T E S T R E P O R T
No.: 19-1-0192101T01a-C1

According to:

Title 47
FCC Regulations Subpart 15C
§15.231(e)
ISED-Regulations
RSS-Gen, Issue 5
RSS-210, Issue 10

for

PACIFIC Industrial Co., Ltd.

Flex-Sens
TPMS transmitter (Universal Sensor)
PMV-E002

FCC-ID: PAXPMVE002
ISED: 3729A-PMVE002

Laboratory Accreditation and Listings
Accredited EMC-Test Laboratory
accredited according to DIN EN ISO/IEC 17025:2018

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The listed attachments are an integral part of this report.

1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests. Also we refer on special conditions with the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

The Equipment Under Test (in this report, hereinafter referred as EUT) incorporates a transceiver operating at 315 MHz nominal frequency and a receiver at 125 kHz, which is not the subject of this test report.

Following tests have been performed to show compliance with applicable FCC Part 15, Subpart C (Unintentional Radiators) of the CFR 47 Rules, Edition 2020 and Canadian RSS-210, Issue 10 and RSS-Gen, Issue 5 standards.

1.1. TEST OVERVIEW FCC 15.231 AND ISED RSS-210, ISSUE 10, CHAPTER A.1

TX-Mode							
TEST CASES	**PORT**	**REFERENCES & LIMITS**			**EUT set-up**	**EUT opera-**	**Result**
		FCC Standard	**RSS Section**	**Test limit**		**ting mode**	
Radiated field strength fundamental @3 m	Cabinet	§2.1046 §15.205 §15.231(e)	RSS-210, Issue 10, Chapter A1.2	67.66 dBµV/m FCC 15.231(e) ISED: Table A1	1	1	Passed
20 dBc bandwidth	Cabinet	§2.202(a) §2.1049	RSS Gen, Issue 5, Chapter 6.7	0.5% of fc	1	1	Passed
99% bandwidth	Cabinet	§2.202(a) §2.1049	RSS Gen, Issue 5, Chapter 6.7	0.5% of fc	1	1	Passed
General field strength emissions (radiated - (9 kHz to 30 MHz)	Cabinet	§15.209(a)	RSS-Gen, Issue 5 Chapter 8.9 Table 6	2400/f(kHz) µV/m 24000/f(kHz) µV/m 30 µV/m	1	1	Passed
Radiated field strength spurious emissions @3 m	Cabinet	§2.1046 §15.205 §15.231(e)	RSS-210, Issue 10, Chapter A1.2	FCC: §15.231(e) ISED: 10-times lower Table A1 or RSS-Gen.	1	1	Passed
Transmitter timing: Periodic transmissions	Cabinet	§15.231(e)	RSS-210, Issue 10, Chapter A1.1	FCC: §15.231(e) ISED: A.1.1	1	1	Passed
Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 5: Chapter 8.8, Table 4	FCC §15.207 limits	--	--	Not applicable Car environment
				ISED: Table 4	--	--	

The test report CETECOM_TR19_1_0192101T01a-C1 dated 2020-08-26 substitutes test report CETECOM_TR19_1_0192101T01a, dated 2020-08-24. The substituted test report gets invalid herewith.

1.2. Attestation:

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.

Digital signiert von: Christian Lorenz
Name: CN = Christian Lorenz email = christian.lorenz@cetecom.com C = DE O = CETECOM GmbH OU = RC&EMC
Datum: 2020.08.26 13:41:59 +02'00'

Guangcheng Huang
2020.08.26 12:46:14 +02'00'

Dipl.-Ing. Ch. Lorenz	M.Sc. G. Huang
Responsible for test section	Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Niels Jeß
Deputy:	Dipl.-Ing. Ninovic Perez

2.2. Test location

2.2.1. Test laboratory

Company name:	see chapter 2.1. Identification of the testing laboratory

2.3. Organizational items

Responsible for test report and project leader:	M.Sc. G. Huang
Receipt of EUT:	2020-01-18
Date(s) of test:	2020-02-28 to 2020-07-29
Date of report:	2020-08-26

Version of template: 13.02	

2.4. Applicant’s details

Applicant’s name:	PACIFIC Industrial Co., Ltd.
Address:	1300-1 Yokoi 503-2397, Godo-cho, Anpachi-gun, Gifu JAPAN
Contact person:	Mr. KUNITAKA YANO

2.5. Manufacturer’s details

Manufacturer’s name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. Technical data of main EUT declared by applicant

Frequency range and channels (US/Canada -bands)	315 MHz		
Type of modulation (packet types)	F2D, A2D		
Max. 20dB bandwidth	126.9231 kHz		
Max. 99% bandwidth	179.4872 kHz		
Number of channels (USA/Canada -bands)	1 (315.00 MHz, measured) Range of operation < 1 MHz		
Number of Antenna ports	-		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna Gain	Not reported		
MAX Field strength (radiated):	56.47 dBµV/m AVG @ 3 m distance (Calculated from Peak value with Duty-Cycle Correction)		
Max. E.R.P.: (calculated from field strength)	-38.73 dBm (0.00013 mW)		
Installed options (not tested within this test report)	☒ Receiver on 125 kHz		
Power supply	☒ Internal lithium battery, nominal voltage: 3 V		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
Firmware	☒ for normal use		☒ Special version for test execution
FCC/ISED label attached	☐ yes		☒ no

3.2. EUT: Type, S/N etc. and short descriptions used in this test report

Short descrip-tion*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A (S10)	Flex-Sens PMV-E002	TPMS transmitter (Universal Sensor)	000000B3	0001	0001
EUT B (S11)	Flex-Sens PMV-E002	TPMS transmitter (Universal Sensor)	000000B7	0001	0001
EUT C (S14)	Flex-Sens PMV-E002	TPMS transmitter (Universal Sensor)	Ox01B0	0001	0002

*) EUT short description is used to simplify the identification of the EUT in this test report.

3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1 (S03)	TPMS compact trigger tool	N5230-00001	FS_Auth_06	0001	va.1.50
AE 2 (S13)	TPMS compact trigger tool	N5230-00001	FS_Auth_07	0001	va.1.50

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A (+ AE 1)	For radiated measurement
set. 2	EUT B (+ AE 1)	For radiated measurement
set. 3	EUT A (+ AE 2)	For radiated measurement
set. 4	EUT C (+ AE 2)	For radiated measurement

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.
Remark: AE 1 and AE 2 are used only before the measurement for setting the EUT.

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information **)
op. 1	TX No.21	TC No.21: Continuous wave transmission for 30 min
op. 2	TX No.28	TC No.28: Continuous ASK modulation for 30 min
op. 3	TX No.29	TC No.29: Continuous FSK modulation for 30 min, Dev = ±20 kHz
op. 4	TX No.30	TC No.30: Continuous FSK modulation for 30 min, Dev = ±25 kHz
op. 5	TX No.31	TC No.31: Continuous FSK modulation for 30 min, Dev = ±30 kHz
op. 6	TX No.32	TC No.32: Continuous FSK modulation for 30 min, Dev = ±35 kHz
op. 7	TX No.33	TC No.33: Continuous FSK modulation for 30 min, Dev = ±40 kHz
op. 8	TX No.34	TC No.34: Continuous FSK modulation for 30 min, Dev = ±50 kHz
op. 9	TX No.2	TC No.2: Send one packet every 16 s, FSK modulation
op. 10	TX No.7	TC No.7: Send one packet every 16 s, ASK modulation
op. 11	TX No.8	TC No.8: One time transmission ASK + FSK (non-periodic)
op. 12	TX No.12	TC No.12: One time transmission FSK + FSK (non-periodic)
op. 13	TX No.17	TC No.17: Send one packet every 256 s, FSK modulation
op. 14	TX No.20	TC No.20: Send one packet every 256 s, ASK modulation

*): EUT operating mode no. is used to simplify the test report.
**): Information provided by applicant.
Remark: TC is the abbreviation for Trigger Command. Details see document “Trigger_Tool_PMV-E002,E102_Instruction_Manual(FCC, IC)_English_200113 (1).pdf” and “Trigger_Tool_PMV-E002,E102_Instruction_Manual(FCC, IC)_English_⊿1_200407.pdf“provided by applicant.

3.6. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	-	-	-	-	-

4. Description of test system set-up's

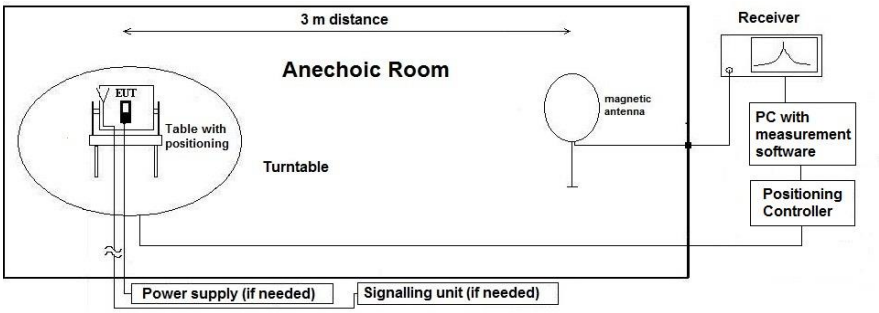
4.1. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1 , ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

General Description: Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

Exploratory, preliminary measurement
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF =Antenna factor
C_L = Cable loss
D_F= Distance correction factor
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A= Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

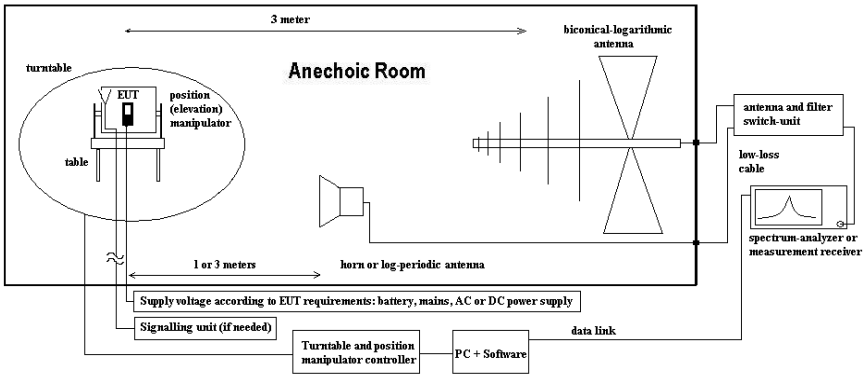
Distance correction: Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

4.2. Test system set-up for radiated electric field measurement 30 MHz to 1 GHz

Specification: ANSI C63.4-2014 chapter 8.2.3, ANSI C63.10-2013 chapter 6.5

General Description: Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1.0 m and 1.82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

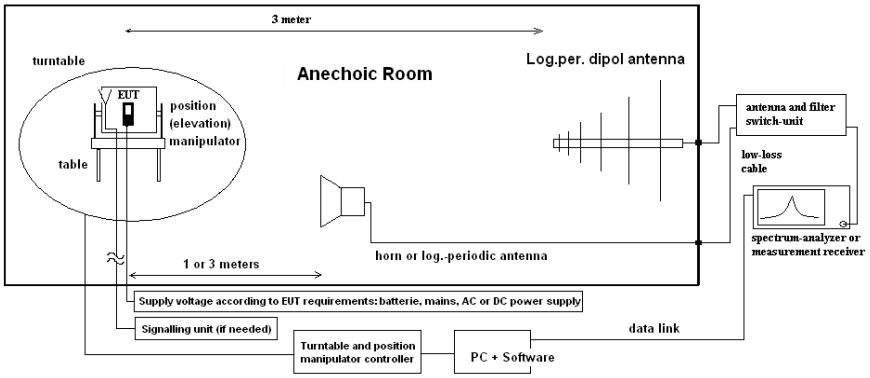
All units are dB-units, positive margin means value is below limit.

4.3. Test system set-up for radiated electric field measurement above 1 GHz

Specification: ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4

General Description: Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined. Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

5. Measurements

5.1. General Limit - Radiated field strength emissions below 30 MHz

5.1.1. Test location and equipment

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☒ 620 ESU26		☐	☐	☐
spectr. analyz.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 250 38 HFH2-Z2	☐ 021 EMCO6502
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 466 Fluke112
line voltage	☐ 060 120 V 60 Hz via PAS 5000					

5.1.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
ANSI	C63.10-2013			
Frequency [MHz]	Field strength limit [µV/m]	[dBµV/m]	Distance [m]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705 – 30	30	29.5	30	Correction factor used due to measurement distance of 3 m
ISED	☒ RSS-Gen: Issue 5: §8.9 Table 6		☐ ICES-001, Issue 2 / CISPR11 ((Table 3b – induction cooking appliances)	
9-490 kHz	6.37/f (f in kHz) (H-Field) (µA/m)		0.009-0.070 MHz	69 (dBµA/m)
490-1705 kHz	63.7/f (f in kHz) (µA/m)		0.070-0.1485 MHz	69 (dBµA/m) decreasing linearly with logarithm of frequency to 39 (dBµA/m)
1705-30 MHz	0.08 (µA/m)		0.1485-4.0 MHz	39 dBµA/m decreasing linearly with logarithm of frequency to 3 (dBµA/m)
			4.0-30 MHz	3 (dBµA/m)

5.1.3. Test condition and test set-up

Signal link to test system (if used):		☐ air link	☐ cable connection	☒ none
EUT-grounding		☒ none	☐ with power supply	☐ additional connection
Equipment set up		☒ table top		☐ floor standing
Climatic conditions		Temperature: (22±3 °C)		Rel. humidity: (40±20)% rH
EMI-Receiver or Analyzer Settings	Scan data	☒ 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz ☒ 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz ☐ other:		
	Scan-Mode Detector Mode: Sweep-Time	☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyzer Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) Repetitive-Scan, max-hold Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle		
General measurement procedures		Please see chapter "Test system set-up radiated magnetic field measurements below 30 MHz"		

5.1.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

Table of measurement results:

Diagram No.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.01	-	1	9 kHz - 30 MHz	2	1	EUT at standing position	☒	☐	☐	passed
2.02	-	1	9 kHz - 30 MHz	2	1	EUT at laying position	☒	☐	☐	passed

5.1.5. Correction factors due to reduced meas. distance (f < 30 MHz)

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors.

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition **(dmeas< $D_{near-field}$)**	2'te Condition **(Limit distance bigger $d_{near-field}$)**	**Distance Correction accord. Formula**
	9.00E+03	33333.33	5305.17		fullfilled	not fullfilled	-80.00
	1.00E+04	30000.00	4774.65		fullfilled	not fullfilled	-80.00
	2.00E+04	15000.00	2387.33		fullfilled	not fullfilled	-80.00
	3.00E+04	10000.00	1591.55		fullfilled	not fullfilled	-80.00
	4.00E+04	7500.00	1193.66		fullfilled	not fullfilled	-80.00
	5.00E+04	6000.00	954.93		fullfilled	not fullfilled	-80.00
	6.00E+04	5000.00	795.78		fullfilled	not fullfilled	-80.00
	7.00E+04	4285.71	682.09		fullfilled	not fullfilled	-80.00
	8.00E+04	3750.00	596.83	**300**	fullfilled	not fullfilled	-80.00
	9.00E+04	3333.33	530.52		fullfilled	not fullfilled	-80.00
kHz	1.00E+05	3000.00	477.47		fullfilled	not fullfilled	-80.00
	1.25E+05	2400.00	381.97		fullfilled	not fullfilled	-80.00
	2.00E+05	1500.00	238.73		fullfilled	fullfilled	-78.02
	3.00E+05	1000.00	159.16		fullfilled	fullfilled	-74.49
	4.00E+05	750.00	119.37		fullfilled	fullfilled	-72.00
	4.90E+05	612.24	97.44		fullfilled	fullfilled	-70.23
	5.00E+05	600.00	95.49		fullfilled	not fullfilled	-40.00
	6.00E+05	500.00	79.58		fullfilled	not fullfilled	-40.00
	7.00E+05	428.57	68.21		fullfilled	not fullfilled	-40.00
	8.00E+05	375.00	59.68		fullfilled	not fullfilled	-40.00
	9.00E+05	333.33	53.05		fullfilled	not fullfilled	-40.00
	1.00	300.00	47.75		fullfilled	not fullfilled	-40.00
	1.59	188.50	30.00		fullfilled	not fullfilled	-40.00
	2.00	150.00	23.87		fullfilled	fullfilled	-38.02
	3.00	100.00	15.92		fullfilled	fullfilled	-34.49
	4.00	75.00	11.94		fullfilled	fullfilled	-32.00
	5.00	60.00	9.55		fullfilled	fullfilled	-30.06
	6.00	50.00	7.96		fullfilled	fullfilled	-28.47
	7.00	42.86	6.82		fullfilled	fullfilled	-27.13
	8.00	37.50	5.97		fullfilled	fullfilled	-25.97
	9.00	33.33	5.31		fullfilled	fullfilled	-24.95
	10.00	30.00	4.77	**30**	fullfilled	fullfilled	-24.04
	10.60	28.30	4.50		fullfilled	fullfilled	-23.53
MHz	11.00	27.27	4.34		fullfilled	fullfilled	-23.21
	12.00	25.00	3.98		fullfilled	fullfilled	-22.45
	13.56	22.12	3.52		fullfilled	fullfilled	-21.39
	15.00	20.00	3.18		fullfilled	fullfilled	-20.51
	15.92	18.85	3.00		fullfilled	fullfilled	-20.00
	17.00	17.65	2.81		not fullfilled	fullfilled	-20.00
	18.00	16.67	2.65		not fullfilled	fullfilled	-20.00
	20.00	15.00	2.39		not fullfilled	fullfilled	-20.00
	21.00	14.29	2.27		not fullfilled	fullfilled	-20.00
	23.00	13.04	2.08		not fullfilled	fullfilled	-20.00
	25.00	12.00	1.91		not fullfilled	fullfilled	-20.00
	27.00	11.11	1.77		not fullfilled	fullfilled	-20.00
	29.00	10.34	1.65		not fullfilled	fullfilled	-20.00
	30.00	10.00	1.59		not fullfilled	fullfilled	-20.00

5.2. Radiated electric field strength emissions (30 MHz to 1 GHz)

5.2.1. TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☐ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☒ 620 ESU26	☐ 25023 ESVS 30	☐	☐	☐
spectr. analyz.	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐	☐
antenna	☒ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 021 EMCO6502
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 466 Fluke112
otherwise	☒ 482 Filter-Matrix	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 477 GPS	☐

5.2.2. FUNDAMENTAL LIMITS: CFR 47, §15.231(e), RSS-210, Issue 10, Chapter A.1.4

Frequency [MHz]	Field strength@3m		Measurement distance [meters]	Remarks
	[µV/m]	[dBµV/m]		
40.66-40.70 (Only USA)	1000	60	3	Linear interpolation
70-130	500	53.98		
130-174	500 to 1500	53.98 to 63.52		
174-260	1500	63.52		
260-470	1500 to 5000	63.52 to 73.98		
Above 470	5000	73.98		

5.2.3. SPURIOUS EMISSION LIMITS: CFR 47, §15.231(e), RSS-210, Issue 10, Chapter A.1.4

Frequency [MHz]	Field strength@3m		Measurement distance [meters]	Remarks
	[µV/m]	[dBµV/m]		
40.66-40.70 (only USA)	100	40	3	Linear interpolation
70-130	50	33.89		
130-174	50 to 150	33.98 to 43.52		
174-260	150	43.52		
260-470	150 to 500	43.52 to 53.98		
Above 470	500	53.98		

5.2.4. Restricted bands of operation (FCC §15.205 / RSS-Gen, Issue 5, Chapter 8.10, Table 7)

MHz	MHz	GHz
0.090-0.110	156.7-156.9	9.0-9.2
0.495-0.505	162.0125-167.17	9.3-9.5
2.1735-2.1905	167.72-173.2	10.6-12.7
3.020-3.026 (Canada only)	240-285	13.25-13.4
4.125-4.128	322-335.4	14.47-14.5
4.17725 - 4.17775	399.9-410	15.35-16.2
4.20725-4.20775	608-614	17.7-21.4
5.677 - 5.683 (Canada only)	960-1240	22.01-23.12
6.215-6.218	1300-1427	23.6-24.0
6.26775-6.26825	960-1427 (only Canada)	31.2-31.8
6.31175-6.31225	1435-1626.5	36.43-36.5
8.291-8.294	1645.5-1646.5	Above 38.6
8.362-8.366	1660-1710	--
8.37625-8.38675	1718.8-1722.2	--
8.41425-8.41475	2200-2300	--
12.29-12.293	2310-2390	--
12.51975-12.52025	2483.5-2500	--
12.57675-12.57725	2690-2900	--
13.36-13.41	2655-2900 (only Canada)	--
16.42-16.423	3260-3267	--
16.69475-16.69525	3332-3339	--
16.80425-16.80475	3345.8-3358	--
25.5-25.67	3500-4400 (only Canada)	--
37.5-38.25	3600-4400	--
73-74.6	4500-5150	--
74.8-75.2	5350-5460	--
108-121.94	7250-7750	--
123-138	8025-8500	--
108-138 (only Canada)	--	--
149.9-150.05	--	--
156.52475-156.52525	--	--
Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209/RSS-Gen.		

5.2.5. TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☐ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3 °C)		Rel. humidity: (40±20)% rH
EMI-Receiver (Analyzer) Settings	Span/Range: 9 kHz to 150 kHz; 150 kHz to 30 MHz RBW/VBW: 200 Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements Quasi-Peak, for final measurement on critical frequencies (f<1 GHz)		

5.2.6. GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013

The **Equipment under Test** (EUT) was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

The measurement loop antenna was situated in 3m distance to the EUT. Between EUT and measurement antenna absorbers are covering the GND-Plane.

5.2.7. MEASUREMENT RESULTS: FUNDAMENTAL FIELD STRENGTH

Table of measurement results:

Diagram No. / Sub-Chapter	Carrier Channel		Nominal Frequency [MHz]	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
3.01	-	1	315 MHz	1	1	EUT at standing position	☒	☒	☐	passed
3.02			315 MHz			EUT at laying position	☒	☒	☐	passed

Remark: Duty-Cycle correction according annex 1, chapter 1.8. Transmission characteristics.

5.2.8. MEASUREMENT RESULTS: RADIATED FIELD STRENGTH (SPURIOUS)

Table of measurement results:

Diagram No. / Sub-Chapter	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
3.11	-	1	30-1000 MHz	1	1	Carrier frequency component on diagram-> not relevant for results EUT at standing position	☒	☐	☒	passed
3.12						Carrier frequency component on diagram-> not relevant for results EUT at laying position	☒	☐	☒	passed

Remark:
*) see diagrams enclosed in annex 1 for details
Carrier visible on diagram → not relevant for spurious emission test

5.3. General Limit – Radiated field strength emissions, above 1 GHz

5.3.1. Test location and equipment FAC

test site	☐441 EMI SAR	☐348 EMI cond.	☒443 EMI FAR	☐347 Radio.lab.	☐ 337 OATS	
spectr. analyz.	☐584 FSU	☐120 FSEM	☐264 FSEK	☒489 ESU 40	☐ 714 FSW	
antenna meas	☐574 BTA-L	☐289 CBL 6141	☐608 HL 562	☒549 HL025	☐ 302 BBHA9170	
antenna subst	☐071 HUF-Z2	☐020 EMCO3115	☐063 LP 3146		☐ 303 BBHA9170	
signaling	☐392 MT8820A	☐371 CBT32	☐547 CMU200	☐594 CMW		
DC power	☐086 LNG50-10	☐087 EA3013	☐354 NGPE 40	☐349 car battery	☐ 350 Car battery	☐466 Fluke112
line voltage	☐ 230 V 50 Hz via public mains		☐060 120 V 60 Hz via PAS 5000			

5.3.2. Requirements/Limits

FCC	☐ Part 15 Subpart B, §15.109 class B ☐ Part 15 Subpart C, §15.209 for frequencies defined in §15.205 ☐ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4) ☒ Part 15 Subpart C, §15.231(e)	
ISED	☐ RSS-Gen., Issue 5, Chapter 8.9, Table 5+6+7 (transmitter license exempt) ☐ RSS-Gen., Issue 5, Chapter 7.3, Table 3 (receiver) ☐ ICES-003, Issue 6, Chapter 6.2.2, Table 7(class B), Table 6 (Class A) ☐ RSS-247, Issue 2, Chapter 5.5 ☐ RSS-247, Issue 2, Chapter 6.2 ☒ RSS-210, Issue 10, A1.4, Table A2	
ANSI	☐ C63.4-2014 ☒ C63.10-2013	
Frequency [MHz]	Limits	
	AV [µV/m]	AV [dBµV/m]
above 470MHz	500	53.98

5.3.3. Test condition and measurement test set-up

Signal link to test system (if used):		☐ air link	☐ cable connection	☒ none
EUT-grounding		☒ none	☐ with power supply	☐ additional connection
Equipment set up		☒ table top 1.5m height		☐ floor standing
Climatic conditions		Temperature: (22±3 °C)		Rel. humidity: (40±20)% rH
Spectrum-Analyzer settings	Scan frequency range:	☐ 1 – 18 GHz ☐ 18 – 25 GHz ☐ 18 – 40 GHz ☒ other: 1-5GHz		
	Scan-Mode	☒ 6 dB EMI-Receiver Mode ☐ 3 dB Spectrum analyzer Mode		
	Detector	Peak and Average		
	RBW/VBW	1 MHz / 3 MHz		
	Mode:	Repetitive-Scan, max-hold		
	Scan step	400 kHz		
	Sweep-Time	Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle		
General measurement procedures		Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz"		

5.3.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
4.01	-	1	1-5 GHz	1	1	-	☒	☒	☐	passed

Remark:

- see diagrams in annex 1 for more details

5.4. RF-Parameter - 20dB and 99% Bandwidth

5.4.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☐ 443 EMI FAR	☒ 347 Radio.lab.	☐ 337 OATS	☐
spectr. analyz.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐ 489 ESU	☒ 683 FSU26	☐
attenuator	☐ 530 10 dB	☐	☐	☐	☐	☐
other	☒ 431 EMCO Model 7405					
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
DC power	☐ 611 E3632A	☐ 087 EA3013	☐ 354 NGPE 40	☐ 086 LNG50-10	☐ 466 Fluke 112	☐
Power supply voltage	☐ 12 V DC		☐060 110 V 60 Hz via PAS 5000			
Others	☐ 613 20dB Attenuator		☐ cable K5			

5.4.2. References of bandwidth measurements

§15.231(c)

(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RSS-210, ISSUE 10, A.1.3

The **99% bandwidth** of momentarily operated devices shall be less or equal to 0.25% of the center frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the 99% bandwidth shall be less or equal to 0.5% of the center frequency.

§15.215(c), RSS-Gen, Issue 5: Chapter 6.7

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

5.4.3. Test condition and measurement test set-up

Signal ink to test system (if used):	☐ air link	☐ cable connection	☒ none
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3 °C)		Rel. humidity: (40±20)% rH
General measurement procedures	Please see chapter “Test system set-up for conducted RF-measurement at antenna Port” (W2 Set-up)		

5.4.4. EUT Settings:

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

5.4.5. Measurement method:

Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. The operating modes have been varied (e.g. data rate, modulation scheme, etc.)

For the **99% emission bandwidth** measurement, two markers are placed on frequency points such that left to lower f-marker and right to higher f-marker only 1% of the TX-power is contained. Between the markers, 99% of the power is laying. The RBW value is readjusted and the measurement repeated until the RBW/EBW ratio is around 1%.

5.4.6. Spectrum-Analyzer settings:

Span	Set as to fully display the emissions + 30%
Scale y display	approximate 30 dB below the maximum PEAK level
Resolution Bandwidth (RBW)	☒ ANSI 63.10:2013 Set to initial value approx. 1% to 5% of the emission bandwidth, re-adjust and proof that RBW/EBW is between 1% and 5%
Video Bandwidth (VBW)	Minimum 3 times the resolution bandwidth
Sweep time	Auto-coupled
Detector	Peak detector
Sweep mode	Repetitive Mode, MAX-HOLD, trace stabilization

5.4.7. Results:

For graphical results pls. see annex 1 to this test report.

20dB BANDWIDTH FCC §15.231:

20dB Bandwidth							
T_{NOM} = 21 °C V_{NOM} = 3 V *	Set.: 1 Op.: 2	Set.: 1 Op.: 3	Set.: 1 Op.: 4	Set.: 1 Op.: 5	Set.: 1 Op.: 6	Set.: 1 Op.: 7	Set.: 1 Op.: 8
Value [kHz]	100.3205	65.3846	83.6538	87.0192	104.8077	107.2115	126.9231
-							

Remark *): The embedded battery is not changeable.

99% OCCUPIED BANDWIDTH (RSS-210):

99% Bandwidth							
T_{NOM} = 21 °C V_{NOM} = 3 V *	Set.: 1 Op.: 2	Set.: 1 Op.: 3	Set.: 1 Op.: 4	Set.: 1 Op.: 5	Set.: 1 Op.: 6	Set.: 1 Op.: 7	Set.: 1 Op.: 8
Value [kHz]	179.4872	62.8205	78.2051	82.0513	99.5192	104.8077	123.5577
-							

Remark *): The embedded battery is not changeable.

5.4.8. VERDICT: pass

5.5. Timing requirements

5.5.1. Test location and equipment

test site	☐441 EMI SAR	☐348 EMI cond.	☐443 EMI FAR	☒347 Radio.lab.	☐ 337 OATS	
spectr. analyz.	☐584 FSU	☒690 FSU	☐264 FSEK	☐489 ESU 40	☐ 714 FSW	
antenna meas	☐574 BTA-L	☐289 CBL 6141	☐608 HL 562	☐549 HL025	☐ 302 BBHA9170	☒ Near field antenna
antenna subst	☐071 HUF-Z2	☐020 EMCO3115	☐063 LP 3146		☐ 303 BBHA9170	
DC power	☐611 E3632A	☐341 Fluke112	☐354 NGPE 40	☐349 car battery	☐ 350 Car battery	☒ 3 V battery
voltage	☐ DC 12V		☐ 060 120 V 60 Hz via PAS 5000			
Others:	☐ 529 Model 1515 for antenna ports					

5.5.2. Requirements/Limits:

FCC 15.231(e) **ISED A.1.4 (b)**	*(1) Intentional radiator operates in multiple modes at a periodic rate exceeding that specified in paragraph 15.231(a). Thus the Intentional radiator complies with 15.231(e).*
	(2) Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

5.5.3. Spectrum-Analyzer settings:

See diagrams in chapter 1.8 of annex 1

5.5.4. Test method

Activation of transmitter	De-activation of transmitter
☒ manual activation of transmitter for op. Mode 9-14	☒ automatically de-activation of transmitter
☐ automatically activation of transmitter	

☐ no tests performed –> see declaration of the applicant
☒ tests performed with set. 1+4 / op. 9 – 14 --> see annex A1, chapter 1.8 for diagrams and measured data

5.5.5. Verdict

Operating Mode 9: Pass
Operating Mode 10: Pass
Operating Mode 11: Pass
Operating Mode 12: Pass
Operating Mode 13: Pass
Operating Mode 14: Pass

5.6. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.
For uncertainty determination, each component used in the concrete measurement set-up was taken in account and its contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U_{CISPR})	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB						E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 GHz - 26.5 GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--	
Power density	-	1 GHz – 2.8 GHz	1.40 dB						--
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	- -	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz 30 MHz - 1 GHz 1 GHz - 20 GHz	5.0 dB 4.2 dB 3.17 dB						Magnetic field E-field Substitution
Timing requirements	--	Long Sweeps Short Sweeps	34.8 ms 12.8 ms						Timing

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV, AVG, CAV	Average detector
EIRP	Equivalent isotopically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
ERP	Effective radiated power
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
ISED	Innovation, Science and Economic Development Canada
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
QP	Quasi peak detector
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Documents from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
VBW	Video bandwidth

7. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	(MRA US-EU 0003)	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	FCC, Federal Communications Commission Laboratory Division, USA
337 487 550 558	-- 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R- 4452 G- 20013 C- 20009 T- 20006	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

8.1. Used equipment

The "Ref.-No" in the left column of the following tables allows the clear identification of the laboratory equipment.

8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
335	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V5,30+ SW-Option K55, K57
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario=
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 9.15.00
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 9.15.00
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
607	Signal Generator	SMR 20	832033/011	V1.25
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	Setup V03.26, Test programm component V03.02.20
670	Univ. Radio Communication Tester	CMU 200	106833	µP1 =V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)
699	Audio Analyzer	UPL16	833494/005	3.06

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	23.05.2021
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	22.05.2022
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.07.2021
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.05.2021
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	23.05.2021
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	30.05.2021
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.05.2021
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	22.05.2022
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
331	Climatic Test Chamber -40/+180 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	10.01.2021
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	23.05.2021
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	21.05.2021
389	Digital Multimeter	Keithley 2000	0583926	Keithley	pre-m	-	
396	Thermo/Hygrometer	Thermo/Hygrometer	-	Conrad	24 M	-	09.01.2021
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.05.2021
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2021
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.05.2021
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	16.04.2021
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.09.2021
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-60/10SS	SN 5	Wainwright	pre-m	2	
517	relais switch matrix	HF Relais Box Keithley System	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	23.05.2021
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2021
550	System CTC S-VSWR Verification SAR-EMI	System EMI Field SAR S-VSWR	-	ETS Lindgren/CETECOM	24 M	-	30.10.2021

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	03.05.2022
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.05.2021
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	30.05.2021
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet 1,5m	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.02.2021
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	24 M	-	30.05.2021
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	
701	CMW500 wide. Radio Comm.	CMW500	158150	Rohde & Schwarz	24 M	-	05.11.2021
703	INNCO Antennen Mast	MA 4010-KT080-XPET-ZSS3	MA4170-KT100-XPET-ZSS3	INNCO	pre-m	-	
704	INNCON Controller	CO 3000-4port	CO3000/933/38410516/L	INNCO Systems GmBh	pre-m	-	
713	Harmonic Mixer, 50 GHz - 75GHz	FS-Z75	101022	Rohde & Schwarz	24 M	-	05.07.2021
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	24 M	-	04.07.2021
748	Pickett-Potter Horn Antenna	FH-PP 4060	010001	Radiometer Physiscs	36 M	-	
750	Pickett-Potter Horn Antenna	FH-PP 220	010011	Radiometer Physics	36 M	-	
751	Digital Optical System	optoCAN-FD Transceiver	17-010416	mk-messtechnik GmbH	-	-	
752	Digital Optical System	optoCAN-FD Transceiver	17-010083	mk-messtechnik GmbH	-	-	
753	Digital Optical System	optoCAN-FD Transceiver	17-010084	mk-messtechnik GmbH	-	-	
754	Digital Optical System	optoCAN-FD Transceiver	17-010415	mk-messtechnik GmbH	-	-	
755	Digital Optical System	optoLAN-100-MAX Transceiver	17-010795	mk-messtechnik GmbH	-	-	
758	Signal Generator	SMU 200A	100754	Rohde & Schwarz	24 M	-	11.10.2020
781	Power Supply	PS 2042-10 B	2815450369	Elektro-Automatik GmbH &Co.KG	-	-	
782	Power Supply	PS 2042-10 B	2815450348	lektro-Automatik GmbH &Co.KG	-	-	
783	Spectrum Analyzer	FSU 26	100414	Rohde & Schwarz	12 M	-	30.04.2021
784	Power Supply	NGSM 32/10	00196	Rohde & Schwarz	12 M	-	
785	RSP	RF Step Attenuator 0…139.9dB	860712/012	Rohde & Schwarz	12 M	-	
786	SAR Probe	ES3DV3	3340	Speag	36 M	-	14.02.2021
788	Precision Omnidirectional Dipole	POD 618	6182558/Q	Seibersdorf Labaratories	36 M	-	30.06.2021
789	Precision Omnidirectional Dipole	POD 16	162496/Q	Seibersdorf Laboratories	36 M	-	30.06.2021
790	Horn Antenna	ASY-SGH-124-SMA	29F14182337	Antenna System Solutions	36 M	-	08.10.2021
791	Pickett-Potter Horn Antenna	FH-PP-325	10024	Radiometer Physics	36 M	-	
792	Pickett-Potter Horn Antenna	FH-PP 075	10006	Radiometer Physics	36 M	-	
793	Pickett-Potter Horn Antenna	FH-PP 140	10008	Radiometer Physics	36 M	-	
794	Pickett-Potter Horn Antenna	FH-PP 110	10014	Radiometer Physics	36 M	-	
795	SGH Antenna	SGH-26-WR10	1144	Anteral S.L.	36 M	-	
798	WR-22 Rectangular Gain Horn	SAR-2309-22-S2	13254-01	SAGE Millimeter, Inc.	36 M	-	
799	Transceiver	optoLAN-Gb	18-014746	mk messtechnik	pre-m	-	
801	Spectrum Analyzer	FSP 13	100960	Rohde & Schwarz	24 M	-	14.01.2021

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
802	Exposure Level Tester	ELT-400	O-0026	NARDA Safety Solutions	24 M	-	30.01.2021
803	Probe	ELT probe 3cm²	O-0026	Narda Safety Test Solution	24 M	-	30.01.2021
805	Thermo-Hygrometer	Web-Thermo-Hygrometer	02749814	W&T	24 M	-	
806	AC2600 Smart Wifi Router	Netgear Nighthawk x4S	5K5188590067B	Netgear	-	-	
807	Direct Coupler	Direct Coupler C-05020-10	511	ET Industries	-	-	
808	Diode Power Sensor	NRV-Z1	829894/001	Rohde & Schwarz	24 M	-	24.05.2021
809	Standard gain Horn Antenna	WR-159 Horn Antenna	-	Pasternack Enterprises Inc.	-	-	
25038	Loop Antenna	HFH2-Z2	879824/13	Rohde & Schwarz	24 M	-	20.04.2022

8.1.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No . 443)
	1d	System CTC-SAR-EMI (Ref.-No . 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	System CTC-FAR-EMS (Ref.-No . 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2020-08-24
C1	Update standard reference	2020-08-26

END OF TEST REPORT