected	Change proposal
1.0	18/02/2019	CJ Deysel	All	N/A
2.0	16/05/2019	CJ Deysel	8	RF module description added

TEST LABORATORY INFORMATION

Established in 2017, iSERT (Pty) Ltd. Provides EMC, RF & Safety testing services by our skilled Engineers. Our services employ a wide variety of advanced cutting-edge test equipment with one of the widest ranges of accredited standards in the country.

The site and apparatus are constructed in conformance with the requirements of CISPR 16-1-4, EN 50147-1 and other equivalent standards. The laboratory is compliant with the requirements of ISO/IEC 17025

It is our definite objective to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with the best EMC, RF & Safety services by knowledgeable and accommodating staff.

Our test site is located at 129 Khai-Apple street, Montana, Pretoria, South Africa 0186.

Company details:

iSERT (Pty) Ltd.
Reg: 2017/186396/07
Tel: + 27 (0)12 548 0940
E-Mail: info@isert.co.za
Website: www.isert.co.za

DEFINITIONS & ACRONYMS

AE – Associated Equipment. Equipment needed to exercise and/or monitor the operation of the EUT.

AM – Amplitude Modulation

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.

Broadcast Receiver Tuner Port – Port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services.

Class A device – A device that is marketed for use in a commercial, industrial or business environment. A 'Class A' device should not be marketed for use by the general public. A 'Class A' device should contain the following warning in its user manual: "Warning: Operation of this equipment in a residential environment could cause radio interference."

Class B device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environment. NOTE: A residential environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10m of the device concerned.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.

LISN – Line Impedance Stabilization Network

NA – Not Applicable

NCR – No Calibration Required

NSA – Normalized Site Attenuation

Optical Fiber Port – Port at which an optical fiber is connected to an equipment.

RF – Radio Frequency

Signal/Control Port – Port intended for the interconnection of components of an EUT, or between an EUT and local AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it). (Examples include: RS-232, USB, HDMI, Fire Wire)

Wired Network Port – Point of connection for voice, data and signaling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network. (Examples include: CATV, PSTN, ISDN, xDSL, LAN and similar networks)

TABLE OF CONTENTS

1. INTRODUCTION

This report details the results of tests performed on the Digital Matter SA (Pty) Ltd. Falcon Cellular 2G asset tracking unit.

The testing was carried out between 11/02/2019 and 14/02/2019 at the iSERT laboratory. Testing was conducted by Johan Deysel.

2. STANDARDS APPLIED

1. ETSI EN 301 489-1 V2.1.1 (2017-02) 'Electromagnetic compatibility and Radio Spectrum Matters (ERM)
2. ETSI EN 301 489-3 V2.1.1 (2013-06) 'Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz'
3. ETSI EN 301 489-52 V1.1.0 (2016-11) 'Specific conditions for Cellular Communications Mobile and portable (UE) radio and ancillary equipment.

3. SUMMARY OF TEST RESULTS

Test Standard	Description	Results
EN 55032 / CISPR 32	Radiated emissions	✓
EN 55032 / CISPR 32	Conducted emissions DC input power	✓
EN / IEC 61000-4-2	Immunity to Electrostatic discharge	✓
EN / IEC 61000-4-3	Immunity to Radiated Electromagnetic Fields	✓
EN / IEC 61000-4-4	Immunity to Electrical Fast Transient	✓
EN / IEC 61000-4-5	Immunity to Surges	✓
EN / IEC 61000-4-6	Immunity to Conducted Disturbances	✓

4. CONCLUSION

Based on the results of our investigation, we have concluded that the EUT (in the configuration tested) complies with the requirements of the standard(s) indicated above. The results obtained in this test report are only valid for the item(s) tested. iSERT (Pty) Ltd. does not make any claims of compliance for samples or variants which were not tested.

5. EMISSION CLASSES AND IMMUNITY CRITERIA

5.1 EMISSIONS

CISPR 32 / EN 55032 defines Class A equipment and Class B associated with two types of end-user environment.

The Class B requirements for equipment are intended to offer adequate protection to broadcast services within the residential environment.

Equipment intended primarily for use in a residential environment shall meet the Class B limits. All other equipment shall comply with the Class A limits.

Broadcast receiver equipment is class B equipment.

NOTE: Equipment meeting Class A requirements may not offer adequate protection to broadcast services within a residential environment.

Class A equipment shall have the following warning in the instructions for use, to inform the user of the risk of operating this equipment in a residential environment:

Warning:

This equipment is compliant with Class A of CISPR 32 / EN 55032. In a residential environment this equipment may cause interference

5.2 IMMUNITY

Description of performance criteria:

A: No loss of performance or function

B: Temporary loss of function or performance which is self-recoverable

C: Temporary loss of function or performance which requires operator intervention or system reset

D: Loss of function which is not recoverable

5.2.1 Classification of SRD equipment

The product family of short-range devices is divided by device type, each having its own set of performance criteria. This classification is based upon the impact on persons and / or goods in case the equipment does not operate above the specified performance level under EMC stress.

Device type	Risk assessment of communication link performance
1.	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person)
2.	Medium reliable SRD communications media; e.g. causing inconvenience to persons, Which cannot simply be overcome by other means
3.	Standard reliable SRD communication media; e.g. inconvenience to persons, which Can simply be overcome by other means (e.g. manual)

5.3 ENVIRONMENTAL CONDITIONS DURING ESD TEST:

Temperature	Relative Humidity
22 - 23°C	41 - 54%

5.4 CALIBRATION OF TEST EQUIPMENT

The computer-controlled EMI Measuring system is checked for amplitude and frequency accuracy with a signal generator (calibrated by a SANAS accredited laboratory and is traceable to the national standards maintained by NMISA) on a monthly basis. The calibration of the equipment is performed by Coral-i and Enterprise, University of Pretoria. All equipment Calibration Certificates are available on request.

5.5 MEASUREMENT OF UNCERTAINTY

ISO / IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions results be included in the test report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor of k = 2)

Measurement Uncertainty		
Test Item	**Frequency**	**Uncertainty (dB)**
Conducted Emissions from the AC mains power ports	150kHz – 30MHz	3.4
Radiated Emissions - Horizontal	> 200 MHz	4.84
	< 200 MHz	4.84
Radiated Emissions - Vertical	> 200 MHz	4.96
	< 200 MHz	5.16

5.5.1 Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG

Where: FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBµV/m.

6. EQUIPMENT UNDER TEST

EUT name:	Falcon Cellular 2G
RF Module:	UBLOX SARA-G350
Serial number:	553404
Highest internal frequency:	1800MHz

6.1 EUT TEST SETUP DETAIL AND OPERATING CONDITION

The specific test methodology will be discussed under each relevant test if different to the general set-up guidelines below.

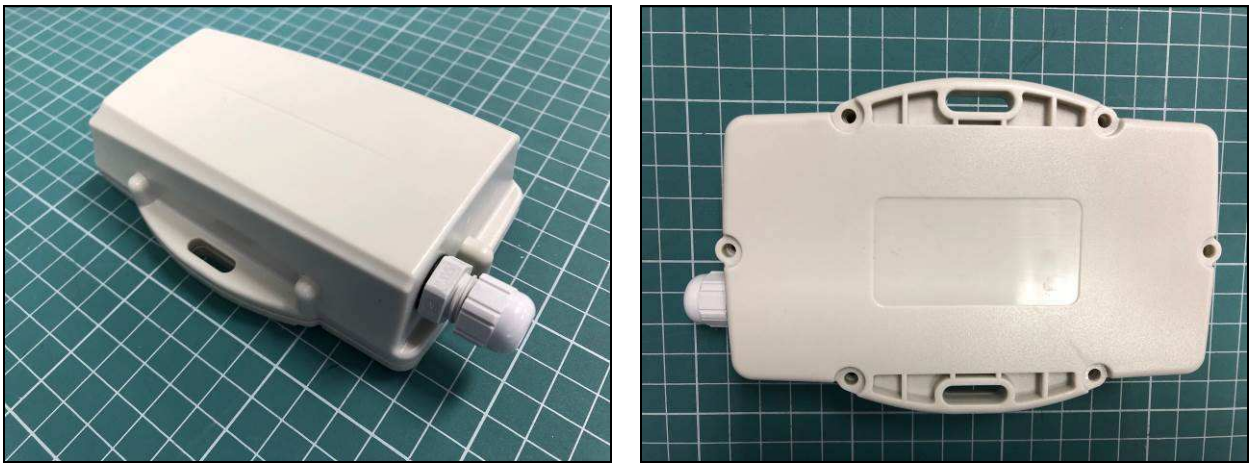
1. The EUT was switched on and operated in accordance with the manufacturer instructions.
2. Tests were performed while the device was fully operational.
3. Deviations from the above set-up will be noted in each specific case.

6.2 WORST CASE MEASUREMENT CONFIGURATION

The EUT was tested in the following modes of operation:

Radiated, Conducted Emissions & Immunity	
Test Mode	**Operating description**
1.	The GPS function of the EUT was exercised by the use of a GPS re-radiator. The EUT was connected to a Rohde & Schwartz CMW 500 base station simulator. The EUT was closely monitored for signs of susceptibility.

6.3 DEVICE IMAGES



Figures 1 & 2: Falcon Cellular 2G device images

6.4 TEST EQUIPMENT LIST

No.	Equipment description	Serial number	Cal Date	Cal Due date
1.	California Instruments Model 4503L AC Power system	HK50775	03/07/2017	July 2018
2.	Bulk Current Injection Probe CLCI-100	581149	25/07/2017	July 2022
3.	RF Current Injection Probe	561383	25/07/2017	July 2022
4.	M2 & M3 Coupling / de-Coupling Network CDN-M325E	521169	25/07/2017	July 2022
5.	Telecommunications Coupling / de-Coupling Network CDN-T8SE	511434	25/07/2017	July 2022
6.	Combilog Antenna AC-200	061128	25/07/2017	July 2022
7.	TESEQ CDN 3425 Capacitive clamp	3082	29/06/2017	June 2019
8.	TESEQ CWM 3451	3312 / 6074	12/07/2017	July 2019
9.	TESEQ FTM 3425	3645 / 6074	12/07/2017	July 2019
10.	TESEQ Power quality plugin – PQM 3403	2463 / 6074	12/07/2017	July 2019
11.	TESEQ Pulse Wave shape adapter INA 752	216	08/08/2017	August 2019
12.	TESEQ NSG 435 ESD Gun	7184	21/07/2017	July 2019
13.	Agilent E7405A EMC analyzer	MY45116923	18/09/2017	September 2018
14.	Agilent 83620B Signal Generator (10MHz – 20GHz)	98091	19/09/2017	September 2019
15.	Agilent Network Analyzer E5062A	MY44100409	22/09/2017	September 2018
16.	Rohde & Schwarz Universal communication tester – CMU200	103025	27/09/2016	September 2018
17.	AH systems SAS-563B	2384	09/02/2013	February 2018
18.	Narda EP-600 Electric Field probe	611WX70397	26/07/2017	Inter-laboratory comparison
19.	EMCO 3810/2 single phase LISN	00069452	19/02/2007	Inter-laboratory comparison
20.	Thurlby Thandar HA1600A Power & harmonics analyzer	479560	29/06/2017	June 2019
21.	AH Systems SAS-571	2455	17/03/2016	March 2021
22.	Environmental Chamber Coolmac	7256-V0-2384	01/10/2017	October 2018
23.	Com-Power AD 100 Tuned dipole set	040195	25/1/2016	January 2021
24.	Aeroflex 2G/3G Prolock 2201 tester	0103149	No calibration required	
25.	Kalmus 757LC 75Watt Amplifier (10kHz – 1GHz)	7591	No calibration required	
26.	Fluke 115 Multi-meter	3451488WS	Manuf. date	September 2018
27.	Keysight N9020A EMI Signal analyzer: ATO-8599	MY52330018	13/02/2018	February 2019
28.	Flus Humidity and temperature meter: ET-951W	2015106449	20/10/2017	October 2018

7. EMISSIONS

7.1 RADIATED EMISSIONS:

Method: Measurements were made in an 8-meter fully anechoic chamber that complies to CISPR 16. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meters. The limit line was adjusted accordingly. The EUT was rotated 360° about its azimuth with the receive antenna located at a fixed height in horizontal and vertical polarities. Final measurements (quasi-peak) were then performed by rotating the EUT 360°. All frequencies within 10 dB of the limit were investigated in both horizontal and vertical antenna polarity, where applicable.

7.1.1 Test set-up

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
b. Automated scans in the frequency band 30MHz to 6000MHz (radiated emissions) were done in order to determine compliance emission results for the EUT.
c. The EUT was tested in both horizontal and vertical polarizations.
d. The EUT was tested while in allocated in 2G mode and GPS.
e. The EUT was tested while supplied with internal batteries and with external batteries.

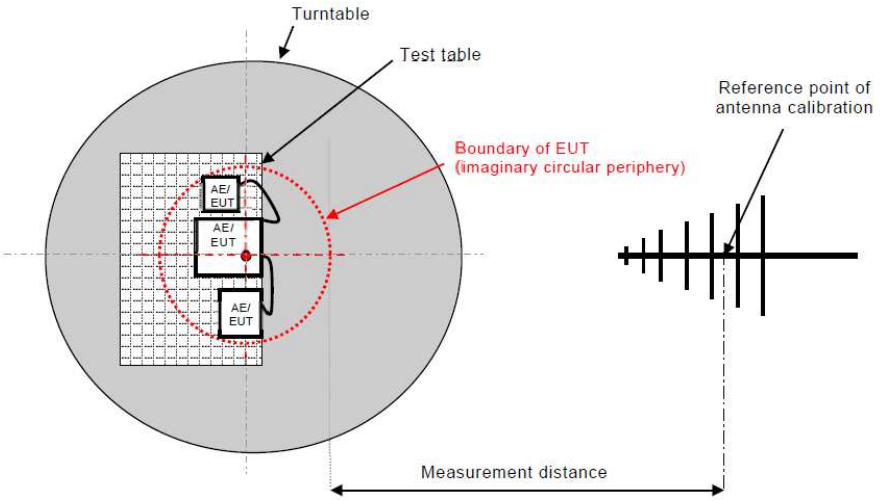
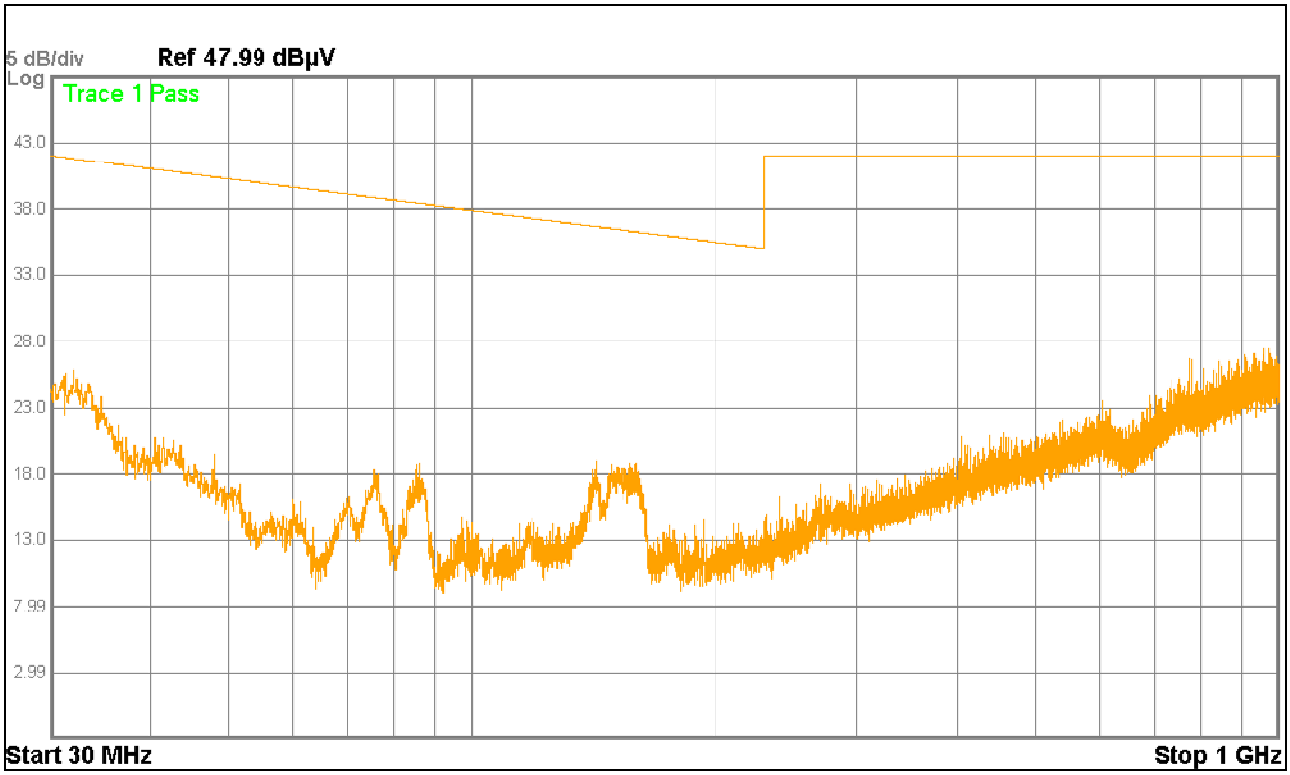


Figure 3: Typical Radiated emissions setup

7.1.2 Radiated Emission: 30 MHz– 1000MHz (Internal batteries)

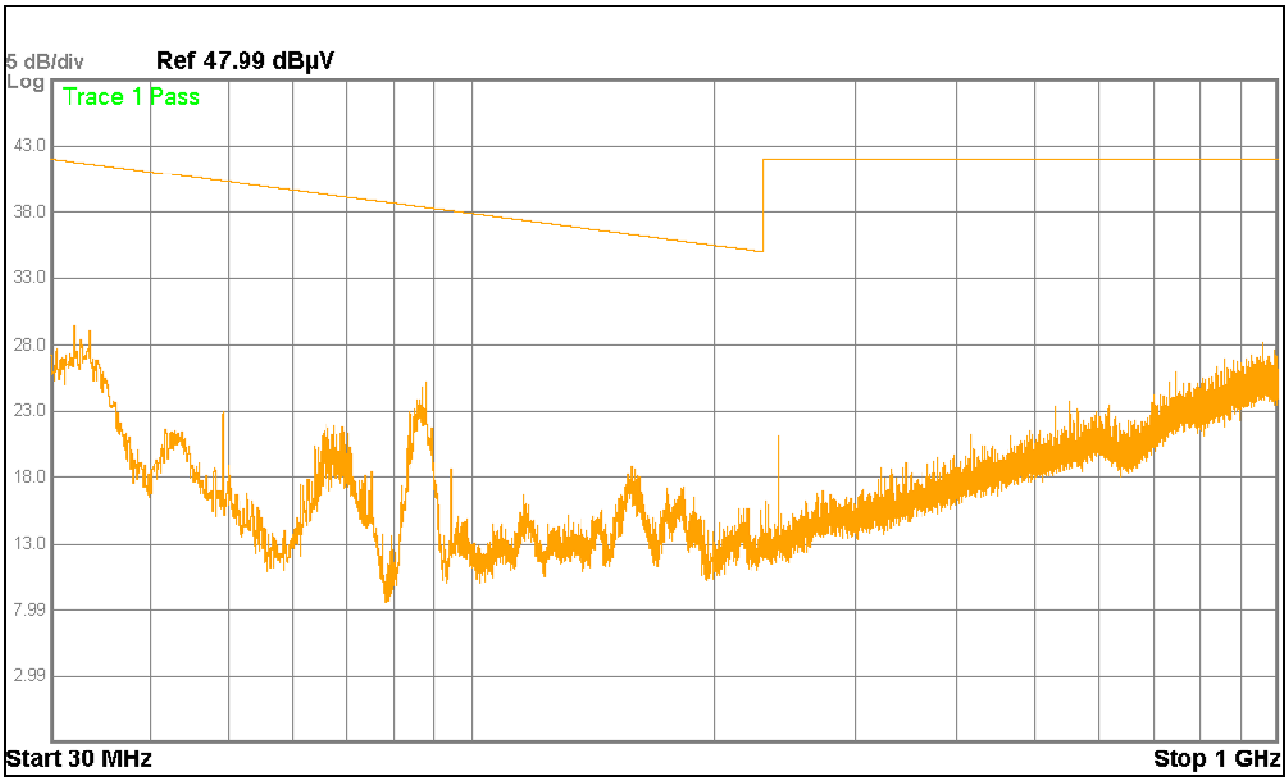
Graph 1: Represents radiated emissions measured from the EUT in the horizontal polarization



Graph 1: Radiated emissions results

7.1.3 Radiated Emission: 30 MHz – 1000MHz (Internal batteries)

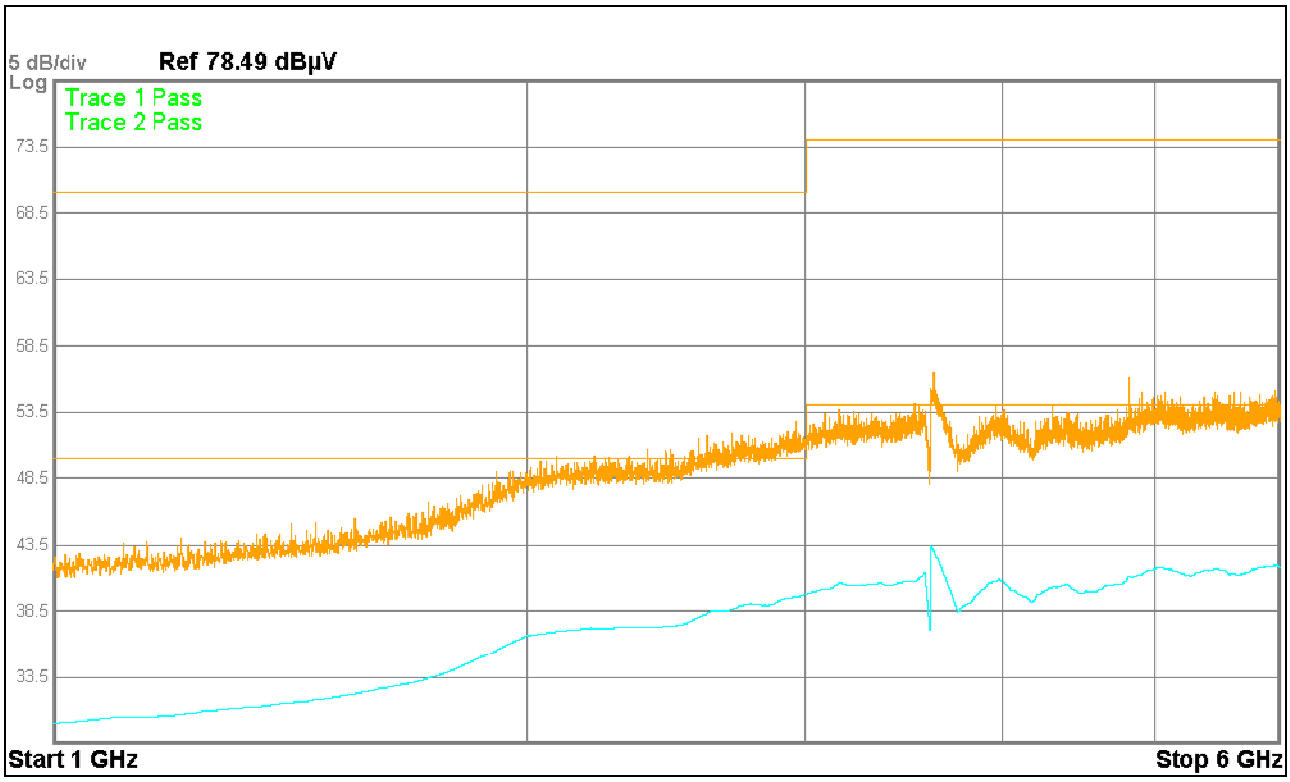
Graph 2: Represents radiated emissions measured from the EUT in the vertical polarization.



Graph 2: Radiated emissions results

7.1.4 Radiated Emission: 1000MHz – 6000MHz (Internal batteries)

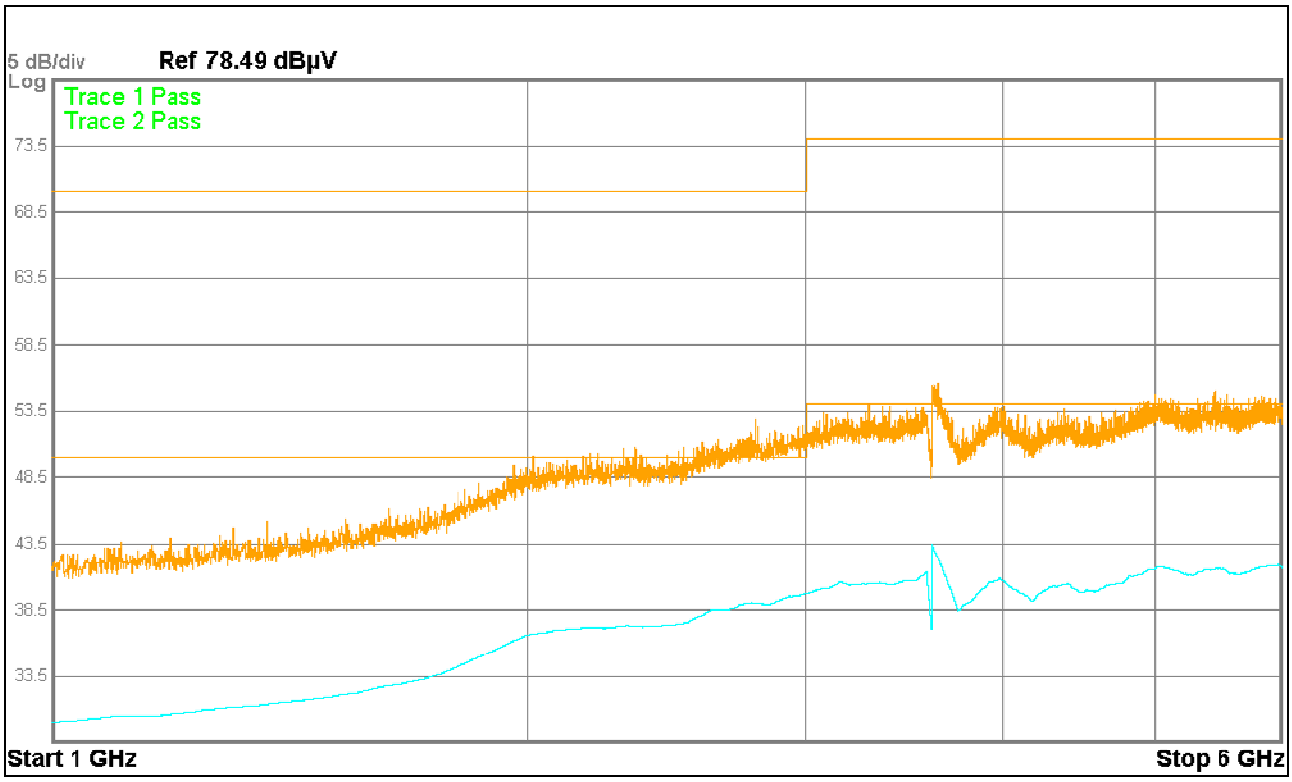
Graph 3: Represents peak and average radiated emissions measured from the EUT in the Horizontal polarization.



Graph 3: Radiated emissions results

7.1.5 Radiated Emission: 1000 MHz – 6000 MHz (Internal batteries)

Graph 4: Represents peak and average radiated emissions measured from the EUT in the vertical polarization



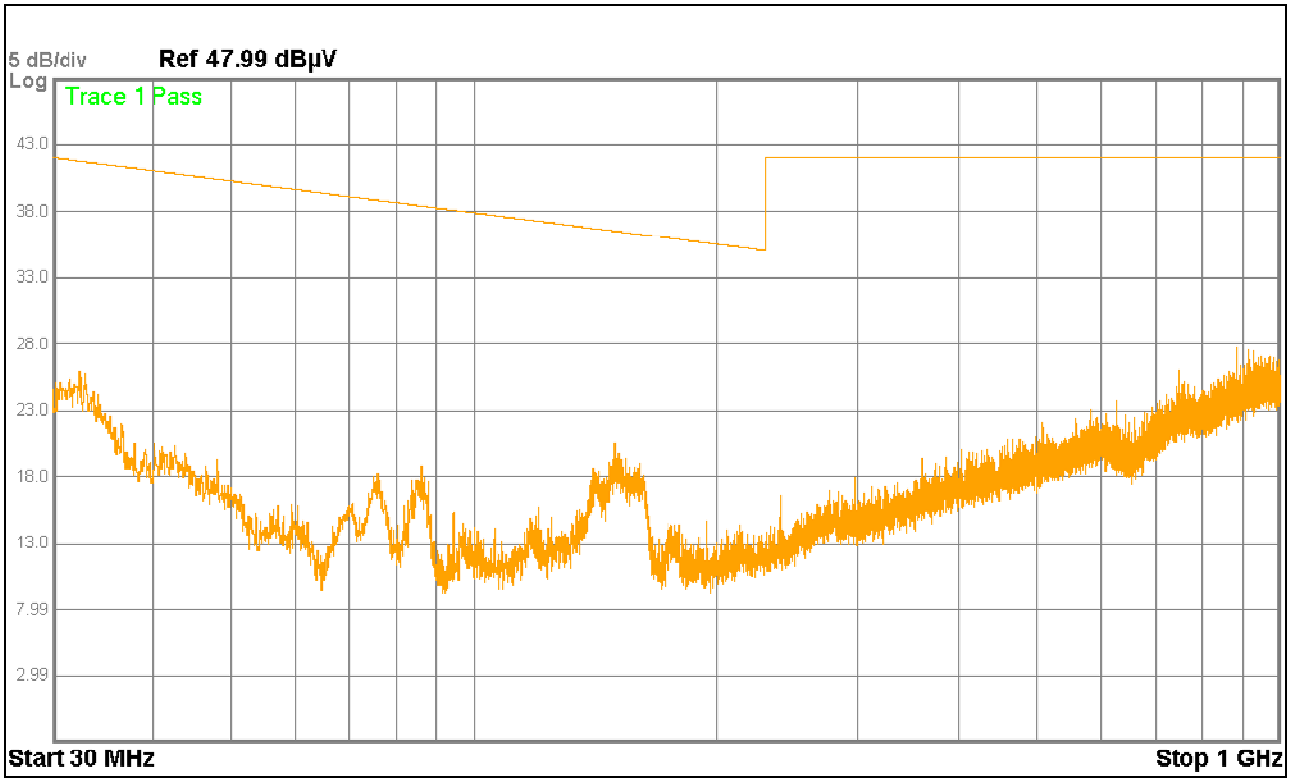
Graph 4: Radiated emissions results

7.1.6 Conclusion

- The EUT complies with the radiated emissions requirements of EN 55032 / CISPR 32.

7.1.7 Radiated Emission: 30 MHz– 1000MHz (External batteries)

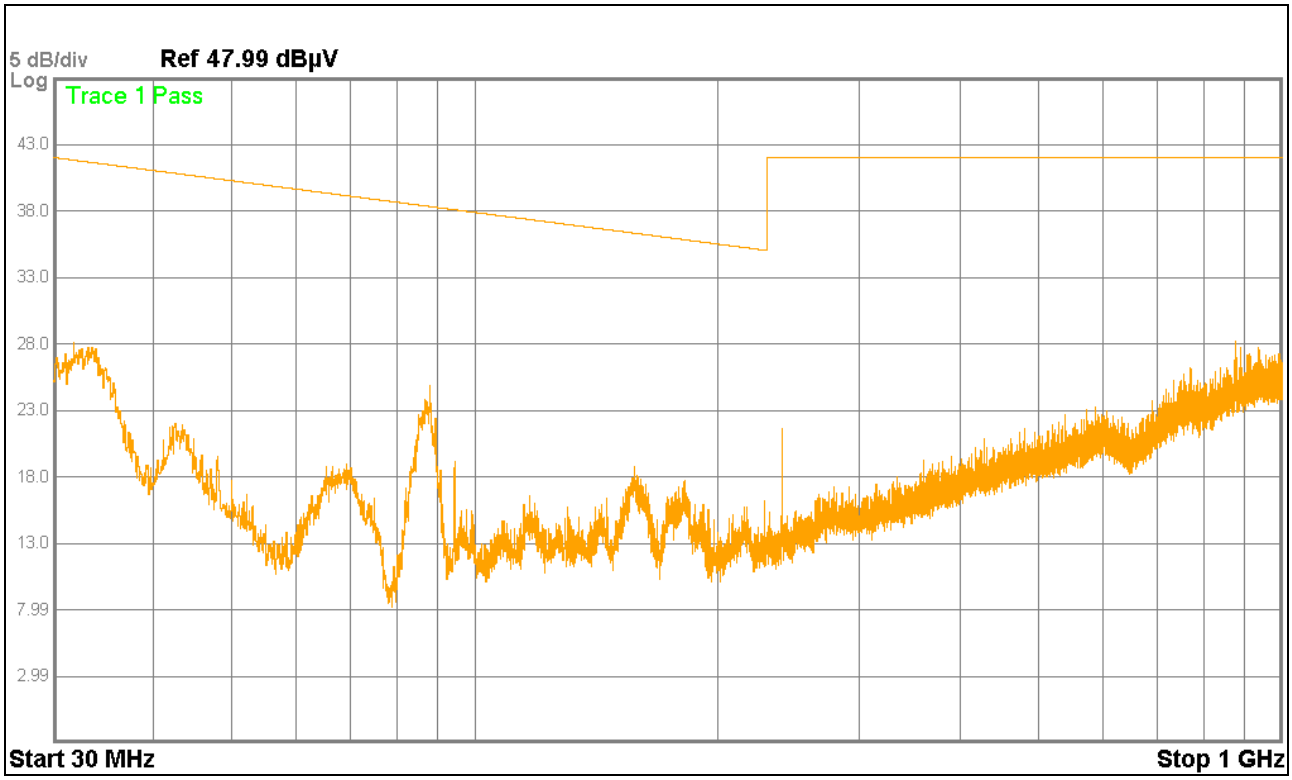
Graph 5: Represents radiated emissions measured from the EUT in the horizontal polarization



Graph 5: Radiated emissions results

7.1.8 Radiated Emission: 30 MHz – 1000MHz (External batteries)

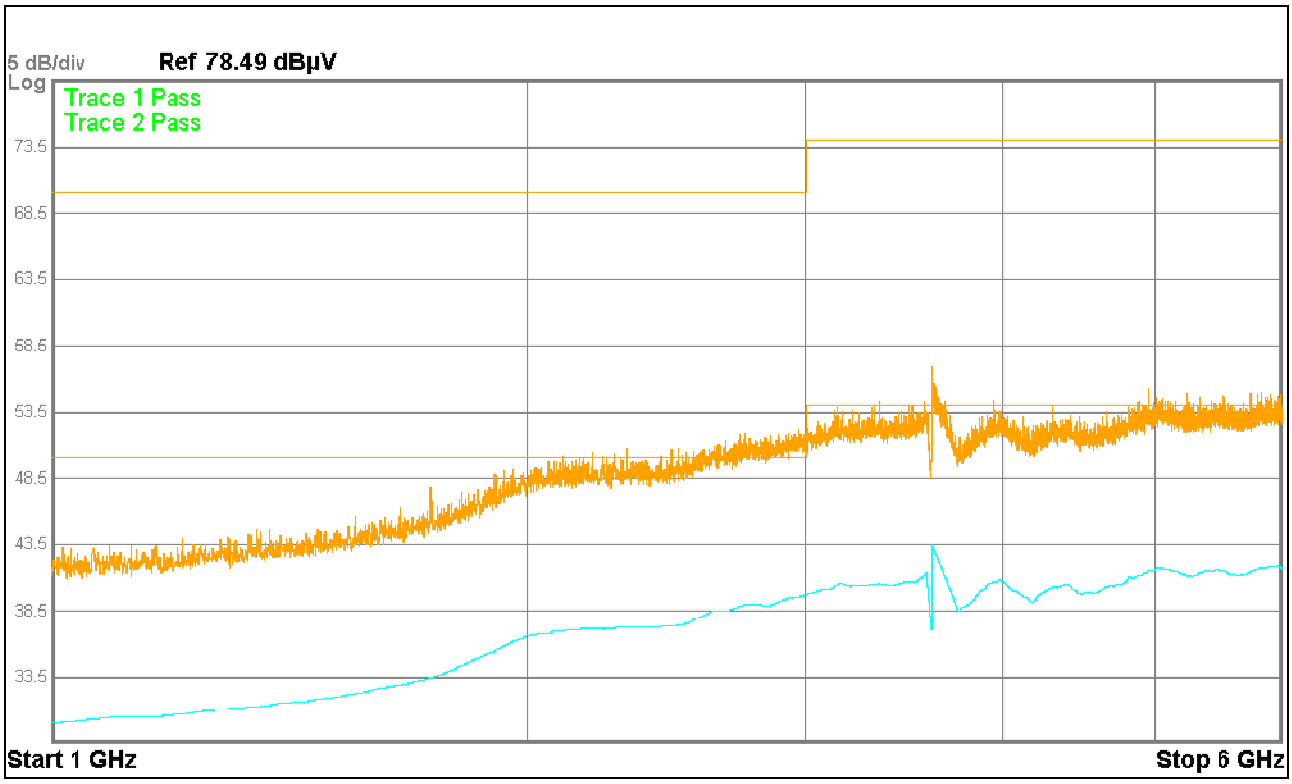
Graph 6: Represents radiated emissions measured from the EUT in the vertical polarization.



Graph 6: Radiated emissions results

7.1.9 Radiated Emission: 1000MHz – 6000MHz (External batteries)

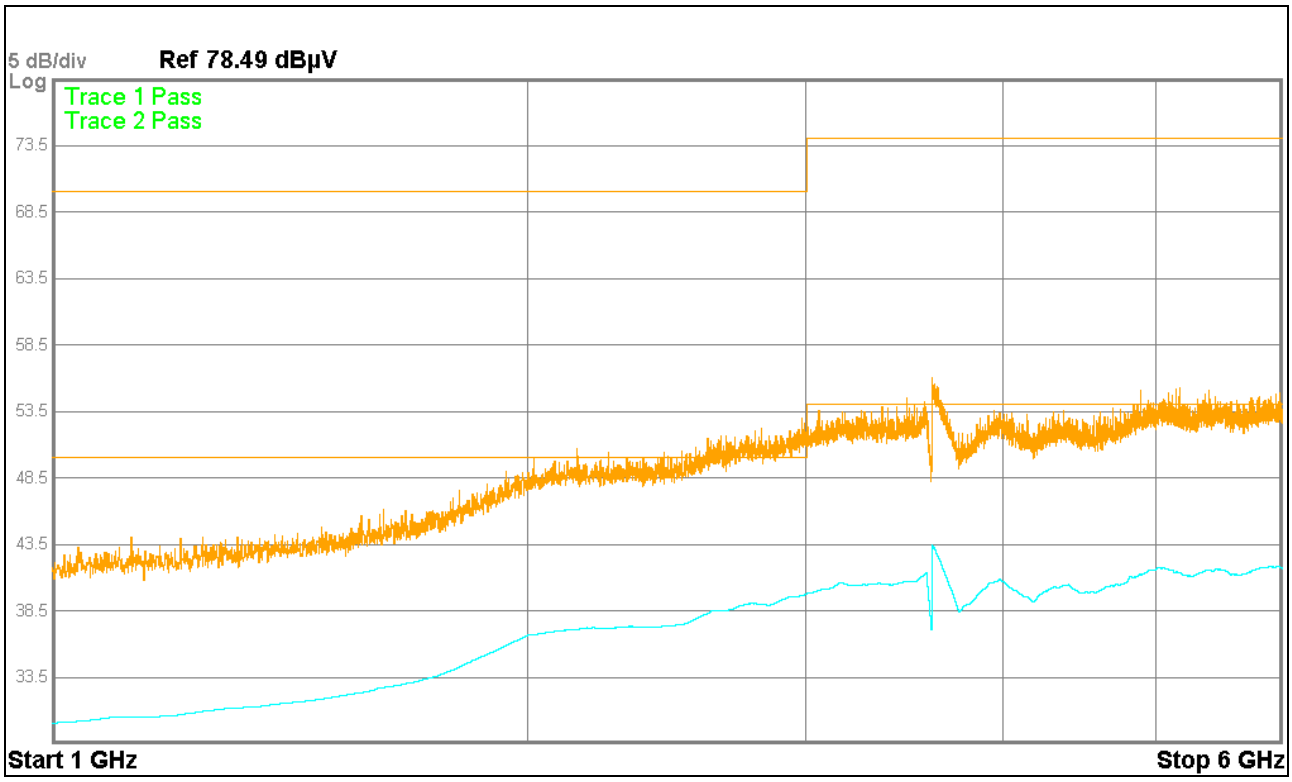
Graph 7: Represents peak and average radiated emissions measured from the EUT in the Horizontal polarization.



Graph 7: Radiated emissions results

7.1.10 Radiated Emission: 1000 MHz – 6000 MHz (External batteries)

Graph 8: Represents peak and average radiated emissions measured from the EUT in the vertical polarization



Graph 8: Radiated emissions results

7.1.11 Conclusion

- The EUT complies with the radiated emissions requirements of EN 55032 / CISPR 32.

7.2 CONDUCTED EMISSIONS:

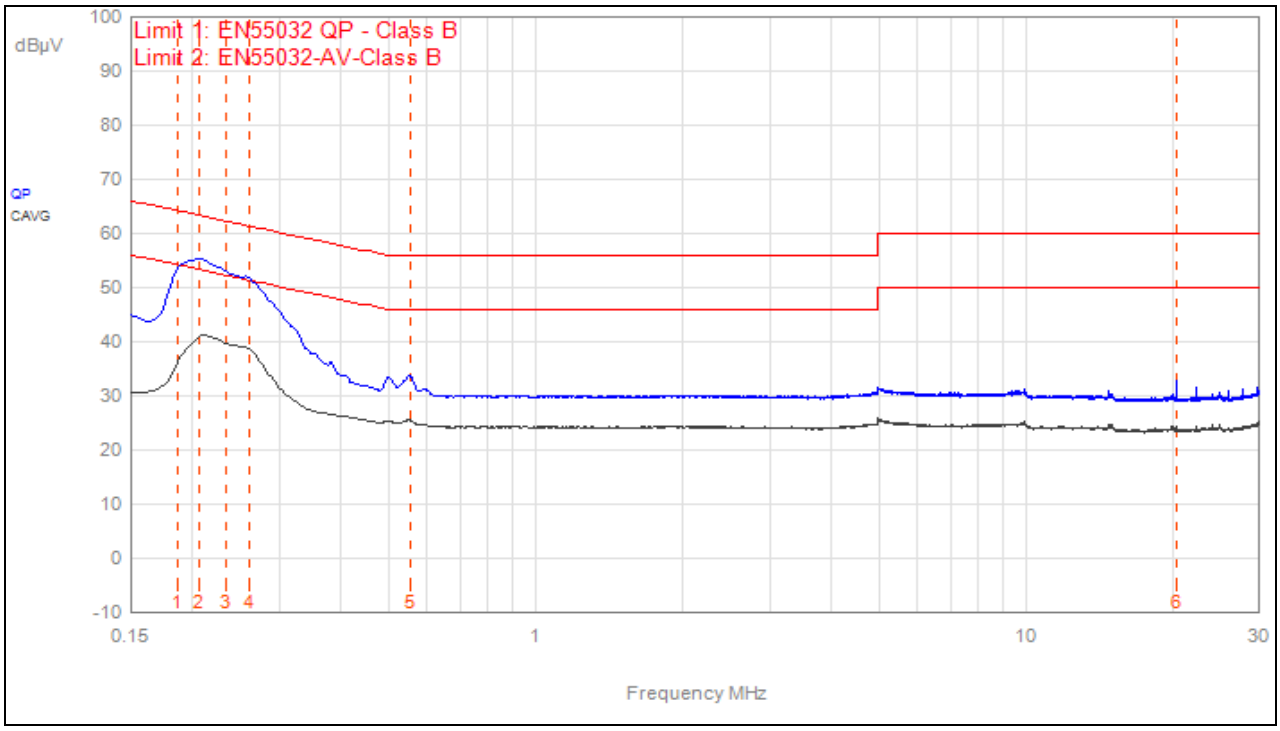
Method: The LISN was placed 0.8m from the boundary of the unit under test and bonded to a ground reference plane. This distance was the closest points of the LISN and the EUT. All other parts of the EUT and associated equipment were at least 0.8m from the LISN. The input power of the EUT was connected to the system through a LISN. Conducted voltage measurements on the mains lines were made at the output of the LISN. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurements with the average detector is unnecessary.

7.2.1 Test set-up

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
b. Automated scans in the frequency band 150kHz to 30MHz (radiated emissions) were done in order to determine compliance emissions results for the EUT.
c. Conducted emissions were tested while supplied with 12Vdc.
d. Both side of the power line were checked for maximum conducted interference.

7.2.2 AC Input - Positive

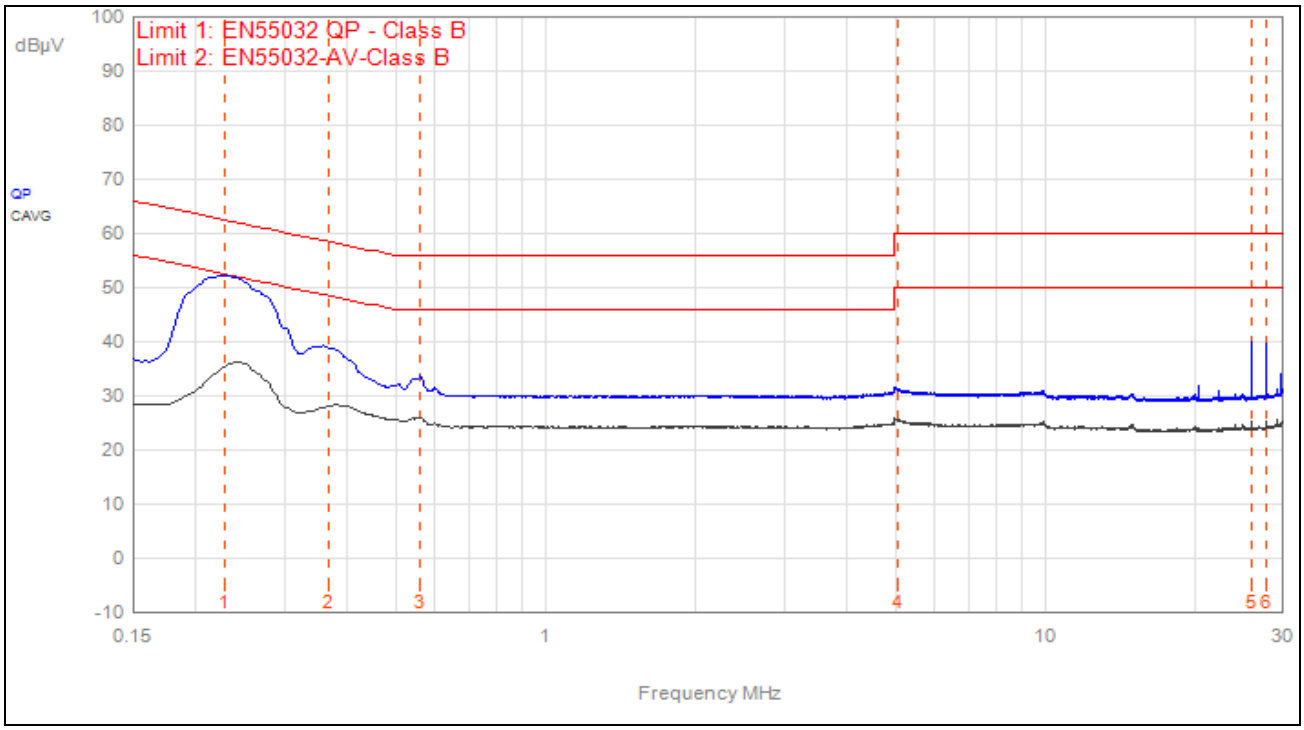
Graph CE1: Peak and Average Conducted emissions measured on the Positive lead of the EUT was below the Class B quasi peak and Average limit.



ID.	Frequency (MHz)	Detector	Measured Level (dBµV)	Limit (dBµV)	Δ Limit (dB)
1	186kHz	QPeak	53.7	Lim1 64.2 Lim2 54.2	Lim1 -10.5 Lim2 -0.5
2	207kHz	QPeak	55.4	Lim1 63.3 Lim2 53.3	Lim1 -8.0 Lim2 2.0
3	234kHz	QPeak	53.0	Lim1 62.3 Lim2 52.3	Lim1 -9.3 Lim2 0.7
4	261kHz	QPeak	51.8	Lim1 61.4 Lim2 51.4	Lim1 -9.6 Lim2 0.4
5	555kHz	QPeak	33.7	Lim1 56.0 Lim2 46.0	Lim1 -22.3 Lim2 -12.3
6	20.430MHz	QPeak	32.6	Lim1 60.0 Lim2 50.0	Lim1 -27.4 Lim2 -17.4
1	186kHz	C_AVG	36.1	Lim1 64.2 Lim2 54.2	Lim1 -28.1 Lim2 -18.1
2	207kHz	C_AVG	41.0	Lim1 63.3 Lim2 53.3	Lim1 -22.3 Lim2 -12.3
3	234kHz	C_AVG	39.8	Lim1 62.3 Lim2 52.3	Lim1 -22.5 Lim2 -12.5
4	261kHz	C_AVG	38.8	Lim1 61.4 Lim2 51.4	Lim1 -22.6 Lim2 -12.6
5	555kHz	C_AVG	25.5	Lim1 56.0 Lim2 46.0	Lim1 -30.5 Lim2 -20.5
6	20.430MHz	C_AVG	24.3	Lim1 60.0 Lim2 50.0	Lim1 -35.7 Lim2 -25.7

7.2.3 AC Input - Negative

Graph CE2: Peak and Average Conducted emissions measured on the Negative lead of the EUT was below the Class B quasi peak and Average limit.



ID.	Frequency (MHz)	Detector	Measured Level (dBµV)	Limit (dBµV)	Δ Limit (dB)
1	228kHz	QPeak	52.2	Lim1 62.5 Lim2 52.5	Lim1 -10.3 Lim2 -0.3
2	369kHz	QPeak	38.8	Lim1 58.5 Lim2 48.5	Lim1 -19.7 Lim2 -9.7
3	564kHz	QPeak	33.7	Lim1 56.0 Lim2 46.0	Lim1 -22.3 Lim2 -12.3
4	5.073MHz	QPeak	31.3	Lim1 60.0 Lim2 50.0	Lim1 -28.7 Lim2 -18.7
5	26.013MHz	QPeak	38.5	Lim1 60.0 Lim2 50.0	Lim1 -21.5 Lim2 -11.5
6	27.861MHz	QPeak	38.5	Lim1 60.0 Lim2 50.0	Lim1 -21.5 Lim2 -11.5
1	228kHz	C_AVG	35.3	Lim1 62.5 Lim2 52.5	Lim1 -27.3 Lim2 -17.3
2	369kHz	C_AVG	28.1	Lim1 58.5 Lim2 48.5	Lim1 -30.5 Lim2 -20.5
3	564kHz	C_AVG	25.9	Lim1 56.0 Lim2 46.0	Lim1 -30.1 Lim2 -20.1
4	5.073MHz	C_AVG	25.5	Lim1 60.0 Lim2 50.0	Lim1 -34.5 Lim2 -24.5
5	26.013MHz	C_AVG	24.9	Lim1 60.0 Lim2 50.0	Lim1 -35.1 Lim2 -25.1
6	27.861MHz	C_AVG	24.9	Lim1 60.0 Lim2 50.0	Lim1 -35.1 Lim2 -25.1

7.2.4 Conclusion

- The EUT complies with the conducted emissions requirements of the standard.

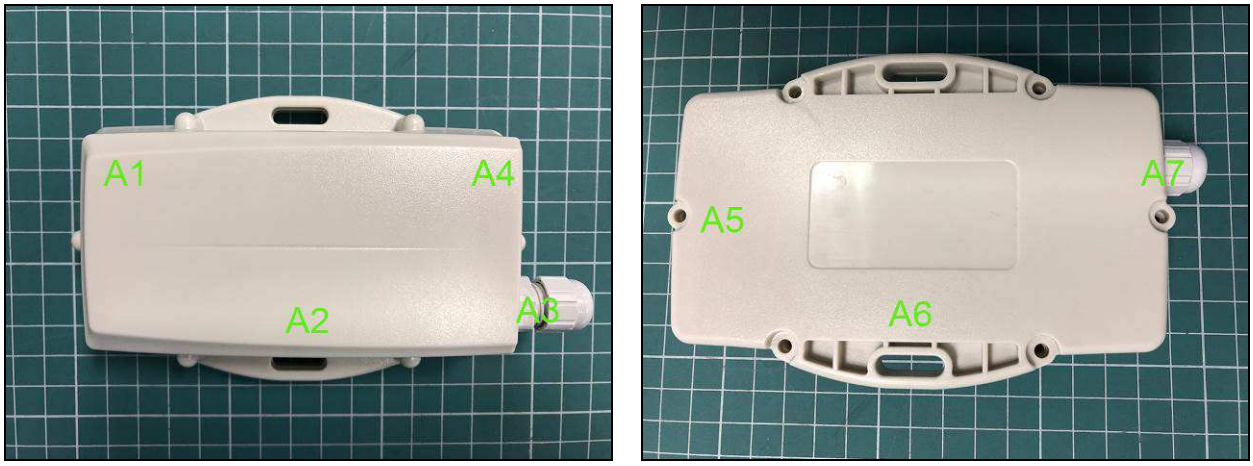
8. IMMUNITY

8.1 EN / IEC 61000-4-2: ESD IMMUNITY

Method: The test is intended to demonstrate the immunity of equipment subjected to static electricity discharges from operators directly and to adjacent objects. The table top equipment under test is placed on a wooden table, 0.8 m high, standing on the ground reference plane. A horizontal coupling plane (HCP), 1.6 x 0.8 m, is placed on the table. The EUT and the cables are isolated from the coupling plane by an insulating support 0.5 mm thick. The floor standing equipment is isolated from the ground reference plane by an insulating support about 0.1 m thick. The vertical coupling plane (VCP) of dimensions 0.5 m x 0.5 m is placed parallel to, and positioned at a distance of 0.1 m from, the EUT.

8.1.1 Set-up

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
b. The EUT was tested as tabletop equipment.



Figures 4 & 5: ESD discharge application points

8.1.2 Results

Discharge Point	Contact discharge voltage	Discharges	Result	Criteria
HCP	± 4kV	10	No effect	A
VCP	± 4kV	10	No effect	A
Discharge Point	**Air discharge voltage**	**Discharges**	**Result**	**Criteria**
A1 – A4	± 8kV	10	No effect	A
A5 – A7	± 8kV	10	No effect	A

8.1.3 Performance criteria

A: No loss of performance or function
B: Temporary loss of function or performance which is self-recoverable
C: Temporary loss of function or performance which requires operator intervention or system reset

Note 1: The EUT was unaffected by the applied ESD pulses.

8.2 EN / IEC 61000-4-3: RADIATED IMMUNITY

Method: The test allows estimating of the radiated immunity of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 80MHz to 6000MHz. The interference is applied on the enclosure of the equipment by using transmitting antennas that was placed 3m from the front of the EUT and support system.

8.2.1 Set-up

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
b. The signal source was stepped through the applicable frequency range at a rate of 1% of the fundamental. The dwell time was set to 1 second.
c. The 1kHz sine wave was amplitude modulated to a depth of 80% over the entire frequency band.
d. The EUT was connected to a Rohde & Schwartz CMW 500 base station simulator.
e. The EUT was closely monitored for signs of susceptibility during testing.

8.2.2 Results

EUT Position	Frequency (MHz)	Polarization	Level (V/m)	Result	Criterion
Front	80 – 1000	H	3	Pass	A
		V	3	Pass	A
Left	80 – 1000	H	3	Pass	A
		V	3	Pass	A
Right	80 – 1000	H	3	Pass	A
		V	3	Pass	A
Rear	80 – 1000	H	3	Pass	A
		V	3	Pass	A

EUT Position	Frequency (GHz)	Polarization	Level (V/m)	Result	Criterion
Front	1 - 6	H	3	Pass	A
		V	3	Pass	A
Left	1 - 6	H	3	Pass	A
		V	3	Pass	A
Right	1 - 6	H	3	Pass	A
		V	3	Pass	A
Rear	1 - 6	H	3	Pass	A
		V	3	Pass	A

8.2.3 Performance criterion

A: No loss of performance or function
B: Temporary loss of function or performance which is self-recoverable
C: Temporary loss of function or performance which requires operator intervention or system reset

Note 1: The EUT was unaffected by the applied RF between 80 – 6000MHz

8.3 EN / IEC 61000-4-4 FAST TRANSIENT IMMUNITY

Method: Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. Mains power tests were conducted with the product connected to a Coupling/Decoupling Network (CDN). I/O lines were tested in a Capacitive Coupling Clamp. One of each unique interface was tested for a period of one (1) minute per polarity.

8.3.1 Set-up and levels

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
a. The EUT was supplied with the required voltage and subjected to a direct injected 5 kHz repetition rate 5/50nS wave interference signal.
b. The EUT was tested as table top equipment.

DC Input port

Injection Method	Voltage	Repetition rate	Result
12 VDC Input	+0.5kV	5 / 100kHz	No Effect
	-0.5kV	5 / 100kHz	No Effect

I/O Ports

Injection Method	Voltage	Repetition rate	Result
Harness	+0.5kV	5 / 100kHz	No Effect
	-0.5kV	5 / 100kHz	No Effect

8.3.2 Performance criterion

A: No loss of performance or function
B: Temporary loss of function or performance which is self-recoverable
C: Temporary loss of function or performance which requires operator intervention or system reset

Note 1: The EUT was unaffected by the applied fast transients.

8.4 EN / IEC 61000-4-6 CONDUCTED IMMUNITY

Method: Measurements were made on a ground plane that extends at least 0.5-meter minimum beyond all sides of the system under test. The EUT was located 10cm above the reference ground plane and any associated I/O cables attached to the EUT were located between 30mm and 50mm above the ground plane. The indicated field was pre-calibrated prior to placement of the system under test.

8.4.1 Set-up and Test Levels

a. The EUT was tested within its intended operating conditions as specified by the manufacturer.
b. The signal source was stepped through 150kHz to 80MHz at a rate of 1% of the fundamental.
c. The 1kHz sine wave was amplitude modulated to a depth of 80% over the entire frequency band.
d. The EUT was closely monitored for signs of susceptibility during testing.

8.4.2 Result

Injection line	Coupling method	Voltage (Vrms)	Dwell time (s)	Result	Criterion
12VDC Input power	BCI	3	1	Pass	A
Harness	BCI	3	1	Pass	A

8.4.3 Performance criteria

A: No loss of performance or function
B: Temporary loss of function or performance which is self-recoverable
C: Temporary loss of function or performance which requires operator intervention or system reset

Note 1: The EUT was un-affected by the interfering signal.

9. APPENDIX A: NORMATIVE REFERENCES

1. ETSI EN 301 489-1 V2.1.1 (2017-02) ‘Electromagnetic compatibility and Radio Spectrum Matters (ERM)

2. ETSI EN 301 489-3 V2.1.1 (2013-06) 'Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz'

3. ETSI EN 301 489-52 V1.1.0 (2016-11) 'Specific conditions for Cellular Communications Mobile and portable (UE) radio and ancillary equipment.

4. EN 61000-4-2 (2009) / IEC 61000-4-2 (2008): Testing and measurement techniques – Electrostatic discharge immunity test

5. EN 61000-4-3 (2006+A2:2010) / IEC 61000-4-3 (2006+A1:2007+A2:2010): Testing and measurement techniques –Radiated, radio-frequency, electromagnetic field immunity test

6. EN 61000-4-4 (2012) / IEC 61000-4-4 (2012): Testing and measurement techniques – Electrical Fast Transient / Burst

7. EN 61000-4-6 (2014) / IEC 61000-4-6 (2013): Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

10. APPENDIX B: Test images

EN 55032 / CISPR 32: Radiated emissions test set-up

EN / IEC 61000-4-4: Fast transient / burst immunity test set-up

*** END OF REPORT ***