


TEST REPORT

No. AR19-0045638-06

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47
Part 15 Subpart B Section 15.107 and 15.109

PRODUCT	Control unit for electronic position indicator system
MODEL(s) TESTED	UC-RF ETHENET/IP
FCC ID	2AVRQ-UC-RF
TRADE MARK(s)	

APPLICANT	ELESA S.p.A. - Via Pompei, 29 – 20900 Monza (MB)
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Tested by	Alessandro Macri [Laboratory technician]	
Approved by	Roberto Colombo [Laboratory manager]	

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2022-07-07	First edition Digital signed - AR19-0045638-06_TR_FCC 15.107/109 _ Elesa_UC-RF

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.
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1. GENERAL DATA

SAMPLE		
Samples received on	2020-07-10	(Item(s) sampled and sent by applicant)
IMQ reference samples	BEM	100208
Samples tested No.	1 (BEM 100208)	
Object under analysis recognition	Not carried out Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
Date of acceptance of test item	2020-07-10	
TEST LOCATION		
Testing dates	2021-02-01	
Testing laboratory.	IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano	
Testing site	Via Quintiliano, 43 – I-20138 Milano	
ENVIRONMENTAL CONDITIONING		
Parameter	Measured	
Ambient Temperature	24.2 °C	
Relative Humidity	47 %	
Atmospheric Pressure	1001 mbar	
The laboratory is monitored by a continuous environmental conditions measurements system. Temperature, humidity and pressure data are recorded on a weekly basis and stored in local archive.		
REMARKS		
Throughout this report a point is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant		

2. REFERENCE DOCUMENT

	DOCUMENT	DATE	TITLE
<input checked="" type="checkbox"/>	47 CFR Part 15	2015	Radio Frequency Device
<input checked="" type="checkbox"/>	ANSI C63.4	2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
<input checked="" type="checkbox"/>	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices

3. UNIT UNDER TEST (EUT) DETAILS

GENERAL DATA

MODEL (basic)	Description
UC-RF ETHERNET/IP(*)	Control unit for electronic position indicator system
VARIANTS (derived)	Description
UC-RF MODBUS TCP	As UC-RF ETHERNET/IP with different communication port
UC-RF PROFINET IO	As UC-RF ETHERNET/IP with different communication port

Note	<p>(*)The devices presented the same radio module and electronics, only the transmission in the communication port varies (same communication port with different software inside).</p> <p>After a preliminary analysis, only the product with the worst results was reported in the report</p>
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FCC ID	2AVRQ-UC-RF
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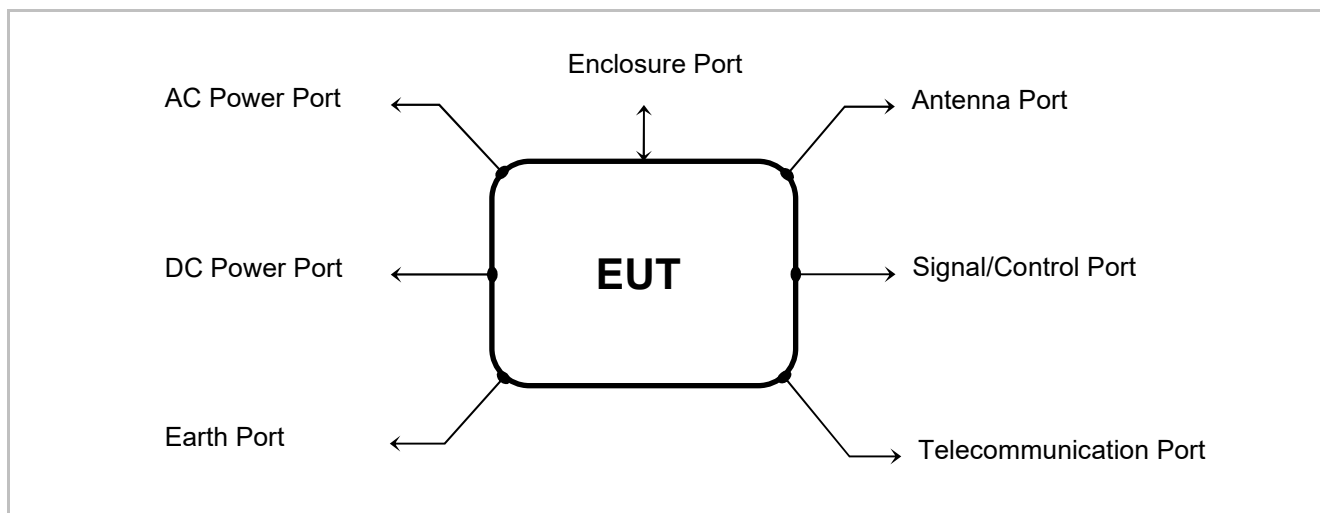
Manufacturer	ELESA S.p.A. - Via Pompei, 29 – 20900 Monza (MB)
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classification	According to the definition 15.3 (o) EUT is a Intentional Radiator operating within the bands 2400 ÷ 2483.5 MHz so it shall fulfill provisions of 47CFR Part 15 Subpart C – Intentional radiators – and Section 15.249
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Type of equipment	Control unit with 2.4 GHz module integrated
Operating frequency:	2400 ÷ 2483.5 MHz
Maximum RF radiated power:	92.53 dBuV/m
Modulation:	MSK modulation
Channel Spacing:	200 kHz
Antenna:	ANT-2.4-WRT-RPS

4. TEST CONFIGURATION OF UNIT UNDER TEST

EUT PORTS



Port	Description	Max length
Enclosure	Plastic	/
AC power	/	/
DC power	24 V DC	/
Earth	Yes	/
Telecommunication	Ethernet	/
Signal	/	/
Control	/	/
Antenna	External	/

STATE OF THE EUT DURING TESTS

Ref.	Mode	Description
#1	Operating	Standby mode

SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested:

Equipment	Manufacturer	Model
/	/	/

ELECTROMAGNETICALLY RELEVANT COMPONENTS

Component	No.	Manufacturer	Model
Main board	1	ELESA	T300 v1.3
Radio module	1	TEXAS INSTRUMENTS	CC2500

RFI SUPPRESSION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EMI PROTECTION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EUT TECHNICAL DOCUMENTATION

Document	Reference
/	/

5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4:2014, ANSI C63.10:2013 and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the § 6 of this test report.

FREQUENCY RANGE INVESTIGATED

Conducted emission tests: from 150 kHz to 30 MHz.

Radiated emission tests: from 9 kHz to 13 GHz (fifth harmonic of highest frequency)

6. SUMMARY OF TEST RESULTS

POSSIBLE TEST CASE VERDICTS:	
Test object meets the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

CFR47 Part 15	TITLE	RESULT
§ 15.107	Conducted emission	PASS
§ 15.109	Radiated disturbances	PASS

7. TEST RESULTS

7.1 CONDUCTED EMISSION

TEST REQUIREMENT	
Test setup	ANSI C63.4
Frequency range	150 kHz ÷ 30 MHz
IF bandwidth	9 kHz
EMC class	B
Limits	section 15.107
EUT operating condition	#1
Remark	None
Testing dates	2021-02-01

TEST RESULT
The EUT meets the requirements of sections 15.107.

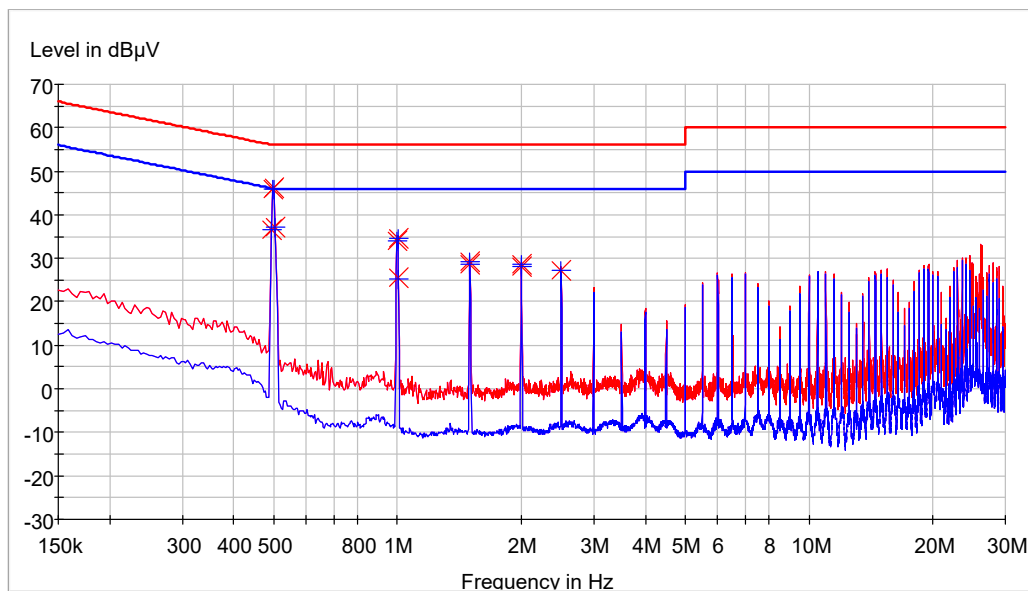
TEST PROCEDURE
<ol style="list-style-type: none"> 1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 10 cm in which is located 40 cm away from the vertical wall the shielded room. 2) Each EUT power cord input cord was individually connected through a 50Ω/50μH LISN to the input power source. 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement. 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz. 5) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 10 kHz during the measurements. 6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are \geq (Q.P. limit - 6 dB).

NOTE
The product falls into class A. In any case, class B limits are included in the report, which are more restrictive than class A.

MEASUREMENTS RESULTS

Port: AC MAINS POWER PORT

Line: PHASE + NEUTRAL



Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Line	Margin QP (dB)	Margin AV (dB)
0.494000	36.5	36.4	N	20.5	10.4
0.498000	45.9	45.9	N	11.1	1.1
0.502000	46.3	46.0	L1	10.7	1.0
0.506000	37.1	37.1	N	19.9	9.9
0.998000	34.0	34.0	N	23.0	13.0
1.002000	34.5	34.5	L1	22.5	12.5
1.006000	25.5	25.3	N	31.5	21.7
1.498000	28.6	28.6	N	28.4	18.4
1.502000	29.1	29.1	N	27.9	17.9
1.998000	28.1	28.0	N	29.0	18.9
2.002000	28.6	28.6	N	28.4	18.4
2.502000	27.2	27.2	N	29.8	19.8

7.2 RADIATED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber
Test distance	3 meters
Frequency range	9 kHz to 13 GHz
IF bandwidth (below 30 MHz)	9 kHz
IF bandwidth (below 1,000 MHz)	120 kHz
IF bandwidth (above 1,000 MHz)	1 MHz
Deviation to test procedure	None
Limits	sections 15.109
EUT operating condition	#1
Remark	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$
Testing dates	2021-02-01

TEST RESULT

The EUT meets the requirements of sections 15.109

LIMITS FOR SPURIOUS		
Band of operations	Limit $\mu\text{V/m}$	Limit $\text{dB}\mu\text{V/m}$
30÷88 MHz	100	40
88÷216 MHz	150	43,5
216÷960 MHz	200	46
Above 960MHz	500	54
Band of operations	Limit $\text{dB}\mu\text{V/m}$ Peak	Limit $\text{dB}\mu\text{V/m}$ Average
Above 1000 MHz	74	54

TEST PROCEDURE

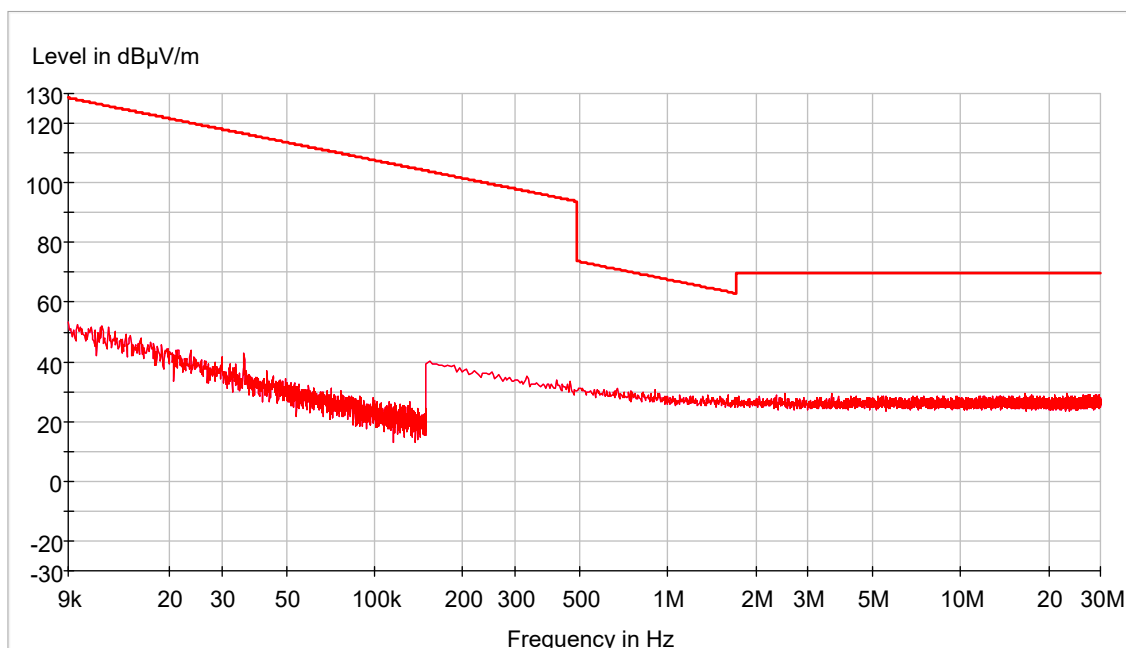
- 1) The EUT was placed on turntable which is 0.8 m above the ground plane
- 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.
- 3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
- 4) The measurements were made with the detector set to **PEAK** amplitude within a bandwidth of 120 kHz below 1000 MHz and 1 MHz above 1000 MHz.
- 5) The receiving antenna was positioned in both horizontal and vertical polarization.
- 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are \geq Q.P. limit – 6 dB (♦ mark symbol).

NOTE

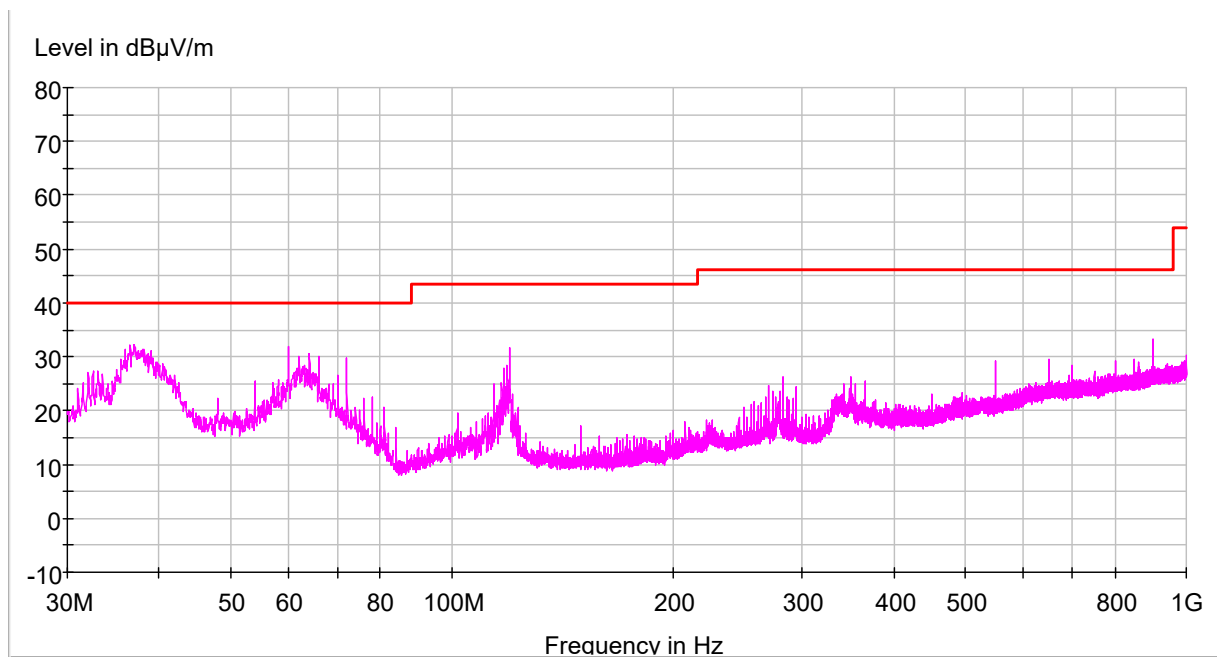
The product falls into class A. In any case, class B limits are included in the report, which are more restrictive than class A.

MEASUREMENTS RESULTS

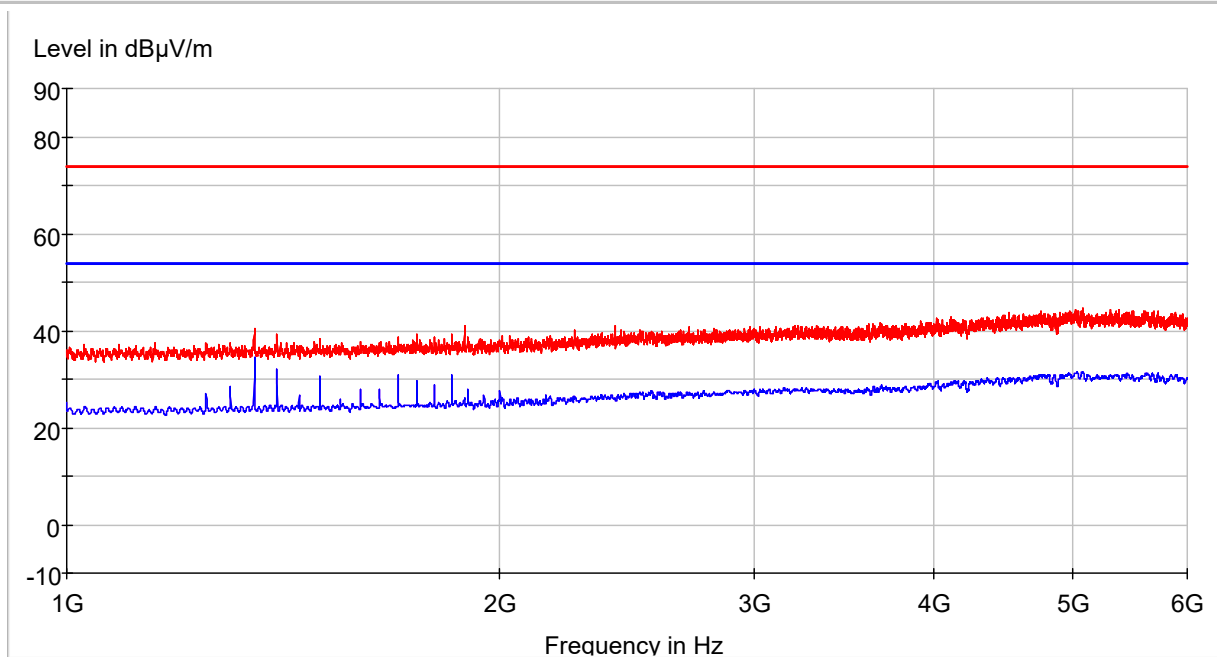
Range: 9 kHz ÷ 30 MHz



Range: 30 ÷ 1000 MHz



Range: 1 ÷ 6 GHz



Tabular worst case measurement result >6,000 MHz (PK & AV)

PEAK RESULT (RBW=1MHz; VBW=3MHz)								
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correct reading	PK Limit (AV + 20dB)		Margin
(MHz)	(dBμV)	(dB@3m)	(dB)	(dB)	(dBμV/m)	(μV/m)	(dBμV/m)	(dB)
f>6000	No significant values were found					5000	74	/

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)								
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correct reading	AV Limit		Margin
(MHz)	(dBμV)	(dB@3m)	(dB)	(dB)	(dBμV/m)	(μV/m)	(dBμV/m)	(dB)
f>6000	No significant values were found (see also above plots)					500	54	/

8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001 and IO-LAB-004. and requirement of NIST Technical Note 1297 and NIS 81:1994 “The Treatment of Uncertainty in EMC Measurements”

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements”, with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.

Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods/Standard	Parameter	Expanded Uncertainty	Unit	Confidence level
Continuous disturbance	QP detector 9 – 150 kHz	2.47	dB	95%
	QP detector 150 k – 30 MHz	2.61	dB	95%
	QP detector using Voltage Probe	2.45	dB	95%
	QP detector using ISN	3.15	dB	95%
	QP detector using Current Probe	2.15	dB	95%
Radiated disturbance	QP detector (30 MHz - 100 MHz) H polarization	4.33	dB	95%
	QP detector (30 MHz - 100 MHz) V polarization	4.22	dB	95%
	QP detector (100 MHz - 200 MHz) H polarization	3.40	dB	95%
	QP detector (100 MHz - 200 MHz) V polarization	4.76	dB	95%
	QP detector (200 MHz - 1000 MHz) H polarization	3.91	dB	95%
	QP detector (200 MHz - 1000 MHz) V polarization	3.82	dB	95%
	P detector 1-6 GHz	4.77	dB	95%

9. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

Instrument	Manufacturer	Model	IMQ Ref.	Cal. Date	Cal. Due
Shielded semi-anechoic chamber	SIDT	/	P01709	2019-10-21	2021-10-31
Turntable controller unit	FRANKONIA	FCTAM01	P02486	/	/
Mast antenna	FRANKONIA	FAM4	P02488	/	/
Log antenna	ARA	LPB-2513	S02385	2020-07-20	2021-07-31
Horn Antenna	SCHWARZBECK	BBHA 9120D	S03463	2020-07-06	2021-07-31
Loop Antenna	ROHDE & SCHWARZ	HFH2-Z2	S02508	2020-08-18	2021-08-31
Spectrum Analyzer	Rohde & Schwarz	FSP40	S03629	2020-12-10	2021-12-31
Preamplifier	Hewlett Packard	HP 8449B	S03542	2020-04-05	2021-04-30
Artificial Mains V-network	ROHDE & SCHWARZ	ESH2-Z5	S00554	2020-11-30	2021-11-30
Pulse limiter	ROHDE & SCHWARZ	ESH3-Z2	S02153	2020-11-30	2021-11-30
Software	ROHDE & SCHWARZ	EMC32 Ver. 6.30	W-00199/E	/	/
PC	/	/	H-00165	/	/

END OF REPORT