



Test Report No.: Prüfbericht-Nr.:		JP232TC8 002	Order No.: Auftrags-Nr.:	150282236	Page 1 of 58 Seite 1 von 58
Client Reference No.: Kunden-Referenz-Nr.:		N/A	Order date: Auftragsdatum:	2023-09-21	
Client: Auftraggeber:		Nisshinbo Micro Devices Inc. 1-1, Fukuoka 2-Chome Fujimino City Saitama, 356-8510 Japan			
Test Item: Prüfgegenstand:		K-Band Doppler Sensor Module (Movement Sensor)			
Identification / Type No.: Bezeichnung / Typ-Nr.:		NJR4267F3B1	Serial No.: Serien-Nr.:	Refer to section 4.3	
Order Content: Auftrags-Inhalt:		Radio Testing			
Test Specification: Prüfgrundlage:		FCC 47 CFR Part 15, Subpart C, Section 15.245 RSS-210 (Issue 10): 2019+Amendment 1:2020			
Date of Sample Receipt: Wareneingangsdatum:		2023-08-28		-/-	
Test Sample No.: Prüfmuster-Nr.:		A003549974, A003554941, A003557079, A003573603			
Testing Period: Prüfzeitraum:		2023-10-02 to 2023-11-10			
Place of Testing: Ort der Prüfung:		Yokohama EMC Laboratory			
Testing Laboratory: Prüflaboratorium:		TÜV Rheinland Japan Ltd.			
Test Result*: Prüfergebnis*:		Pass			
compiled by: zusammengestellt von:				authorized by: genehmigt von:	
Date: 2024-02-06 Datum:		Takeshi Nagata		Issue Date: 2024-02-06 Ausstellungsdatum:	Pin Zhang
Position / Stellung:		Inspector		Position / Stellung:	Authorizer
Other / Sonstiges:					
Condition of the test item at delivery: Zustand des Prüfgegenstandes bei Anlieferung:			Test item complete and undamaged Prüfmuster vollständig und unbeschädigt		
* Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested * Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet					
This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.					

V05

REVISIONS

Report No.	Issue date	Changes / Remarks
JP232TC8 001	2023-12-13	Original document (Test report for Intentional radiator aspects)
JP232TC8 002	2024-02-06	Corrections of typos in the section 1.1, 3.2, 5.2.3 and 5.2.5

Note: This test report JP232TC8 002 replaces the original test report JP232TC8 001.

REMARKS

1	The equipment used during the specified testing period was calibrated according to the test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of the laboratory's management system.
2	Unless otherwise specified by the applied standard(s), the decision rule used in this test report for statements of conformity based on numerical measurement results is the "Zero Guard Band"/"Simple Acceptance" rule in accordance with ILAC G8:2019 and IEC Guide 115:2021. When the "Zero Guard Band" rule is applied, measurement uncertainty is not taken in account. For additional information on the risk resulting from the application of the "Zero Guard Band" decision rule, refer to ILAC G8:2019.

Contents

1.	GENERAL REMARKS.....	5
1.1	TEST SPECIFICATIONS	5
1.2	COMPLEMENTARY MATERIALS	6
2.	TEST SITES.....	7
2.1	TEST FACILITIES	7
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS	7
2.3	MEASUREMENT UNCERTAINTY	10
3.	GENERAL PRODUCT INFORMATION	11
3.1	PRODUCT FUNCTION AND INTENDED USE	11
3.2	RATINGS AND SYSTEM DETAILS	11
3.3	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	11
3.4	SUBMITTED DOCUMENTS AND INFORMATION	12
4.	TEST SETUP AND OPERATION MODES	13
4.1	TEST METHODOLOGY	13
4.2	OPERATION MODES.....	13
4.3	PHYSICAL CONFIGURATION FOR TESTING	13
4.4	TEST SOFTWARE.....	15
4.5	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT.....	16
4.6	COUNTERMEASURES TO ACHIEVE COMPLIANCE.....	17
5.	TEST RESULTS R A D I O	18
5.1	TECHNICAL REQUIREMENTS.....	18
5.1.1	Supply Voltage Requirements.....	18
5.1.2	Antenna Requirements	18
5.1.3	Restricted Bands of Operation.....	19
5.2	RADIATED MEASUREMENTS	20
5.2.1	Duty Cycle	20
5.2.2	20dB Bandwidth	26
5.2.3	99% Bandwidth	30
5.2.4	Field Strength of Fundamental.....	33
5.2.5	Radiated Spurious Emissions of Transmitter	37
5.3	AC POWER LINE CONDUCTED MEASUREMENTS	46
5.3.1	AC Power Line Conducted Emission of Transmitter	46
6.	PHOTOGRAPHS OF THE TEST SETUP.....	49

Test Report No.:	JP232TC8 002	Page 4 of 58
Prüfbericht-Nr.:		Seite 4 von 58

7.	LIST OF TABLES.....	57
8.	LIST OF FIGURES.....	58
9.	LIST OF PHOTOGRAPHS	58

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 5 of 58
Seite 5 von 58

1. General Remarks

1.1 Test Specifications

Table 1: Test Summary

Test	Specifications	Result
Emission: FCC 47 CFR Part 15, Subpart C, Section 15.245 ANSI C63.10-2013 RSS-210 (Issue 10): 2019+Amendment 1:2020 RSS-Gen (Issue 5): 2018+Amendment 1:2019+Amendment 2:2021 ANSI C63.10-2013		
Supply Voltage Requirements FCC §15.31(e)	See the section 5.1.1.	Pass
Antenna Requirements FCC §15.203	See the section 5.1.2.	Pass
Restricted Bands of Operation FCC §15.205 RSS-Gen §8.10	See the section 5.1.3.	Pass
Duty Cycle	-/-	Reference
20dB Bandwidth FCC §15.215 (c)	20dB bandwidth shall be contained within the designated frequency band.	Pass
99% Bandwidth RSS-Gen §6.7 and §8.11	-/-	Reference
Field Strength of Fundamental FCC §15.245(b) and RSS-210 §Annex F, Table F1	2500mV/m (127.9dBuV/m) at 3m distance	Pass
Radiated Spurious Emissions of Transmitter FCC §15.245(b) and RSS-210 §7.1, 7.2, 7.3, RSS-Gen §8.1 and RSS-210 §Annex F, Table F1	9kHz - 100GHz 2 nd and 3 rd Harmonics: 7.5mV/m (77.5dBuV/m) at 3m distance	Pass
Conducted Emission on AC Power Ports of Transmitter FCC §15.207 and RSS-Gen §8	150kHz - 30MHz	Pass

1.2 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is recognized by Innovation, Science and Economic Development Canada (ISED) as Wireless Device Testing Laboratory under ISED number 3466B-1 and CAB identifier JP0011.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017-1 according to ISO/IEC 17025:2017.

The test facility is accredited by A2LA (member of ILAC) under certification number 5056.02 according to ISO/IEC 17025:2017.

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Power Port Conducted Emission (CE)							
Path Loss Correction Factors for CE	-/-	-/-	-/-	RF-0597	1 year	2023-02-06	2024-02-06
Conducted Emission Measurement Software	Toyo Corporation	EP9/CE	Ver. 4.2.010	RF-0810	N/A	N/A	N/A
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2023-09-11	2024-09-11
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	1 year	2023-05-16	2024-05-16
LISN	Rohde & Schwarz	ENV216	101958	RF-0708	1 year	2023-05-16	2024-05-16
For Radiated Emission (RE)							
Path Loss Correction Factors for RE below 1GHz	-/-	-/-	-/-	RF-0596	1 year	2023-02-06	2024-02-06

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 8 of 58
Seite 8 von 58

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
Path Loss Correction Factors for RE above 1GHz	-/-	-/-	-/-	RF-0995	1 year	2022-12-05	2023-12-05
Radiated Emission Measurement Software (above 30MHz)	Toyo Corporation	EP7/RE	VER. 8.0.90	RF-0026	N/A	N/A	N/A
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2023-03-17	2024-03-17
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2023-09-11	2024-09-11
Signal Analyzer, 40GHz	Rohde & Schwarz	FSV40	101835	RF-1183	1 year	2023-09-22	2024-09-22
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	N/A	N/A	N/A
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2023-07-25	2024-07-25
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2023-05-30	2024-05-30
5dB Attenuator	Pasternack	PE7047-5	-/-	RF-0731	1 year	2023-05-29	2024-05-29
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2022-12-21	2023-12-21
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2022-12-22	2023-12-22
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA9120 D	9120D-2280	RF-0845	1 year	2023-03-18	2024-03-18
Preamplifier, 1-40GHz	NEXTEM	RFA-1050000-40	RFA-1905-01	RF-1140	1 year	2023-03-22	2024-03-22
Horn Antenna with Preamplifier, 8-18GHz (RX)	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2023-05-01	2024-05-01
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2023-05-01	2024-05-01
Horn Antenna with Preamplifier, 6-18GHz (RX)	Toyo Corporation	HAP06-18W	B1510452 210-123	RF-1094	1 year	2023-11-10	2024-11-10
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	G089	RF-1095	1 year	2023-11-10	2024-11-10
Horn Antenna with Preamplifier, 18-26.5GHz (RX)	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2023-05-01	2024-05-01
20dB Attenuator	Weinshel Associates	WA54-20-12	-/-	RF-0560	1 year	2023-07-14	2024-07-14
Horn Antenna with Preamplifier, 26.5 -40GHz (RX)	Toyo Corporation	HAP26-40N	00000007	RF-0069	1 year	2023-05-01	2024-05-01
Horn Antenna with Preamplifier, 26.5 -40GHz (RX)	Toyo Corporation	HAP26-40W	B3208602 210-126	RF-1097	1 year	2023-11-10	2024-11-10
Preamplifier, 18-40GHz	Toyo Corporation	TPA1840-60	B3208602 009-053	RF-0861	1 year	2023-03-22	2024-03-22

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Radiated Spurious Emission (above 40GHz)							
Spectrum Analyzer	Keysight	N9041B	US57220181	G1825220	1 year	2023-04-21	2024-04-21
Horn Antenna 40-60GHz (RX)	Custom Microwave Inc.	HO19R	-/-	BT-8334	1 year	2023-08-08	2024-08-08
LNA 40-50GHz	ERAVANT	SBL-4036033080-1919	20101-01	RF-1061	1 year	2023-08-10	2024-08-10
Horn Antenna 50-75GHz (RX)	Custom Microwave Inc.	HO15R	-/-	G1810345	1 year	2023-08-09	2024-08-09
LNA 50-75GHz	AT Microwave	AT-LNA-5075-3804T	MCDE02	RF-0972	1 year	2023-08-16	2024-08-16
Horn Antenna 75-110GHz (RX)	Custom Microwave Inc.	HO10R	-/-	BT-8338	1 year	2023-08-09	2024-08-09
LNA 75G-110GHz	SAGE Millimeter, Inc.	SBL75311420401010E1	13352-01	G1810348	1 year	2023-08-17	2024-08-17
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
DC Power Supply	Agilent	E3646A	MY50350007	RF-0412	N/A	N/A	N/A
True RMS Multimeter	Fluke	87V	97680445	RF-0281	1 year	2022-12-08	2023-12-08

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025 has been confirmed before each testing.

2.3 Measurement Uncertainty

Table 3: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty (k=2)
Conducted Emission on Power Ports	150kHz-30MHz	±3.31dB
Radiated Emission, 3m Distance	30MHz-1GHz	±6.01dB (Vertical) ±4.91dB (Horizontal)
Radiated Emission, 3m Distance	1-6GHz	±5.15dB
	6-18GHz	±5.09dB
	18-40GHz	±5.18dB
Radiated Emission (mmW)	40-110GHz	±4.71dB

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (Equipment Under Test) is K-band movement sensor module based on the Doppler Effect. Although the module incorporates transmitter and receiver, they can only be operated simultaneously.

3.2 Ratings and System Details

Fundamental Field Strength: 105.63dB μ V/m @3m, Average
Antenna gain: +6.82dBi
Antenna type: Patch antenna (printed on PCB)
Antenna mounting type: Internal
Frequency range: 24.075 - 24.175GHz
Nominal Frequency: 24.089 – 24.161GHz
Number of channels: 10
Modulation type: No modulation
FCC classification: FDS (Part 15 Field Disturbance Sensor)

Input Voltage: DC 5.0V
Typical Nominal Voltage: DC 5.0V
Input Current: 90mA
Protection Class: III

Test voltage: DC 5.0V (For EUT)
AC 120V (For AC Adapter) (*)
Test frequency: 60Hz (For AC Adapter) (*)

Note:

(*) One off-the-shelf AC Adapter was used.

3.3 Noise Generating and Noise Suppressing Parts

The highest frequency generated or used by the EUT is 24.161GHz for fundamental component as intentional radiator portion.

3.4 Submitted Documents and Information

Following document has been submitted by the client:

Instruction for the testing

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

4. Test Setup and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and 15.245.

The test methods, which have been used, are based on ANSI C63.10.

For details, see under each test item.

4.2 Operation Modes

The operation modes used for testing are:

- A. Transmitting and receiving at the lowest frequency Channel (24.089 GHz) with the 100% Duty Cycle.
- B. Transmitting and receiving at the middle frequency Channel (24.129 GHz) with the 100% Duty Cycle.
- C. Transmitting and receiving at the highest frequency Channel (24.161 GHz) with the 100% Duty Cycle.

Note: As the EUT can transmit at 100% Duty Cycle (CW mode) in the normal operation, measurements were performed at this setting unless otherwise stated.

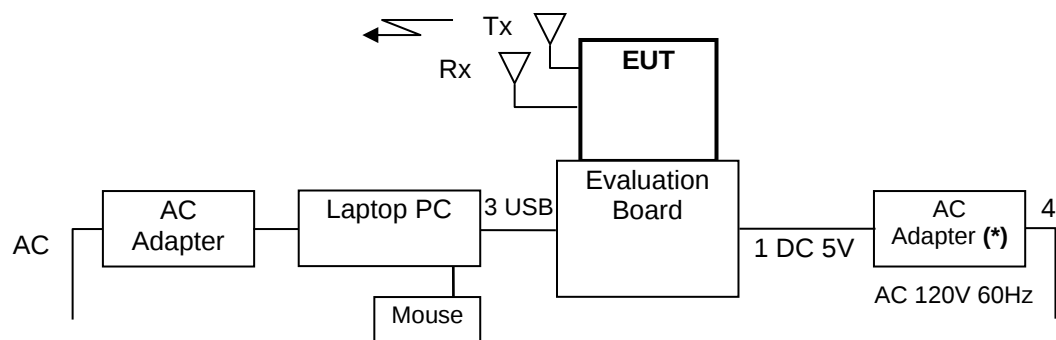
4.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis and the test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

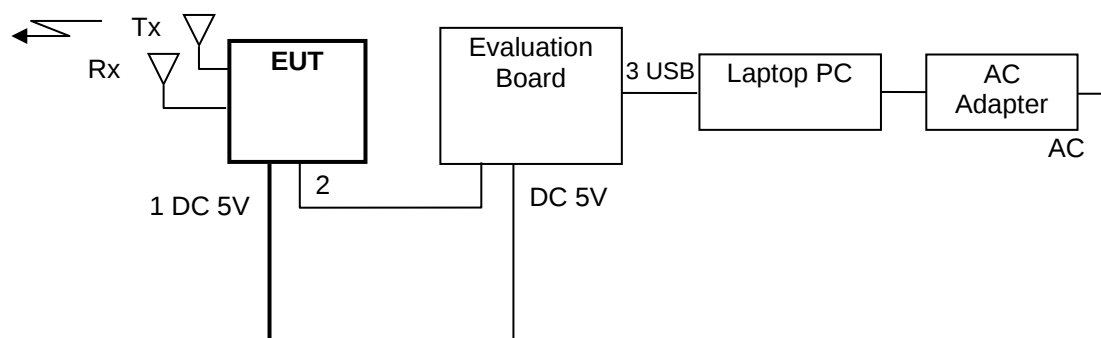
Figure 1: Block Diagram

For AC Power Line Conducted Emission of Transmitter



Note: (*) Off-the-shelf AC Adapter was used, it was connected to a LISN.

For Other Test Items of Transmitter



Note: The EUT was tested as stand-alone configuration, the Laptop PC and its AC Adapter were used for an initial setup purpose in order to configure a required test mode for each test item.

Table 4: Interfaces present on the EUT

No.	Interface		Cable Length for Testing, Shielding	Interface Classification
1.	DC cable	for CE	1.2m, Un-shielded	DC input power port (*)
		for others	2.2m, Un-shielded	
2.	Signal Cable		2.2m, Un-shielded	Signal port (*)
3.	USB Cable		0.5m, Shielded	Signal port
4.	AC cable (for AC Adapter)		1.0m, Un-shielded	AC input power port

Note:

(*) In order to enable testing as Stand-alone configuration, interface cables were extended for the testing purpose.

Table 5: Serial Number on the EUT

Serial Number	Remarks
Sample 01	Test items for the Fundamental
Sample 02	All the other items

For more details, refer to section: Photographs of the Test Set-Up.

4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required modes.

Software used for testing is:

- NJR4267x1 Controller.exe version Ver1.1 by Nisshinbo Micro Devices Inc.

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation modes listed in section 4.2 as appropriate.

4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop PC
Manufacturer: Lenovo
Model: ThinkPad L560
Rated Voltage: DC 20V
Input Current: 2.5A
Protection Class: III
Serial Number: MP-180XOS 17/05
2. Product: AC Adapter for Laptop PC
Manufacturer: Lenovo
Model: ADLX45NCC2A
Rated Voltage: AC 100-240V
Input Current: 1.3A
Frequency: 50-60Hz
Rated Voltage: DC 20V
Output Current: 2.25A
Protection Class: II
Serial Number: 8SSA10E75794C1SG8BP0L5H REV:1
3. Product: USB Mouse
Manufacturer: Lenovo
Model: MO28UOB
Rated Voltage: DC5V
Input Current: 100mA
Protection Class: III
Serial Number: 8SSM50G45918G68E1715
4. Product: AC Adapter for EUT
Manufacturer: UNIFIVE
Model: UNI318-0530
Rated Voltage: AC 100-240V
Input Current: 0.4A
Frequency: 50/60Hz
Output Voltage: DC 5.0V
Output Current: 3.0A
Protection Class: II
Serial Number: L12-0430880

Test Report No.: **JP232TC8 002**
Prüfbericht-Nr.:

Page 17 of 58
Seite 17 von 58

5. Product: Evaluation Board
Manufacturer: Nisshinbo Micro Devices Inc.
Model: R4267K-100-2.0
Rated Voltage: DC 5V
Protection Class: III
Serial Number: Un-specified

4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Supply Voltage Requirements

RESULT:

Pass

Requirements:

FCC §15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the supply voltage requirements.

5.1.2 Antenna Requirements

RESULT:

Pass

Requirements:

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The antenna is permanently attached to the PCB board and is not able to be replaced. Hence it complies with the antenna requirements.

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 19 of 58
Seite 19 von 58

5.1.3 Restricted Bands of Operation

RESULT:

Pass

Requirements:

FCC §15.205 and RSS-Gen §8.10

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 24.075 - 24.175GHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

5.2 Radiated Measurements

5.2.1 Duty Cycle

RESULT:

Reference

Date of testing: 2023-10-03, 2023-11-10

Ambient temperature: 26, 26°C

Relative humidity: 42, 52%

Atmospheric pressure: 1014, 1015hPa

Requirements:

N/A, this test item was performed as reference.

Test procedure:

ANSI C63.10-2013 §7.5

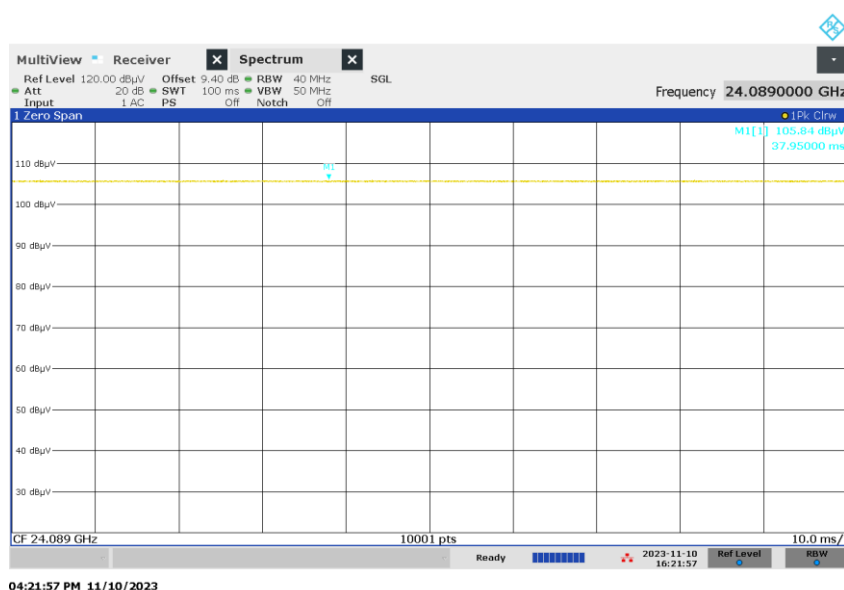
Note: As the EUT can operate in continuous transmit mode (i.e. 100% duty cycle) in the normal operation, all measurements were performed at the setting in this test report. In this section the lowest possible duty cycle was measured as reference, too.

Table 6: Duty Cycle at the highest duty cycle

Mode	Conf.	On Time Duration [ms]	Period of the Pulse Train [ms]	Duty Cycle [%]
A	a	100.0	100.0	100
B	a	100.0	100.0	100
C	a	100.0	100.0	100

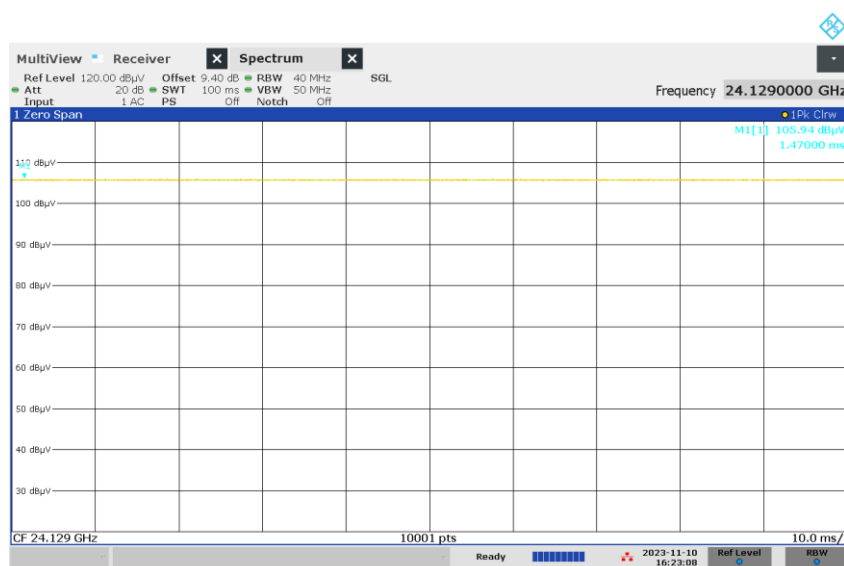
Note: 100% duty cycle in configuration a.

Figure 2: Duty Cycle, Mode A at the highest duty cycle



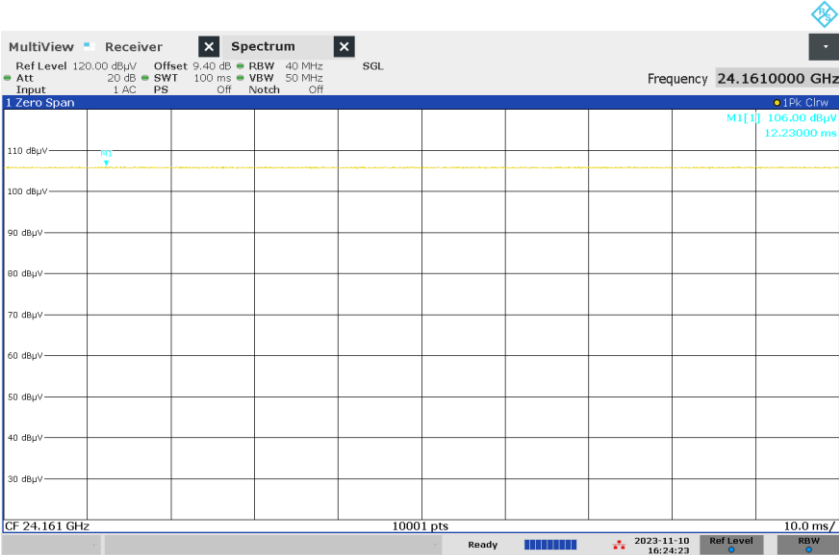
04:21:57 PM 11/10/2023

Figure 3: Duty Cycle, Mode B at the highest duty cycle



04:23:08 PM 11/10/2023

Figure 4: Duty Cycle, Mode C at the highest duty cycle



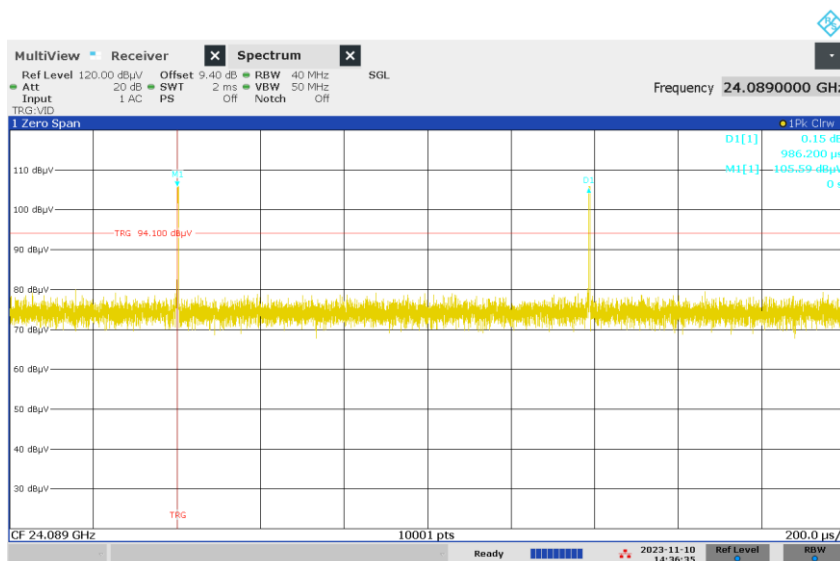
04:24:23 PM 11/10/2023

Table 7: Duty Cycle at the lowest duty cycle

Mode	Conf.	On Time Duration [us]	Period of the Pulse Train [us]	Duty Cycle [%]
A	b	3.911682	986.200	0.397%
B	b	3.921054	982.600	0.399%
C	b	3.969311	982.800	0.404%

Note: The EUT operates at the lowest duty cycle (Nominal 0.4%) in the configuration b.

Figure 5: Duty Cycle, Mode A at the lowest duty cycle



02:36:35 PM 11/10/2023

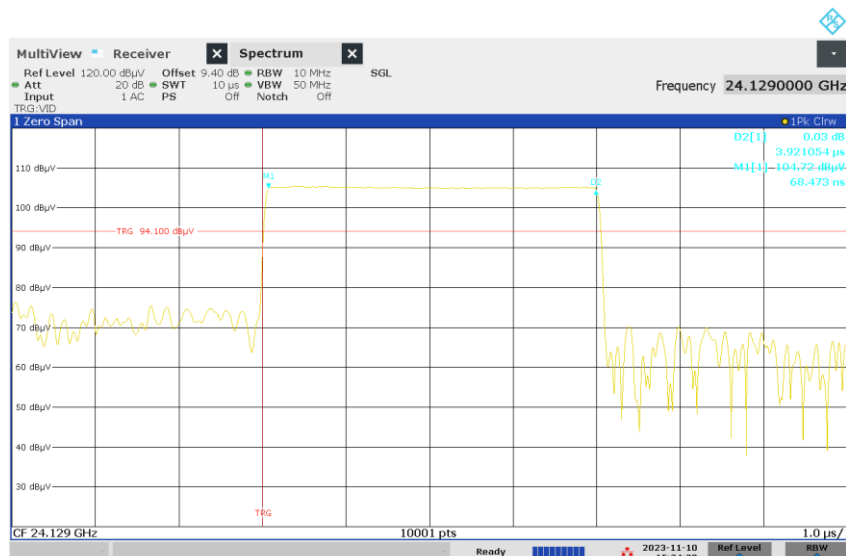
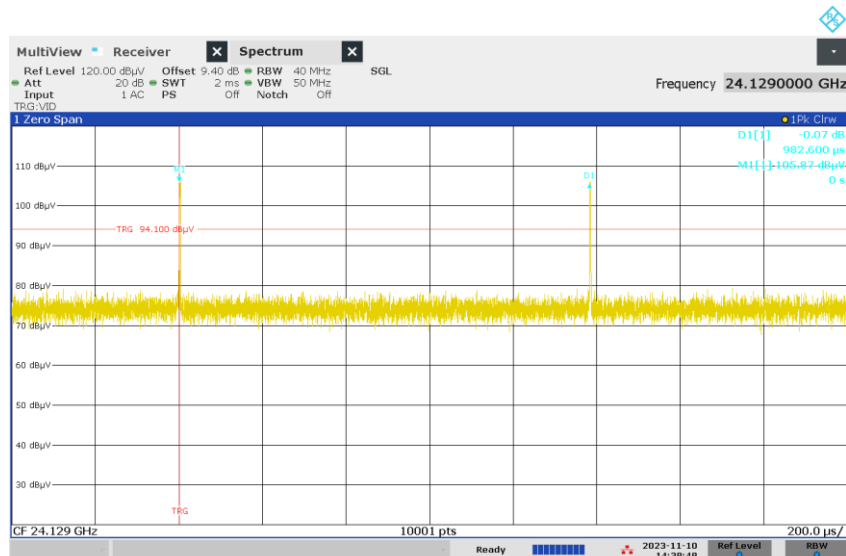


03:26:02 PM 11/10/2023

Test Report No.: **JP232TC8 002**
Prüfbericht-Nr.:

Page 24 of 58
Seite 24 von 58

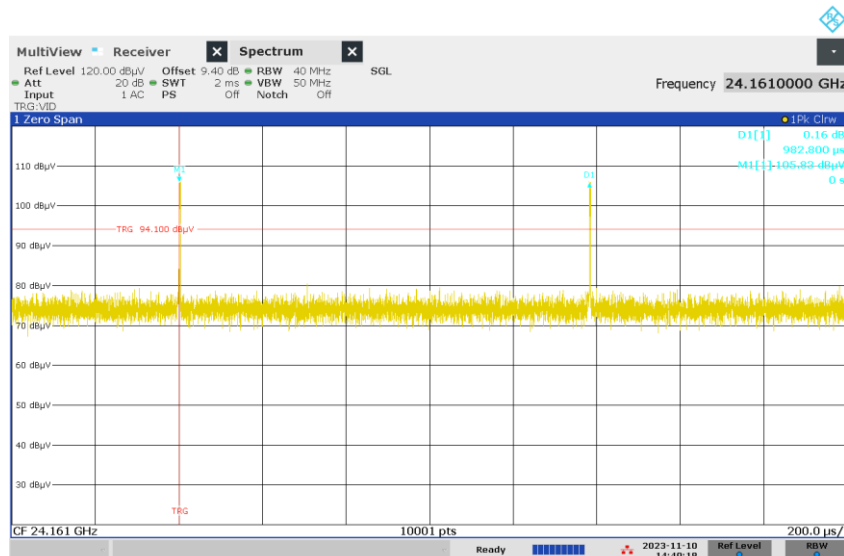
Figure 6: Duty Cycle, Mode B at the lowest duty cycle



Test Report No.: **JP232TC8 002**
Prüfbericht-Nr.:

Page 25 of 58
Seite 25 von 58

Figure 7: Duty Cycle, Mode C at the lowest duty cycle



02:40:18 PM 11/10/2023



02:45:16 PM 11/10/2023

5.2.2 20dB Bandwidth

RESULT:

Pass

Date of testing: 2023-10-03, 2023-11-10

Ambient temperature: 26, 26°C

Relative humidity: 42, 52%

Atmospheric pressure: 1014, 1015hPa

Requirements:

FCC §15.215(c) and §15.245

The 20dB bandwidth of the emission shall be contained within the frequency band (24.075 - 24.175GHz) designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §6.9.2

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a horn antenna connected to a spectrum analyzer with the following settings:

- RBW = 100kHz, VBW = 300kHz, peak detector with Max Hold

Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 27 of 58
Seite 27 von 58

Table 8: 20dB Bandwidth Edge Frequencies

Mode	20dB Bandwidth Edge Side	Edge Frequency [GHz]	Limit [GHz]	Margin [MHz]
A	Lower side	24.0882606	24.075	13.261
	Higher side	24.0902584	24.175	84.742
C	Lower side	24.1617004	24.075	86.700
	Higher side	24.1640146	24.175	10.985

Note: Lower side of the Lowest Ch and Higher side of the Highest Ch were measured.

Table 9: 20dB Bandwidth

Mode	20dB Bandwidth [MHz]	RBW [kHz]	Ratio	Remark
A	1.99780	100	5.00%	
B	2.16439	100	4.60%	
C	2.31420	100	4.30%	

Note: Ratio was calculated in order to confirm its RBW setting at each measurement (i.e. 1% to 5%).

Figure 8: 20dB Bandwidth, Mode A

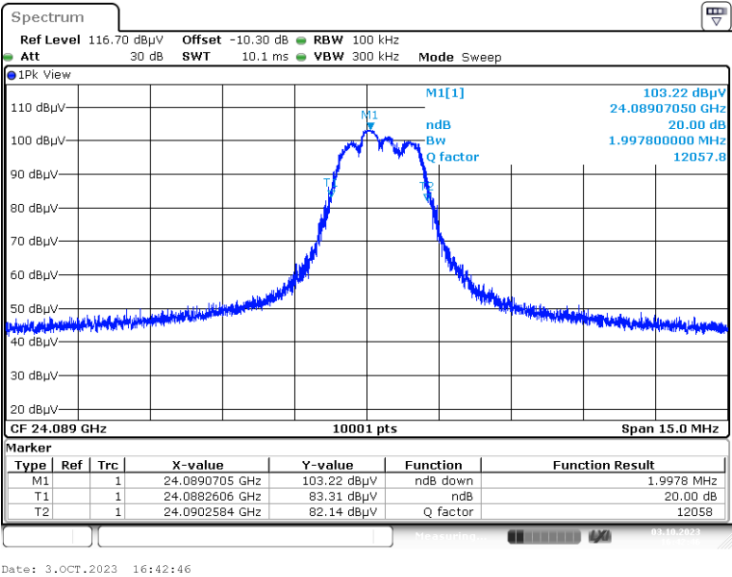


Figure 9: 20dB Bandwidth, Mode B

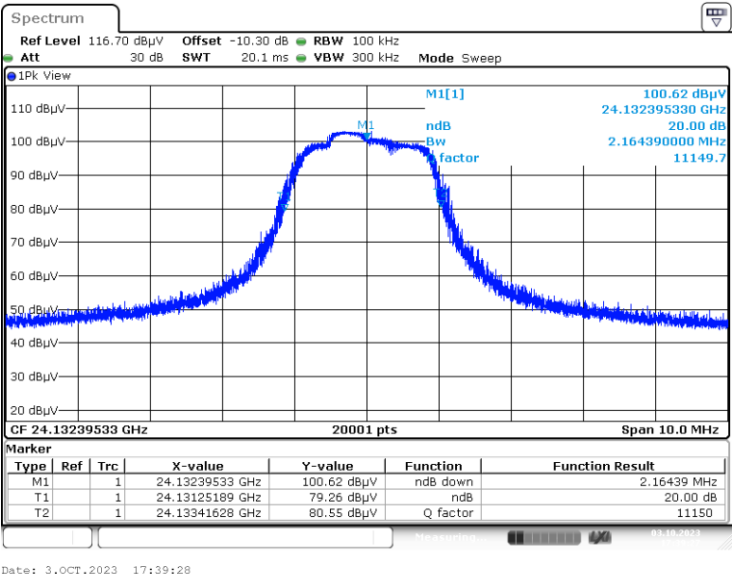
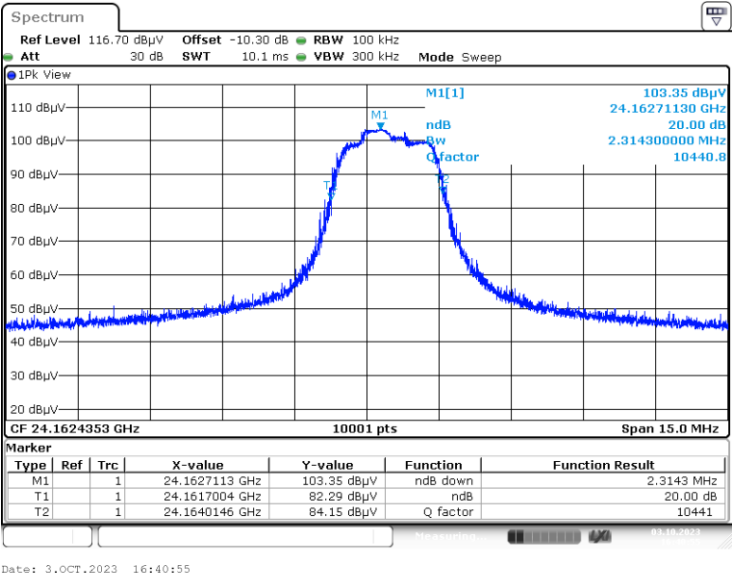


Figure 10: 20dB Bandwidth, Mode C



5.2.3 99% Bandwidth

RESULT:

Reference

Date of testing: 2023-10-03, 2023-11-10

Ambient temperature: 26, 26°C

Relative humidity: 42, 52%

Atmospheric pressure: 1014, 1015hPa

RSS-Gen §6.7 and §8.11

The 99% bandwidth shall be reported and shall lie entirely outside the restricted bands and the prohibited TV bands of 54-72MHz, 76-88MHz, 174-216MHz, 470-608MHz and 614-806MHz, unless otherwise indicated.

Test procedure:

ANSI C63.10 §6.9.3

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 99% bandwidth was measured with a horn antenna connected to a spectrum analyzer with the following settings:

- RBW = 100kHz, VBW = 300kHz, Sample detector with Max Hold

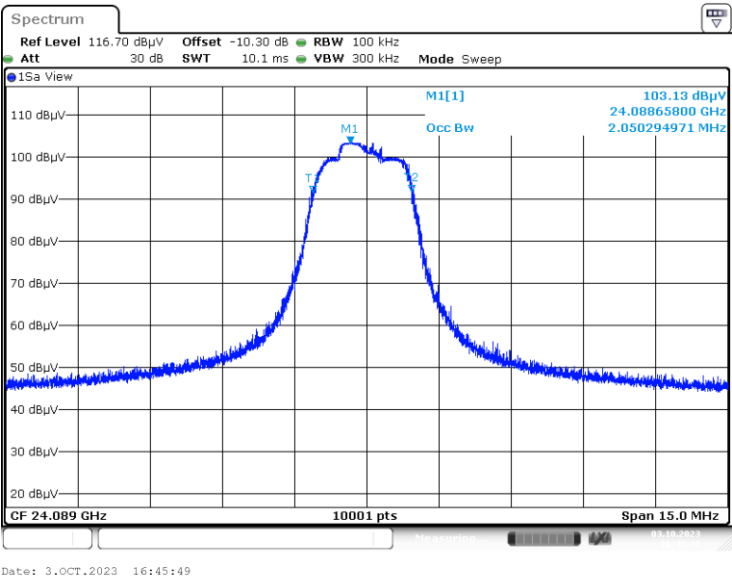
Markers were placed at the lowest and highest intersections of the trace by 99% OBW function to obtain the value of the emission bandwidth.

Table 10: 99% Bandwidth

Mode	99% Bandwidth [MHz]	RBW [kHz]	Ratio	Remark
A	2.050294971	100	4.90%	
B	2.090895455	100	4.80%	Widest 99 OBW
C	2.015798420	100	5.00%	

Note: Ratio was calculated in order to confirm its RBW setting at each measurement (i.e. 1% to 5%).
Gray shading data is the widest 99% OBW in this test report.

Figure 11: 99% Bandwidth, Mode A



Test Report No.: **JP232TC8 002**
Prüfbericht-Nr.:

Page 32 of 58
Seite 32 von 58

Figure 12: 99% Bandwidth, Mode B

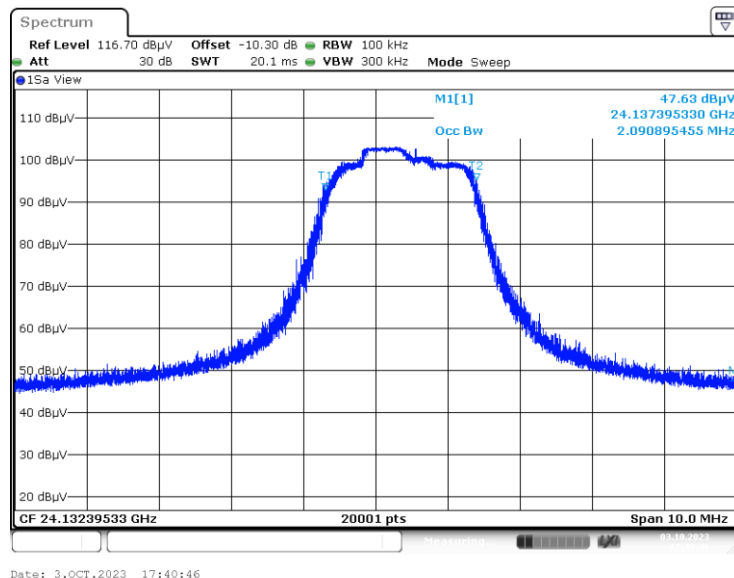
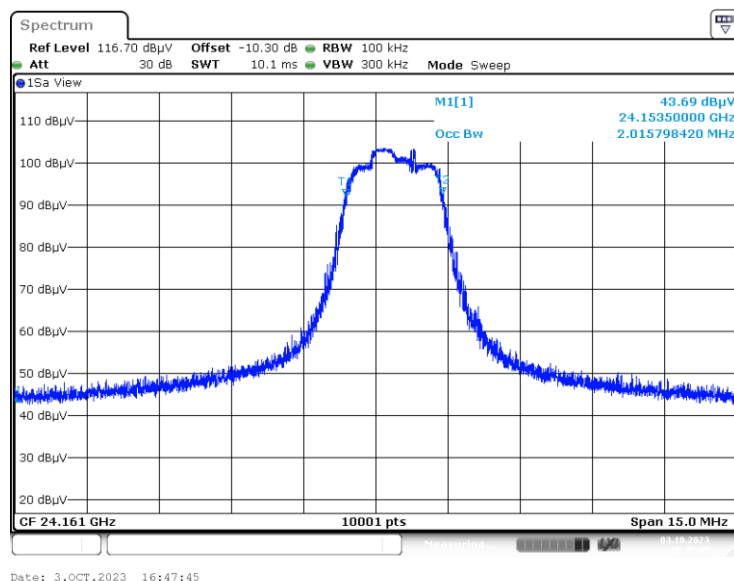


Figure 13: 99% Bandwidth, Mode C



5.2.4 Field Strength of Fundamental

RESULT:

Pass

Date of testing: 2023-10-03, 2023-11-10

Ambient temperature: 26, 26°C

Relative humidity: 42, 52%

Atmospheric pressure: 1014, 1015hPa

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Test mode applied: A, B, C

Requirements:

FCC §15.245 (b) and RSS-210 Annex F, F.1

The field strength of fundamental shall not exceed the level specified in FCC 15.245 (b).
The field strength of fundamental shall not exceed the level specified in RSS-210 Annex F.1, Table F1.

Test procedure:

ANSI C63.10 §6.3 and §6.6

The EUT was placed on a non-conductive table raised 1.5m above the ground plane for the fundamental measurements. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for the three EUT orientations (X, Y, Z) in order to specify the worst case condition.

Measurements were performed using a spectrum analyzer with a suitable span to encompass the maximum point of the fundamental and using the following settings;

- RBW = 3MHz, VBW = 10MHz, peak detector with max hold for Peak;
- RBW = 3MHz, VBW = 10MHz, linear average detector with max hold for Average.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

In the taken spectra in this section, the Yellow trace corresponds to the peak measurement. The Green trace corresponds to the average measurement.

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 34 of 58
Seite 34 von 58

Table 11: Field Strength of Fundamental, Average Data

Mode	Frequency [MHz]	EUT / Ant. Orient.	Reading Level AV [dBμV]	Factor [dB/m]	Average Level [dBμV/m]	Average Limit [dBμV/m]	Margin [dB]
A	24091.186	X/V	95.93	9.70	105.63	127.9	22.3
B	24127.890	X/V	96.04	9.50	105.54	127.9	22.4
C	24161.194	X/V	96.02	9.40	105.42	127.9	22.5

Note: Average limit in dBμV/m is calculated as follows: Average limit = $20 \times \log_{10}(2500000 \text{ uV/m})$.

Average Level was calculated by the following formula;

- Average Level at 3m = Reading Level AV + Factor

Gray shading data shows the highest E-field strength of the fundamental in this test report.

Table 12: Field Strength of Fundamental, Peak Data

Mode	Frequency [MHz]	EUT / Ant. Orient.	Reading Level PK [dBμV]	Factor [dB/m]	Peak Level [dBμV/m]	Peak Limit [dBμV/m]	Margin [dB]
A	24091.506	X/V	96.42	9.70	106.12	147.9	41.8
B	24128.564	X/V	96.40	9.50	105.90	147.9	42.0
C	24162.688	X/V	96.40	9.40	105.80	147.9	42.1

Note: Peak limit in dBμV/m is calculated as follows: Peak limit = Average limit + 20dB.

Peak Level was calculated by the following formula;

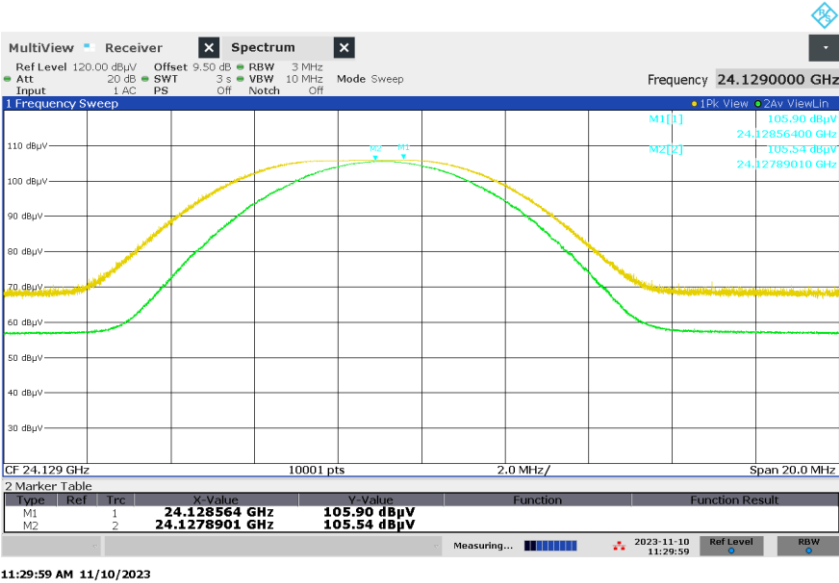
- Peak Level at 3m = Reading Level PK + Factor

Figure 14: Field Strength of Fundamental, Spectral Diagram, Mode A



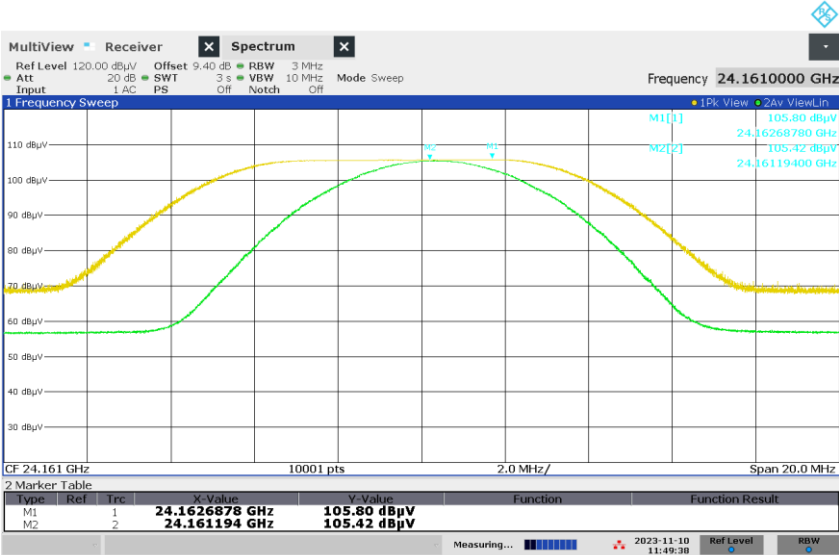
11:04:14 AM 11/10/2023

Figure 15: Field Strength of Fundamental, Spectral Diagram, Mode B



11:29:59 AM 11/10/2023

Figure 16: Field Strength of Fundamental, Spectral Diagram, Mode C



11:49:38 AM 11/10/2023

5.2.5 Radiated Spurious Emissions of Transmitter

RESULT:

Pass

Date of testing: 2023-10-02, 2023-10-03, 2023-10-16
2023-11-06, 2023-11-07, 2023-11-08
2023-11-09

Ambient temperature: 22, 26, 24, 22, 23, 24, 24°C
Relative humidity: 60, 42, 47, 61, 64, 53, 48%
Atmospheric pressure: 1007, 1014, 1005, 1016, 1003hPa
1017, 1022hPa

Frequency range: 9kHz - 100GHz
Measurement distance: 3m below 40GHz
1.2m 40 - 75GHz
1.0m 75 - 100GHz
Kind of test site: Semi Anechoic Chamber

Test mode applied: A, B, C

Requirements:

FCC §15.205, §15.209, §15.245, RSS-Gen §8.9 and §8.10 and RSS-210 Annex F.

Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a) and RSS-Gen §8.10 (table 7), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen §8.9 (tables 5 and 6).

Radiated emissions which is outside of the authorized band, shall be attenuated by at least 50dBc or to the general emission, whichever is the lesser attenuation.

Test procedure:

ANSI C63.10 §6.3, 6.4, 6.5, 6.6, 6.10, 9 and RSS-Gen §6.13 and 8.1

The EUT was placed on a non-conductive table. The table height was 0.8m for measurements below 1GHz and 1.5m for measurements above 1GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to 100GHz. Final radiated emission measurements were made at 3m distance below 40GHz and 1.0 or 1.2m above 40GHz.

At each frequency selected for final measurement, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a receiver operating in the CISPR quasi-peak detection mode. The receiver's 6dB bandwidth was set to 120kHz.

For emissions above 1GHz, measurements were performed with a spectrum analyzer using the following settings: for peak field strength: RBW = 1MHz & VBW = 3MHz; for average field strength: RBW = 1MHz & VBW = 10Hz.

Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

No spurious emission was found in the range from 9kHz to 30MHz at 3m measurement distance.

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 39 of 58
Seite 39 von 58

Table 13: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
56.222	Z/V	49.2	-21.0	28.2	40.0	11.8	100	305
56.272	Y/V	50.1	-21.0	29.1	40.0	10.9	100	205
56.623	X/V	48.3	-21.0	27.3	40.0	12.7	100	18
835.727	X/H	37.8	-9.7	28.1	46.0	17.9	234	74
835.730	Z/H	37.9	-9.7	28.2	46.0	17.8	167	253
835.733	Y/H	37.7	-9.7	28.0	46.0	18.0	223	0
862.497	Y/V	46.4	-9.6	36.8	46.0	9.2	100	275
862.503	Z/V	46.5	-9.6	36.9	46.0	9.1	100	286
862.506	X/V	46.2	-9.6	36.6	46.0	9.4	100	302

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Gray shading data shows the highest Radiated Emission observed in this test report.

Table 14: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1793.896	Z/H	46.3	-19.8	26.5	54.0	27.5	136	65
1794.954	X/V	45.9	-19.8	26.1	54.0	27.9	186	205
1996.256	X/V	45.4	-18.0	27.4	54.0	26.6	100	303
2188.568	Z/V	44.9	-16.9	28.0	54.0	26.0	136	0
2396.134	Y/V	45.9	-17.0	28.9	54.0	25.1	193	92
2396.678	X/V	46.0	-17.0	29.0	54.0	25.0	126	57
2398.158	Z/H	44.9	-17.0	27.9	54.0	26.1	187	230
2398.833	Y/H	44.5	-17.0	27.5	54.0	26.5	148	212
3194.191	Y/V	44.9	-13.7	31.2	54.0	22.8	167	75
3198.266	X/V	43.9	-13.7	30.2	54.0	23.8	147	82
10811.141	Z/V	36.0	-5.4	30.6	54.0	23.4	121	68
15883.709	Y/V	35.4	-5.0	30.4	54.0	23.6	161	70
15946.911	X/V	35.0	-5.1	29.9	54.0	24.1	186	9
25942.678	X/H	43.3	-11.5	31.8	54.0	22.2	185	210
26040.086	Y/V	43.5	-11.5	32.0	54.0	22.0	108	187
26043.332	Z/H	43.0	-11.5	31.5	54.0	22.5	101	159
37665.692	Z/V	71.0	-38.5	32.5	54.0	21.5	154	197
38042.768	X/H	72.1	-38.8	33.3	54.0	20.7	106	134

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 15: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1793.896	Z/H	69.9	-19.8	50.1	74.0	23.9	136	65
1794.954	X/V	69.2	-19.8	49.5	74.0	24.5	186	205
1996.256	X/V	65.1	-18.0	47.1	74.0	26.9	100	303
2188.568	Z/V	65.8	-16.9	48.9	74.0	25.1	136	0
2396.134	Y/V	71.2	-17.0	54.2	74.0	19.8	193	92
2396.678	X/V	72.3	-17.0	55.3	74.0	18.7	126	57
2398.158	Z/H	65.4	-17.0	48.4	74.0	25.6	187	230
2398.833	Y/H	62.9	-17.0	45.9	74.0	28.1	148	212
3194.191	Y/V	66.5	-13.7	52.8	74.0	21.2	167	75
3198.266	X/V	63.3	-13.7	49.6	74.0	24.4	147	82
10811.141	Z/V	49.8	-5.4	44.4	74.0	29.6	121	68
15883.709	Y/V	49.1	-5.0	44.1	74.0	29.9	161	70
15946.911	X/V	49.2	-5.1	44.1	74.0	29.9	186	9
25942.678	X/H	57.1	-11.5	45.6	74.0	28.4	185	210
26040.086	Y/V	56.8	-11.5	45.3	74.0	28.7	108	187
26043.332	Z/H	56.6	-11.5	45.1	74.0	28.9	101	159
37665.692	Z/V	84.9	-38.5	46.4	74.0	27.6	154	197
38042.768	X/H	86.7	-38.8	47.9	74.0	26.1	106	134

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 16: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]
48178.0	X/H	35.17	19.59	1.2	-7.96	46.80	77.5	30.7
48178.4	X/V	38.22	19.59	1.2	-7.96	49.85	77.5	27.7
72264.0	X/H	35.48	21.36	1.2	-7.96	48.88	77.5	28.6
72265.0	X/V	35.28	21.36	1.2	-7.96	48.68	77.5	28.8

Note: Level AV = Reading AV + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Table 17: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]
48177.6	X/V	48.97	19.59	1.2	-7.96	60.60	97.5	36.9
48178.0	X/H	45.62	19.59	1.2	-7.96	57.25	97.5	40.3
72262.0	X/V	38.30	21.36	1.2	-7.96	51.70	97.5	45.8
72263.0	X/H	38.88	21.36	1.2	-7.96	52.28	97.5	45.2

Note: Level PK = Reading PK + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 41 of 58
Seite 41 von 58

Table 18: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode B

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
56.222	Y/V	49.9	-21.0	28.9	40.0	11.1	100	329
56.589	Z/V	50.4	-21.0	29.4	40.0	10.6	105	150
56.614	X/V	50.3	-21.0	29.3	40.0	10.7	105	5
835.730	X/H	38.0	-9.7	28.3	46.0	17.7	184	230
835.731	Y/H	38.3	-9.7	28.6	46.0	17.4	240	133
835.733	Z/H	38.5	-9.7	28.8	46.0	17.2	117	193
862.489	Y/V	46.0	-9.6	36.4	46.0	9.6	100	277
862.496	X/V	46.3	-9.6	36.7	46.0	9.3	100	277
862.500	Z/V	46.1	-9.6	36.5	46.0	9.5	100	274

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 19: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1790.911	Z/V	46.1	-19.8	26.3	54.0	27.7	194	149
1803.978	X/V	47.2	-19.7	27.5	54.0	26.5	176	186
1997.526	Z/V	45.2	-18.0	27.2	54.0	26.8	203	298
2395.202	Z/V	45.8	-17.0	28.8	54.0	25.2	193	95
2396.357	X/V	45.9	-17.0	28.9	54.0	25.1	114	321
2399.521	Y/V	47.2	-17.0	30.2	54.0	23.8	198	96
3195.430	Y/V	44.1	-13.7	30.4	54.0	23.6	147	81
3197.753	X/V	44.0	-13.7	30.3	54.0	23.7	167	44
5872.384	X/H	42.2	-7.5	34.7	54.0	19.3	168	209
7170.771	Z/H	41.1	-3.8	37.3	54.0	16.7	193	134
10802.462	Y/V	36.2	-5.4	30.8	54.0	23.2	121	56
15928.450	Z/V	35.0	-5.1	29.9	54.0	24.1	202	59
25968.462	Y/H	43.3	-11.5	31.8	54.0	22.2	127	60
26306.358	X/H	43.0	-11.5	31.5	54.0	22.5	180	259
26499.368	Z/H	42.4	-11.2	31.2	54.0	22.8	102	121
37776.708	X/H	71.2	-38.6	32.6	54.0	21.4	114	128
38137.800	Z/V	72.7	-39.2	33.5	54.0	20.5	114	229

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 20: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1790.911	Z/V	67.6	-19.8	47.8	74.0	26.2	194	149
1803.978	X/V	73.2	-19.7	53.4	74.0	20.6	176	186
1997.526	Z/V	64.8	-18.0	46.8	74.0	27.2	203	298
2395.202	Z/V	71.0	-17.0	54.0	74.0	20.0	193	95
2396.357	X/V	71.1	-17.0	54.1	74.0	19.9	114	321
2399.521	Y/V	71.0	-17.0	54.0	74.0	20.0	198	96
3195.430	Y/V	65.4	-13.7	51.7	74.0	22.3	147	81
3197.753	X/V	63.2	-13.7	49.5	74.0	24.5	167	44
5872.384	X/H	55.5	-7.5	47.9	74.0	26.1	168	209
7170.771	Z/H	54.3	-3.8	50.6	74.0	23.4	193	134
10802.462	Y/V	49.7	-5.4	44.3	74.0	29.7	121	56
15928.450	Z/V	49.4	-5.1	44.3	74.0	29.7	202	59
25968.462	Y/H	57.0	-11.5	45.5	74.0	28.5	127	60
26306.358	X/H	56.6	-11.5	45.1	74.0	28.9	180	259
26499.368	Z/H	59.8	-11.2	48.6	74.0	25.4	102	121
37776.708	X/H	85.2	-38.6	46.6	74.0	27.4	114	128
38137.800	Z/V	86.6	-39.2	47.4	74.0	26.6	114	229

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 21: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode B

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]
48260.0	X/H	30.51	19.59	1.2	-7.96	42.14	77.5	35.4
48260.8	X/V	35.16	19.59	1.2	-7.96	46.79	77.5	30.7
72384.0	X/V	30.61	21.36	1.2	-7.96	44.01	77.5	33.5
72388.0	X/H	30.54	21.36	1.2	-7.96	43.94	77.5	33.6

Note: Level AV = Reading AV + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Table 22: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode B

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]
48255.2	X/H	47.91	19.59	1.2	-7.96	59.54	97.5	38.0
48260.0	X/V	46.05	19.59	1.2	-7.96	57.68	97.5	39.8
72382.0	X/V	32.29	21.36	1.2	-7.96	45.69	97.5	51.8
72386.0	X/H	35.04	21.36	1.2	-7.96	48.44	97.5	49.1

Note: Level PK = Reading PK + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 43 of 58
Seite 43 von 58

Table 23: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode C

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
53.073	Z/V	47.8	-20.8	27.0	40.0	13.0	111	188
56.567	X/V	48.1	-21.0	27.1	40.0	12.9	100	351
56.613	Y/V	48.6	-21.0	27.6	40.0	12.4	100	188
835.728	X/H	38.4	-9.7	28.7	46.0	17.3	250	336
862.489	X/V	45.8	-9.6	36.2	46.0	9.8	100	270
862.500	Y/V	46.1	-9.6	36.5	46.0	9.5	100	274
862.501	Z/V	46.3	-9.6	36.7	46.0	9.3	100	325
935.413	Z/H	36.1	-7.6	28.5	46.0	17.5	112	332
948.566	X/V	34.6	-7.5	27.1	46.0	18.9	100	270
960.066	Y/H	35.6	-7.5	28.1	54.0	25.9	100	191

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 24: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1793.577	Z/H	45.9	-19.8	26.1	54.0	27.9	100	96
1794.709	Y/V	47.0	-19.8	27.2	54.0	26.8	147	189
1995.029	X/V	45.6	-18.0	27.6	54.0	26.4	185	184
2393.270	X/V	46.0	-17.0	29.0	54.0	25.0	188	80
2396.410	Z/V	45.7	-17.0	28.7	54.0	25.3	118	329
2397.299	Y/V	45.3	-17.0	28.3	54.0	25.7	147	353
2589.875	Z/V	45.3	-16.0	29.3	54.0	24.7	147	59
3197.387	X/V	44.3	-13.7	30.6	54.0	23.4	167	72
15377.437	X/H	35.3	-5.5	29.8	54.0	24.2	103	159
16000.773	Y/H	34.9	-5.2	29.7	54.0	24.3	173	142
24414.668	Y/V	42.1	-11.4	30.7	54.0	23.3	102	284
25999.650	Z/H	43.1	-11.5	31.6	54.0	22.4	152	253
26122.476	X/H	43.7	-11.5	32.2	54.0	21.8	134	337
37735.936	X/H	71.2	-38.5	32.7	54.0	21.3	174	286
37856.112	Z/V	71.5	-38.6	32.9	54.0	21.1	105	278
38111.976	Y/V	72.2	-39.1	33.1	54.0	20.9	162	270
38295.356	Y/H	72.6	-39.7	32.9	54.0	21.1	105	0

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Test Report No.: **JP232TC8 002**
Prüfbericht-Nr.:

Page 44 of 58
Seite 44 von 58

Table 25: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1793.577	Z/H	71.0	-19.8	51.2	74.0	22.8	100	96
1794.709	Y/V	72.8	-19.8	53.0	74.0	21.0	147	189
1995.029	X/V	66.9	-18.0	48.9	74.0	25.1	185	184
2393.270	X/V	71.9	-17.0	54.9	74.0	19.1	188	80
2396.410	Z/V	70.6	-17.0	53.6	74.0	20.4	118	329
2397.299	Y/V	67.8	-17.0	50.8	74.0	23.2	147	353
2589.875	Z/V	66.1	-16.0	50.1	74.0	23.9	147	59
3197.387	X/V	65.9	-13.7	52.2	74.0	21.8	167	72
15377.437	X/H	49.9	-5.5	44.4	74.0	29.6	103	159
16000.773	Y/H	48.4	-5.2	43.2	74.0	30.8	173	142
24414.668	Y/V	55.3	-11.4	43.9	74.0	30.1	102	284
25999.650	Z/H	56.3	-11.5	44.8	74.0	29.2	152	253
26122.476	X/H	57.7	-11.5	46.2	74.0	27.8	134	337
37735.936	X/H	85.0	-38.5	46.5	74.0	27.5	174	286
37856.112	Z/V	85.7	-38.6	47.1	74.0	26.9	105	278
38111.976	Y/V	86.1	-39.1	47.0	74.0	27.0	162	270
38295.356	Y/H	86.7	-39.7	47.0	74.0	27.0	105	0

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log₁₀(uV/m)

Table 26: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode C

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]
48318.8	X/H	36.12	19.59	1.2	-7.96	47.75	77.5	29.8
48321.2	X/V	34.53	19.59	1.2	-7.96	46.16	77.5	31.3
72481.0	X/H	33.34	21.36	1.2	-7.96	46.74	77.5	30.8
72484.0	X/V	32.05	21.36	1.2	-7.96	45.45	77.5	32.1

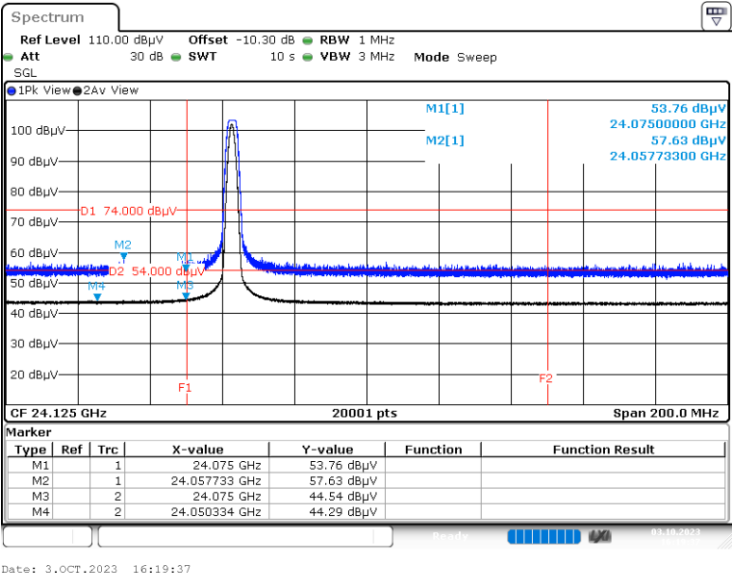
Note: Level AV = Reading AV + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Table 27: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode C

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	D [m]	DCF [dB]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]
48317.6	X/H	47.91	19.59	1.2	-7.96	59.54	97.5	38.0
48321.2	X/V	49.85	19.59	1.2	-7.96	61.48	97.5	36.0
72477.0	X/H	36.08	21.36	1.2	-7.96	49.48	97.5	48.0
72484.0	X/V	35.72	21.36	1.2	-7.96	49.12	97.5	48.4

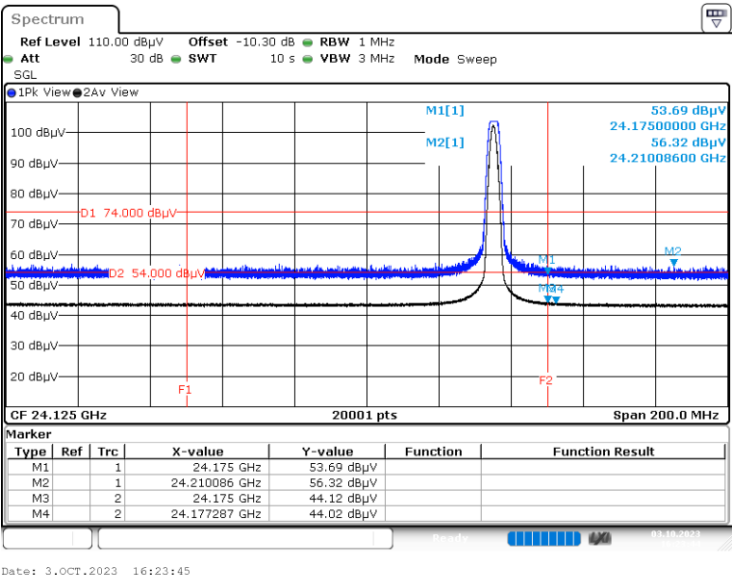
Note: Level PK = Reading PK + Factor + DCF, dB(uV/m) = 20 × Log₁₀(uV/m)
DCF = 20 × Log₁₀ (D/3.0) [dB]

Figure 17: Radiated Emissions at Band Edge, Spectral Diagram, Mode A



Note: The upper trace shows the peak value and the lower trace shows the average value. Radiated emissions which is outside of the authorized band were attenuated below the general emission limits.

Figure 18: Radiated Emissions at Band Edge, Spectral Diagram, Mode C



Note: The upper trace shows the peak value and the lower trace shows the average value. Radiated emissions which is outside of the authorized band were attenuated below the general emission limits.

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT:

Pass

Date of testing: 2023-10-10

Ambient temperature: 25°C

Relative humidity: 59%

Atmospheric pressure: 1004hPa

Frequency range: 0.15 - 30MHz

Kind of test site: Shielded Room

Test mode applied: A, B, C

Test configuration applied: 1

Requirements:

FCC §15.207 and RSS-Gen §8.8

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC §15.207 and RSS-Gen §8.8 (table 4).

Test procedure:

ANSI C63.10 §6.2 and RSS-Gen §8.1

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The AC adapter of the EUT was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with a receiver operating in the CISPR quasi-peak and average detection modes. The receiver's 6dB bandwidth was set to 9kHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 47 of 58
Seite 47 von 58

Table 28: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode A

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.15000	N	30.3	14.1	9.6	39.9	23.7	66.0	56.0	26.1	32.3
0.32300	N	31.4	23.4	9.7	41.1	33.1	59.6	49.6	18.5	16.5
1.04300	N	13.4	6.2	9.7	23.1	15.9	56.0	46.0	32.9	30.1
4.32700	N	10.8	3.2	9.9	20.7	13.1	56.0	46.0	35.3	32.9
18.00400	N	19.5	12.6	10.3	29.8	22.9	60.0	50.0	30.2	27.1
19.75900	N	23.5	19.1	10.3	33.8	29.4	60.0	50.0	26.2	20.6
0.15200	L1	30.0	13.8	9.6	39.6	23.4	65.9	55.9	26.3	32.5
0.32200	L1	31.3	22.8	9.7	41.0	32.5	59.7	49.7	18.7	17.2
1.31900	L1	10.8	3.7	9.8	20.6	13.5	56.0	46.0	35.4	32.5
4.36800	L1	9.4	2.4	9.9	19.3	12.3	56.0	46.0	36.7	33.7
17.97000	L1	19.4	12.2	10.2	29.6	22.4	60.0	50.0	30.4	27.6
20.79900	L1	25.5	22.5	10.3	35.8	32.8	60.0	50.0	24.2	17.2

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

Gray shading data shows the highest Conducted Emission observed in this test report.

Table 29: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode B

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.15000	N	30.4	14.1	9.6	40.0	23.7	66.0	56.0	26.0	32.3
0.32200	N	31.5	23.1	9.7	41.2	32.8	59.6	49.6	18.4	16.8
0.86200	N	14.1	7.0	9.7	23.8	16.7	56.0	46.0	32.2	29.3
1.05900	N	14.1	6.6	9.7	23.8	16.3	56.0	46.0	32.2	29.7
3.68900	N	8.9	1.7	9.9	18.8	11.6	56.0	46.0	37.2	34.4
20.72000	N	25.4	22.4	10.4	35.8	32.8	60.0	50.0	24.2	17.2
0.18500	L1	26.0	13.4	9.6	35.6	23.0	64.2	54.2	28.6	31.2
0.32200	L1	31.4	23.1	9.7	41.1	32.8	59.6	49.6	18.5	16.8
0.55900	L1	13.2	5.9	9.7	22.9	15.6	56.0	46.0	33.1	30.4
4.83500	L1	10.7	2.4	9.9	20.6	12.3	56.0	46.0	35.4	33.7
17.59800	L1	20.3	13.9	10.2	30.5	24.1	60.0	50.0	29.5	25.9
20.83900	L1	24.8	21.4	10.3	35.1	31.7	60.0	50.0	24.9	18.3

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

Test Report No.:
Prüfbericht-Nr.:

JP232TC8 002

Page 48 of 58
Seite 48 von 58

Table 30: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode C

Freq. [MHz]	Phase	Reading QP [dBμV]	Reading AV [dBμV]	Factor [dB]	Level QP [dBμV]	Level AV [dBμV]	Limit QP [dBμV]	Limit AV [dBμV]	Margin QP [dB]	Margin AV [dB]
0.15000	N	30.3	14.1	9.6	39.9	23.7	66.0	56.0	26.1	32.3
0.32200	N	31.5	23.3	9.7	41.2	33.0	59.6	49.6	18.4	16.6
1.09300	N	13.7	6.6	9.7	23.4	16.3	56.0	46.0	32.6	29.7
3.03200	N	10.7	3.2	9.8	20.5	13.0	56.0	46.0	35.5	33.0
4.18300	N	10.3	2.6	9.9	20.2	12.5	56.0	46.0	35.8	33.5
20.75900	N	24.1	21.2	10.4	34.5	31.6	60.0	50.0	25.5	18.4
0.15100	L1	30.6	14.0	9.6	40.2	23.6	65.9	55.9	25.7	32.3
0.32300	L1	31.5	23.3	9.7	41.2	33.0	59.6	49.6	18.4	16.6
0.85800	L1	14.6	7.7	9.7	24.3	17.4	56.0	46.0	31.7	28.6
1.70100	L1	9.6	2.3	9.8	19.4	12.1	56.0	46.0	36.6	33.9
4.83100	L1	10.9	2.6	9.9	20.8	12.5	56.0	46.0	35.2	33.5
19.20000	L1	20.2	14.4	10.2	30.4	24.6	60.0	50.0	29.6	25.4

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

7. List of Tables

Table 1: Test Summary	5
Table 2: List of Test and Measurement Equipment	7
Table 3: Emission Measurement Uncertainty	10
Table 4: Interfaces present on the EUT	15
Table 5: Serial Number on the EUT	15
Table 6: Duty Cycle at the highest duty cycle	21
Table 7: Duty Cycle at the lowest duty cycle	23
Table 8: 20dB Bandwidth Edge Frequencies	27
Table 9: 20dB Bandwidth	27
Table 10: 99% Bandwidth	31
Table 11: Field Strength of Fundamental, Average Data	34
Table 12: Field Strength of Fundamental, Peak Data	34
Table 13: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A	39
Table 14: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A	39
Table 15: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A	40
Table 16: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode A	40
Table 17: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode A	40
Table 18: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode B	41
Table 19: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B	41
Table 20: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B	42
Table 21: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode B	42
Table 22: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode B	42
Table 23: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode C	43
Table 24: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C	43
Table 25: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C	44
Table 26: Radiated Emission, Average Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode C	44
Table 27: Radiated Emission, Peak Data, 40 - 100GHz, Horizontal and Vertical Antenna Orientations, Mode C	44
Table 28: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode A	47
Table 29: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode B	47
Table 30: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode C	48

8. List of Figures

Figure 1: Block Diagram	14
Figure 2: Duty Cycle, Mode A at the highest duty cycle	21
Figure 3: Duty Cycle, Mode B at the highest duty cycle	21
Figure 4: Duty Cycle, Mode C at the highest duty cycle	22
Figure 5: Duty Cycle, Mode A at the lowest duty cycle	23
Figure 6: Duty Cycle, Mode B at the lowest duty cycle	24
Figure 7: Duty Cycle, Mode C at the lowest duty cycle	25
Figure 8: 20dB Bandwidth, Mode A	28
Figure 9: 20dB Bandwidth, Mode B	28
Figure 10: 20dB Bandwidth, Mode C	29
Figure 11: 99% Bandwidth, Mode A	31
Figure 12: 99% Bandwidth, Mode B	32
Figure 13: 99% Bandwidth, Mode C	32
Figure 14: Field Strength of Fundamental, Spectral Diagram, Mode A	35
Figure 15: Field Strength of Fundamental, Spectral Diagram, Mode B	35
Figure 16: Field Strength of Fundamental, Spectral Diagram, Mode C	36
Figure 17: Radiated Emissions at Band Edge, Spectral Diagram, Mode A	45
Figure 18: Radiated Emissions at Band Edge, Spectral Diagram, Mode C	45

9. List of Photographs

Photograph 1: Set-up for AC Power Line Conducted Emission, Front View	49
Photograph 2: Set-up for AC Power Line Conducted Emission, Rear View	49
Photograph 3: Set-up for Radiated Emission below 30MHz, Perpendicular	50
Photograph 4: Set-up for Radiated Emission below 30MHz, Ground-parallel	50
Photograph 5: Set-up for Radiated Emission below 1GHz, Front View	51
Photograph 6: Set-up for Radiated Emission below 1GHz, Rear View	51
Photograph 7: Set-up for Radiated Emission above 1GHz, Front View	52
Photograph 8: Set-up for Radiated Emission above 1GHz, Rear View	52
Photograph 9: Set-up for Radiated Emission above 40GHz, General View	53
Photograph 10: Set-up for Radiated Emission above 40GHz, Close View	53
Photograph 11: Set-up for X-Axis of the EUT	54
Photograph 12: Set-up for Y-Axis of the EUT	54
Photograph 13: Set-up for Z-Axis of the EUT	55
Photograph 14: EUT	55
Photograph 15: Evaluation Board	56

– End of test report –