



RF - TEST REPORT

- FCC Part 15.225 -

Type / Model Name : IQH1-HH50

Product Description : Slid on device with integrated HF-RFID Reader (13,56MHz)

Applicant : Pepperl+Fuchs Inc.

Address : 1600 Enterprise Parkway

Twinsburg OH 44087

Manufacturer : ACD Elektronik GmbH

Address : Engelberg 2

88480 Achstetten, Germany

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. :	T46808-00-01HU	23. March 2021
		Date of issue



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

Contents

1	<u>TEST STANDARDS</u>	3
2	<u>SUMMARY</u>	4
3	<u>EQUIPMENT UNDER TEST</u>	5
3.1	Photo documentation of the EUT – See attachment A	5
3.2	Power supply system utilised	5
3.3	Short description of the equipment under test (EUT)	5
4	<u>TEST ENVIRONMENT</u>	6
4.1	Address of the test laboratory	6
4.2	Environmental conditions	6
4.3	Statement of the measurement uncertainty	6
4.1	Measurement Protocol for FCC, VCCI and AUSTEL	7
5	<u>TEST CONDITIONS AND RESULTS</u>	8
5.1	Conducted emissions	8
5.2	Field strength of the fundamental wave	9
5.3	Spurious emissions	11
5.4	Frequency tolerance	13
5.5	20 dB Bandwidth	15
5.6	Transmitter spectrum mask	17
5.7	Receiver radiated emissions	19
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	20

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (December 15, 2020)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths
Part 15, Subpart A, Section 15.38	Incorporation by reference

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (December 15, 2020)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.215	Additional provisions to the general radiated emission limitations
Part 15, Subpart C, Section 15.225	Operation within the band 13.110 - 14.010 MHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

ANSI C63.10: 2013 Testing Unlicensed Wireless Devices

ANSI C95.1:2005 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

CISPR 16-4-2: 2003 Uncertainty in EMC measurement

2 SUMMARY

GENERAL REMARKS:

For testing, the NFC Reader was set in TX-continuous mode. The test software is available for testing only.

The EUT is a part of a LF-RFID Reader system. The test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst case position of the EuT.

For detailed information about the device please refer to the user manual.

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 16. November 2020

Testing concluded on : 09. December 2020

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage : 3.3 V / DC (supplied via M2SmartSE)

3.3 Short description of the equipment under test (EUT)

The EUT is a slide on device with integrated LF-RFID Reader for use for a handheld terminal. It will be powered via M2SmartSE handheld unit.

Number of tested samples: 1 System
Serial number: 19600000011

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Cont. tag reading mode at 13.56 MHz modulated (ASK)

-

EUT configuration:

The following peripheral devices and interface cables were connected during the measurements:

- M2SmartSE Model : Handheld terminal, S/N.: 193600000076
- HF-RFID TAG Model : IQC21-50, Part No.: 285978
- _____ Model : _____

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

FCC ID: IREIQH1HH50**4.1 Measurement Protocol for FCC****4.1.1 GENERAL INFORMATION****4.1.1.1 Test methodology**

The test methods used comply with ANSI C63.10, „Testing Unlicensed Wireless Devices “.

4.1.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.1.1.3 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011

General Standard information

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.2 Deviations or Exclusions from the Requirements and Standards

Frequency tolerance test:

The test sample does not have its own power supply. It is supplied by the handheld terminal. The operating voltage of the test sample is kept constant by the voltage control circuit in the hand-held terminal. As soon as the battery capacity of the handheld terminal is no longer sufficient to supply the test sample and keep it constant, it is switched off or the reading process cannot be started.

⇒ The test was only performed with V_{nom} .

Only the temperature was changed accd. the relevant test standard.

The M2SmartSE handheld unit equipped with a WLAN/BT5 2x2 MU-MIMO module SPB228 (802.11 ac/a/b/g/n, BLE 5.0). In order to prove that the radio modules used have no influence on the HF-RFID Reader (13.56 MHz), a pre measurement, with all transmitter modules are on, was carried out in the chamber. This has proven that the emissions (magnetic field strength and spurious emissions) from the HF-RFID Reader (13.56 MHz) are not influenced in any way.

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: NONE

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.107(a):

Except for Class A devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range:

Min. limit margin

Limit according to FCC Part 15, Section 15.107(a):

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

The requirements are

Remarks: The measurement is not applicable.

The EuT is powered via M2SmartSE handheld unit.

5.2 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part CPR 1.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up – see Attachment B

5.2.3 Applicable standard

According to FCC Part 15, Section 15.225(a):

The field strength of any emission within the band 13.553 – 13.567 MHz shall not exceed 15848 $\mu\text{V}/\text{m}$ at 30 m.

5.2.4 Description of Measurement

The transmitted field strength of the EUT has to be measured at an open area test site using a tuned receiver and a shielded loop antenna. The set up of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade.

FCC ID: IREIQH1HH50

5.2.5 Test result

a) Result at a measurement distance of 3m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)
13.56	41.3	36.5	34.8	9.0	20	61.3	56.5	54.8

b) Result extrapolated to a distance of 30 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit dB(μ V/m)	Delta (dB)
13.56	1.3	-3.5	-5.2	20	21.3	16.5	14.8	84.0	-67.5

Limit according to FCC Part 15, Section 15.225(a):

Frequency (MHz)	Field strength of fundamental wave		Measurement distance
	(μ V/m)	dB(μ V/m)	(metres)
13.553 - 13.567	15848	84.0	30

The requirements are **FULFILLED**.

Remarks:

FCC ID: IREIQH1HH50

5.3 Spurious emissions

For test instruments and accessories used see section 6 Part SER 1, SER 2.

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up – see Attachment B

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from an intentional radiator shall not exceed the field strength levels specified in the table below.

5.3.4 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The set up of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz
 150 kHz – 30 MHz: RBW: 9 kHz
 30 MHz – 1000 MHz: RBW: 120 kHz

5.3.5 Test result

Results at a measurement distance of 3m

Frequency [kHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

Frequency [MHz]	L: QP [dBµV]	Correct. [dB]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges. Only ambient noises could be detected!

FCC ID: IREIQH1HH50

Limit according to FCC Part 15 Subpart 15.209(a):

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(μ V/m)	dB(μ V/m)	
0.009 - 0.490	2400/F(kHz)	--	300
0.490 - 1.705	24000/F (kHz)	--	30
1.705 - 30.0	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

The requirements are **FULFILLED**.

Remarks: Measurement has been performed up to 1 GHz.

No undesired emissions occurred in the frequency range from 9 kHz up to 135.6 MHz

FCC ID: IREIQH1HH50**5.4 Frequency tolerance**

For test instruments and accessories used see section 6 Part FE.

5.4.1 Description of the test location

Test location: AREA4 (Climatic Chamber)

5.4.2 Photo documentation of the test set-up – see Attachment B**5.4.3 Applicable standard**

According to FCC Part 15, Section 15.225(e):

The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature range of -20 °C to $+50$ °C at normal supply voltage and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. For battery operated equipment, the equipment shall be performed using a new battery.

5.4.4 Description of Measurement

The frequency tolerance has been measured radiated using a spectrum analyser. The center frequency of the spectrum analyser has been set to the fundamental frequency. This is an alternative test method because the EuT can not be operated in un-modulated mode. The limit line was set to 10 dB below the carrier. The frequencies of the upper (f_U) and lower (f_L) points, where the displayed power envelope of the modulation including frequency drift is equal to the appropriate level, have been recorded. The centre frequency is calculated as $f_C = (f_U + f_L)/2$. The measurement has been performed at normal and extreme test conditions from -20 °C to $+50$ °C in steps of 10 degrees (According to FCC Part 2.1055).

FCC ID: IREIQH1HH50

5.4.5 Test result

Test conditions		Test result
		Frequency (MHz)
$T_{min} (-20)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600581
$T (-10)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600581
$T (0)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600582
$T (10)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600587
$T_{nom} (20)^{\circ}C$	$V_{min} (3.3 V)$	13.5600587
	$V_{nom} (3.3 V)$	13.5600587
	$V_{max} (3.3 V)$	13.5600587
$T (30)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600593
$T (40)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600593
$T_{max} (50)^{\circ}C$	$V_{nom} (3.3 V)$	13.5600591
Measurement uncertainty		$\pm 10 \text{ Hz}$

Carrier frequency: $f_c = 13.5600587 \text{ MHz}$

Limit: max. tolerance: $\pm 0.01 \%$ of $13.56 \text{ MHz} = \pm 1.356 \text{ kHz}$

Max. frequency tolerance: $f_i = 13.5600593 \text{ MHz}$

Lowest tolerance: $f_i - f_c = + 0.0006 \text{ kHz} < \pm 1.356 \text{ kHz}$

Limit according to FCC Part 15, Section 15.225(e):

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01 \%$ of the operating frequency.

The requirements are **FULFILLED**.

Remarks: _____

FCC ID: IREIQH1HH50

5.5 20 dB Bandwidth

For test instruments and accessories used see section 6 Part MB.

5.5.1 Description of the test location

Test location: AREA4 (Climatic Chamber)

5.5.2 Photo documentation of the test set-up – see Attachment B

5.5.3 Applicable standard

According to FCC Part 15C, Section 15.215(c):
 Intentional radiators operating under the alternative provisions to the general emission limits, as contained in section 15.217 to 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated. 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.

5.5.4 Description of Measurement

The frequency range has been measured radiated using a test fixture and a spectrum analyser. The limit line is set to 20 dB below the carrier. The frequency of the upper (F_H) and lower (F_L) points, where the displayed power envelope of the modulation including frequency drift is equal to the appropriate level, is recorded as the modulation bandwidth. The measurement has been performed at normal and extreme test conditions in modulated transmitting mode.

Spectrum analyzer settings:

RBW: 1 kHz
 VBW: 3 kHz
 Detector Peak

5.5.5 Test result

Carrier Frequency (MHz)	(F_L) (MHz)	(F_H) (MHz)	Bandwidth (kHz)	Limit (kHz)
13.56	13.5596275	13.56256375	2.94	14.0

Limit according to FCC Part 15C, Section 15.215(c):

Frequency band (MHz)	Limit 20 dB bandwidth (kHz)
13.553 - 13.567	14.0

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocol.

FCC ID: IREIQH1HH50

5.6 Transmitter spectrum mask

For test instruments and accessories used see section 6 Part MB.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up – see Attachment B

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.225 (a-d):

The field strength of any emission shall not exceed the limits given in FCC Part 15C, Section 15.225 (a-d)

5.6.4 Description of Measurement

The spectrum mask is measured using a spectrum analyser. The profile of the spectrum mask is displayed on analyser and have to be adjusted to the reference level given as maximum output power measured in OATS. The marker is set up manually to the particular maximum level at the effective limit in the frequency range and recorded. The measurement was performed radiated.

5.6.5 Test result

Frequency band (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)
13.110 – 13.410	≤ 10	40.5
13.410 - 13.553	≤ 10	50.5
13.553 - 13.567	14.8	84.0
13.567 – 13.710	≤ 10	50.5
13.710 – 14.010	≤ 10	40.5
outside of 13.110 – 14.010	≤ 10	29.5

Limits according to FCC Part 15C, Section 15.225(a-d):

The absolute levels of RF power at any frequency shall not exceed the limits defined in the following table:

Frequency band (MHz)	Emission level limit at 30 m (µV/m)
13.110 – 13.410	106
13.410 - 13.553	334
13.553 - 13.567	15.848
13.567 – 13.710	334
13.710 – 14.010	106
outside of 13.110 – 14.010	30

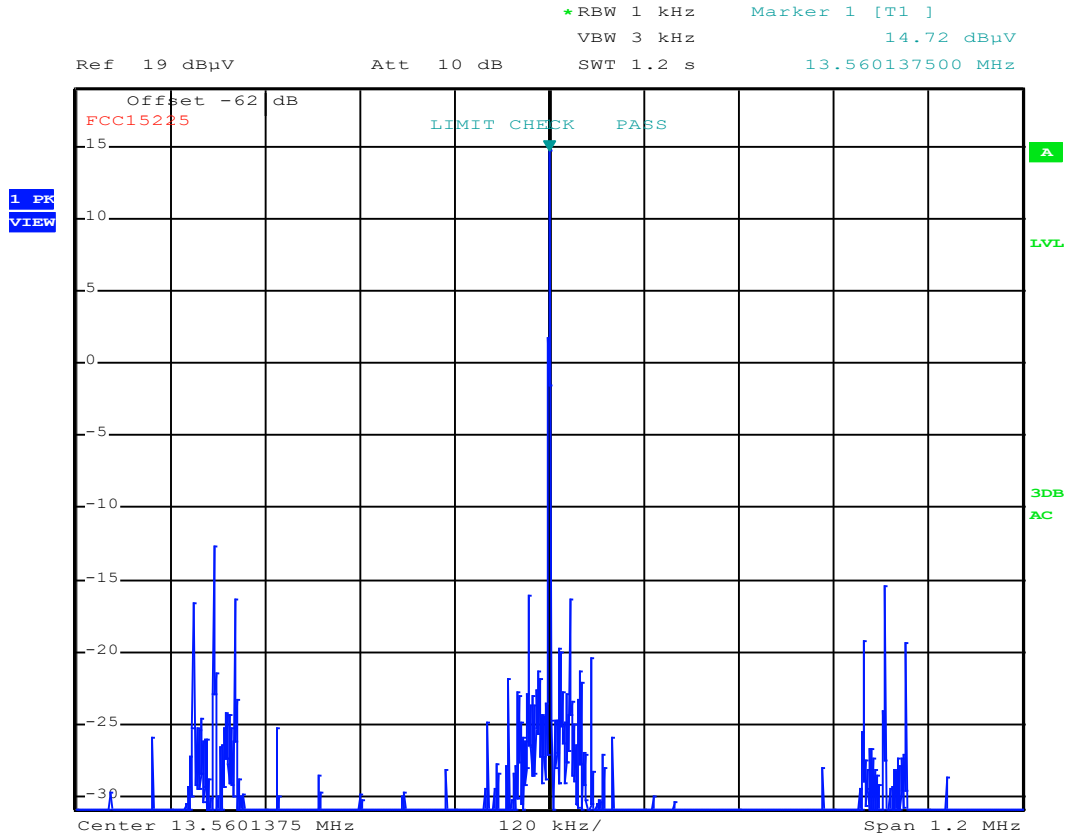
The requirements are **FULFILLED**.

Remarks:

FCC ID: IREIQH1HH50

5.6.6 Test protocol

Spectrum mask of modulated signal



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

FCC ID: IREIQH1HH50

5.7 Receiver radiated emissions

5.7.1 Description of the test location

Test location: None

5.7.2 Applicable standard

According to FCC Part 15, Section 15.109(a):

The emission of an unintentional radiator shall not exceed the specified field strength level at 3 m.

Remarks: This test is not applicable. In practical operation the receive mode is too short
to make an assessment.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 1	ESCI	02-02/03-05-005	24/11/2021	24/11/2020		
	HFH 2 - Z 2	02-02/24-15-001	01/04/2021	01/04/2020		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
FE	ESCI	02-02/03-05-005	24/11/2021	24/11/2020		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
MB	ESCI	02-02/03-05-005	24/11/2021	24/11/2020		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
SER 1	ESCI	02-02/03-05-005	24/11/2021	24/11/2020		
	HFH 2 - Z 2	02-02/24-15-001	01/04/2021	01/04/2020		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	02-02/24-05-005	19/09/2020	19/07/2019		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				