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Produkte
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Prüfbericht - Nr.: *Test Report No.:*	**50073207 001**	**Seite 1 von 38** *Page 1 of 38*

Auftraggeber: *Client:*	**New Japan Radio** 1-1, Fukuoka 2-Chome. Fujimino City Saitama, 356-8510 Japan
Gegenstand der Prüfung: *Test Item:*	**K-Band Doppler Sensor Module (Movement Sensor)**
Bezeichnung: *Identification:*	**NJR4265RTF3**
Serien-Nr.: *Serial No.:*	**Z000002Z**
Wareneingangs-Nr.: *Receipt No.:*	**A000514054-001 to -014**
Eingangsdatum: *Date of Receipt:*	**2017-03-15**
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of Test Item at Delivery:*	**Good**
Prüfort: *Testing Location:*	**TÜV Rheinland Japan Ltd. – Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan
Prüfgrundlage: *Test Specification:*	**FCC 47 CFR Part 15, Subpart C, Sections 15.207, 15.209 and 15.245 (October 1, 2015)** **RSS-210 (Issue 9): 2016** **RSS-Gen (Issue 4): 2014** ANSI C63.10-2013
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Japan Ltd. – Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
2017-04-11	A. Abe / Inspector		2017-04-11	R. Meiranke / Reviewer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges / *Other Aspects:*

Abkürzungen:				*Abbreviations:*			
P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*	
F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*	
N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*	
N/T	=	*nicht getestet*		*N/T*	=	*not tested*	

TEST SUMMARY

5.1.1 SUPPLY VOLTAGE REQUIREMENTS
RESULT: PASS

5.1.2 ANTENNA REQUIREMENTS
RESULT: PASS

5.1.3 RESTRICTED BANDS OF OPERATION
RESULT: PASS

5.2.1 RADIATED EMISSIONS OF TRANSMITTER (CARRIER, HARMONICS AND SPURIOUS)
RESULT: PASS

5.2.2 20DB BANDWIDTH
RESULT: PASS

5.2.3 99% BANDWIDTH

5.3.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER
RESULT: PASS

Contents

1. General Remarks

1.1 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 Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

Innovation, Science and Economic Development Canada has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with Canadian requirements. The description of the test facility is listed under OATS filing number 3466B-1.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005.

ilac-MRA VLAC Lab Accreditation VLAC-017

TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For AC Power Line Conducted Emission							
Conducted Emission Measurement Software	Toyo Corporation	EP5/CE	Ver. 5.0.20	RF-0025	14 months	2017-03-31	2018-05-31
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2016-07-30	2017-07-30
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	1 year	2016-05-27	2017-05-27
LISN	Schwarzbeck Mess-Electronik	NSLK 8128 (4X32/50A)	8128-239	RF-0017	1 year	2016-09-27	2017-09-27
For Radiated Emission							
Radiated Emission Measurement Soft-ware (below 30MHz)	Toyo Corporation	EP5/ME	Ver. 5.0.10	RF-0172	14 months	2017-03-31	2018-05-31
Radiated Emission Measurement Soft-ware (above 30MHz)	Toyo Corporation	EP7/RE	Ver. 5.0.2	RF-0026	14 months	2017-03-31	2018-05-31
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2016-07-30	2017-07-30
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2016-08-31	2017-08-31
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	14 months	2017-03-31	2018-05-31
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2016-06-03	2017-06-03
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2016-03-30	2017-03-30
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2017-03-01	2018-03-01
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2017-01-18	2018-01-18
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2017-01-18	2018-01-18
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2016-06-03	2017-06-03
Microwave Preamplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	1 year	2017-01-25	2018-01-25
Horn Antenna with Preamplifier, 8-18GHz	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2016-06-03	2017-06-03
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2016-07-01	2017-07-01

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
Horn Antenna with Preamplifier, 18-26.5GHz	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2016-06-03	2017-06-03
Horn Antenna with Preamplifier, 26.5-40GHz	Toyo Corporation	HAP26-40N	00000007	RF-0069	1 year	2016-06-03	2017-06-03
Preamplifier, 26.5-40GHz	Toyo Corporation	HAP2640-S	-	RF-0258	1 year	2016-03-31	2017-03-31
For Transmitter and Receiver Radiated Spurious Emission (above 40GHz)							
Spectrum Analyzer	Agilent	E4447A	MY48250005	BT-8267	1 year	2017-01-11	2018-01-11
Harmonic Mixer 40-60GHz	Agilent	11970U	MY30030222	BT-8348	1 year	2016-11-04	2017-11-04
Horn Antenna 40-60GHz (RX)	Custom Microwave Inc.	HO19R	-	BT-8334	N/A	N/A	N/A
Harmonic Mixer 50-75GHz	Agilent	11970V	MY30033072	BT-8367	1 year	2017-01-25	2018-01-25
Horn Antenna 50-75GHz (RX)	Custom Microwave Inc.	HO15R	-	BT-8336	N/A	N/A	N/A
Harmonic Mixer 75-110GHz	Agilent	11970W	MY25210462	BT-8350	1 year	2017-01-26	2018-01-26
Horn Antenna 75-110GHz (RX)	Custom Microwave Inc.	HO10R	-	BT-8338	N/A	N/A	N/A
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
CVCF (Shielded Room)	NF Corporation	ES2000S	9075612	RF-0210	1 year	2017-03-21	2018-03-21
CVCF Booster (Shielded Room)	NF Corporation	ES2000B	9074403	RF-0211	1 year	2017-03-21	2018-03-21
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	1 year	2017-03-21	2018-03-21
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	1 year	2017-03-21	2018-03-21
True RMS Multimeter	Fluke	87V	16110176	RF-0414	1 year	2016-08-22	2017-08-22

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
AC Power Line Conducted Emission	150kHz - 30MHz	±2.0dB
Radiated Emission	9kHz – 150kHz	±4.0dB
	150kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±4.7dB
	1GHz – 40GHz	±4.7dB
Radiated Emission (MMW)	40GHz - 50GHz	±4.6dB
	50GHz - 75GHz	±5.0dB
	75GHz – 110GHz	±5.0dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (**E**quipment **U**nder **T**est) is a movement sensor module based on Doppler effect radar. The module incorporates transmitter and receiver. Transmitter and receiver can only be operated simultaneously. Since the receiver does not employ any local oscillator, the measurement output signal is derived directly from the difference of the emitted and received frequency (homodyne system).

The EUT has one external control input port. A host device provides a control signal with adjustable duty cycle. Then, the EUT transmits a continuous wave with repetition rate corresponding to the duty cycle.

3.2 System Details

Measured output power:	10.2dBm at EIRP
Antenna gain:	+7.1dBi
Antenna type:	Patch antenna (printed on PCB)
Antenna mounting type:	Internal
Frequency range:	24.075-24.175GHz
Number of channels:	1 (Fixed)
Modulation type:	No modulation, CW (Duty cycle can be selectable.)
FCC classification:	FDS
ISED classification:	Field Disturbance Sensor
Emission designator:	1M81N0N for ISED
Rated voltage:	DC 3.3 to 5.0V
Rated current:	55mA
Protection class:	III
Test voltage:	AC 120V for AC/DC Adapters DC 5.0V and 3.3V for EUT **(*)**
Test frequency:	60Hz for AC/DC Adapters

Note: **(*)** Two typical rating of commercial available AC/DC adapters were used without any modification.

3.3 Clock Frequencies

The highest frequency generated or used by the EUT is 24.125GHz for the carrier of transmitter.

3.4 Noise Suppressing Parts

Refer to schematics.

4. Test Set-up 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 and 15.209.

The test methods, which have been used, are based on ANSI C63.10 and RSS-Gen.

For details, see under each test item.

4.2 Operation Modes

The basic operation mode used for testing is:

A. Intended operation continuous transmission and receiving at the nominal frequency 24.125GHz.

Configurations;

1. CW (100% duty cycle)
2. Maximum adjustable duty cycle (19.4%)
3. Minimum adjustable duty cycle (0.06%)

Table 3: Duty cycle setting for the test

Conf.	Duty cycle	Pulse width	Repetition rate	Remark
1	100%	-/-	-/-	Always low signal
2	19.4%	24µs	124µs	
3	0.06%	24µs	39.380ms	

Note:

For non-continuous transmitting, pulse width is set to 24µs, repetition rate is varied. This signal was provided from a functional generator via interface No.6 Control signal to set the duty cycle.

The EUT does not have standby mode.

4.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis (only attached to the test jig) 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

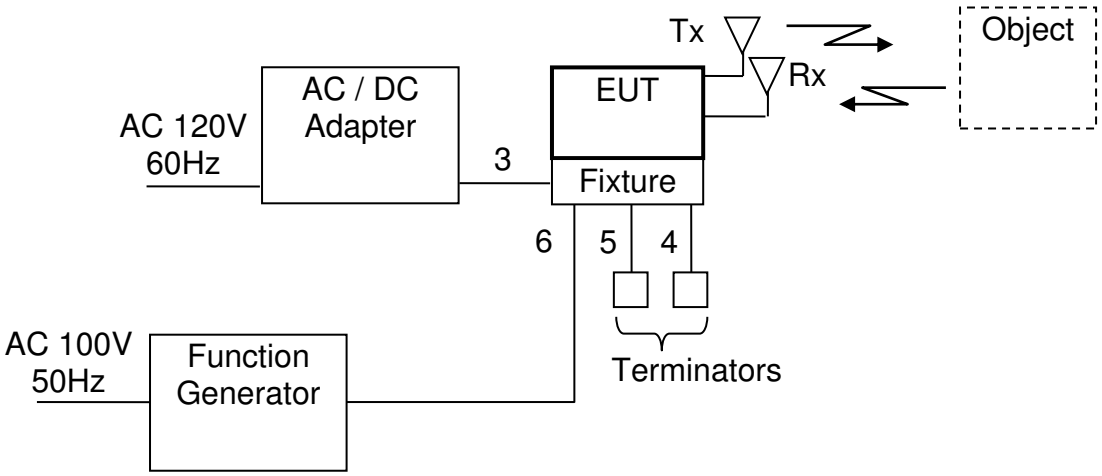

Table 4: Interfaces present on the EUT

No.	Interface (*)	Cable Length for Testing, Shielding	Interface Classification
1.	AC Mains for AC/DC Adapter 1,2	(Direct plug-in type) **(**)**	AC Input Power Port
2.	AC Cable for AC/DC Adapter 3	1.8m, un-shielded	AC Input Power Port
3.	DC Mains	2.5m, un-shielded	DC input power port
4.	I_{ch} signal output	0.86m, shielded	Signal port
5.	Q_{ch} signal output	0.86m, shielded	Signal port
6.	Control signal	2.1m, shielded	Signal port

Note:

(*) All interface ports of the EUT are designed as direct plug-in type by the manufacturer. However, these ports were connected with cables as listed in the above table for testing purpose.

(**) AC extension cable was used with the AC/DC adapter 1 and 2 for AC Power Line Conducted Measurements in the section 5.3.

The EUT does not need any second radio device for its radio operating, since the EUT is a radar module and does not have any wireless data communication function.

Representative AC/DC adapters provided by the customer were tested together with the EUT. For details, refer to section 6: Photographs of the Test Set-Up.

4.4 Test Software

No special test software was used to operate the EUT.

4.5 Special Accessories and Auxiliary Equipment

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

1. Product: AC Adapter 1 for DC 3.3V
   Manufacturer: Go Forward Enterprise Corp.
   Model: GF12-US03320
   Rated Voltage: AC 100-240V
   Input Current: 0.3A
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: 1409-07

2. Product: AC Adapter 2 for DC 3.3V
   Manufacturer: Unifive Co., Ltd.
   Model: US303320
   Rated Voltage: AC 100-240V
   Input Current: 0.3A
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: F02-0004242

3. Product: AC Adapter 3 for DC 5V
   Manufacturer: Unifive Co., Ltd.
   Model: UI318-05
   Rated Voltage: AC 100-240V
   Input Current: 0.4A
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: E01-0005228

4. Product: Function Generator
   Manufacturer: NF Corporation
   Model: WF1973
   Rated Voltage: AC 100-230V
   Frequency: 50/60Hz
   Protection Class: I
   Serial Number: 9082191

Note:

AC/DC adapter(s) No. 1, 2 and 3 were pre-checked for each test items.

For the radiated measurements, final measurements were conducted with the AC/DC adapter No. 3.

For the AC conducted measurements, final measurements were conducted with the AC/DC adapter No. 2.

A fixture does not have any electrical component to keep a stable position of the EUT during testing. Refer to a picture in section 6 for details.

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 one internal DC voltage regulator to supply 2.7V for the RF circuit. Minimum rated voltage is 3.3 V. Then 85% of 3.3V is 2.8V. Therefore, 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 EUT has an internal antenna which is not user accessible. Therefore, it complies with the antenna requirements.

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. It was verified during testing that the carrier is fully contained within the unrestricted frequency band 24.075 - 24.175GHz. Therefore only spurious emissions except for second and third harmonics of carrier may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

For details, refer to the section 5.2.1 Radiated Emissions of Transmitter (Carrier, Harmonics and Spurious) of this test report.

5.2 Radiated Measurements

5.2.1 Radiated Emissions of Transmitter (Carrier, Harmonics and Spurious)

RESULT: **PASS**

Date of testing:	2017-03-16, 2017-03-17, 2017-03-21
Ambient temperature:	25, 26, 23°C
Relative humidity:	59, 57, 41%
Atmospheric pressure:	1012, 1013, 1007hPa
Frequency range:	9kHz - 100GHz
Measurement distance:	3m from 9kHz to 40GHz 0.01m from 40 to 100GHz
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC 15.209, 15.245 and 15.205. RSS-Gen §8.9, §8.10 and RSS-210 §4.4, Annex F.1.

Radiated emissions must comply with the limits specified in FCC 15.209(a), 15.245(b) (1) (ii) and 15.205, RSS-Gen §8.9 (table 4 and 5), §8.10 table 6 and RSS-210 Annex F.1.

Test procedure:

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

The EUT was placed on a nonconductive turntable. 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 configuration of the EUT (i.e. duty cycle) 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 the 5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower (i.e. 100GHz) according to the ANSI C63.10-2013 Table 2 of clause 5.5. Final radiated emission measurements were made at 3m or 0.01m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° in order to determine the emission's maximum level. For frequencies above 30MHz, the antenna was raised and lowered from 1 to 4m and measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth 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 ≥ 1MHz; 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 following ranges. 9kHz - 30MHz, 1 - 8GHz, 8 – 18GHz and 26.5 – 40GHz.

No spurious emission other than second and third harmonics was found in the range of 40 – 100GHz at a distance of 0.01m.

Table 5: Radiated Emissions of the Carrier, Average Data, Mode A (24.125GHz) at DC 5V with configuration 1

Frequency [MHz]	EUT / Antenna Orientation	Reading AV at 3m [dBµV]	Factor [dB(1/m)]	Level AV at 3m [dBµV/m]	Limit at 3m [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
24124.410	Y / V	111.1	-6.0	105.1	128	22.9	179	330

Note: Level AV = Reading AV + Factor

Table 6: Radiated Emissions of the Carrier, Peak Data, Mode A (24.125GHz) at DC 5V with configuration 1

Frequency [MHz]	EUT / Antenna Orientation	Reading PK at 3m [dBµV]	Factor [dB(1/m)]	Level PK at 3m [dBµV/m]	Limit at 3m [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
24124.410	Y / V	111.4	-6.0	105.4	148	42.6	179	330

Note: Level PK = Reading PK + Factor

Table 7: Radiated Emissions of the Harmonics of Carrier, Average Data, Mode A (24.125GHz) at DC 5V with configuration 1

Frequency [MHz]	EUT / Antenna Orientation	Reading AV [dBµV/m]	Distance Conversion Factor [dB]	Level AV at 3m [dBµV/m]	Limit at 3m [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
48245.600	Z / V	85.0 **(*)** at 0.01m	-49.5	35.5	77.5	42.0	-/-	0
72373.300	Z / V	100.3 **(*)** at 0.01m	-49.5	50.8	77.5	26.7	-/-	0

Note: **(*)** Peak measurement data was used against Average limit instead of average measurement data.

Level AV at 3m = Reading AV + Distance Conversion Factor

Each Distance Conversion Factor was considered for second and third harmonics measurement by the following formula.

Distance conversion factor = $20 \times \text{Log}_{10}$ (d / 3), where d = measurement distance in m;

– Distance conversion factor = $20 \times \text{Log}_{10}$ (0.01 / 3) = -49.5 [dB] for second and third harmonics.

Table 8: Radiated Emissions of the Harmonics of Carrier, Peak Data, Mode A (24.125GHz) at DC 5V with configuration 1

Frequency [MHz]	EUT / Antenna Orientation	Reading PK [dBµV/m]	Distance Conversion Factor [dB]	Level PK at 3m [dBµV/m]	Limit at 3m [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
48245.600	Z / V	85.0 at 0.01m	-49.5	35.5	97.5	62.0	-/-	0
72373.300	Z / V	100.3 at 0.01m	-49.5	50.8	97.5	46.7	-/-	0

Note: Level PK at 3m = Reading PK + Distance Conversion Factor

Each Distance Conversion Factor was considered for second and third harmonics measurement by the following formula.

Distance conversion factor = 20 × Log_{10} (d / 3), where d = measurement distance in m;

– Distance conversion factor = 20 × Log_{10} (0.01 / 3) = -49.5 [dB] for second and third harmonics.

Table 9: Radiated Spurious Emissions at Band Edge, Mode A (24.125GHz) at DC 5V with configuration 1

Spurious Emission Frequency [GHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
24.075	Y / V	38.97	51.01	54.00	74.00	15.03	22.99

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.
Average limit in dBµV/m is calculated as follows: Average limit = 20 × Log_{10} (500µV/m).
Peak limit in dBµV/m is calculated as follows: Peak limit = Average limit + 20dB.

RBW was used at 3MHz instead of 1MHz. Test result at 3MHz RBW was more severe than those of at 1MHz RBW.

Figure 2: Radiated Emissions at Band Edge, Spectral Diagram, Mode A (24.125GHz) at DC 5V with configuration 1

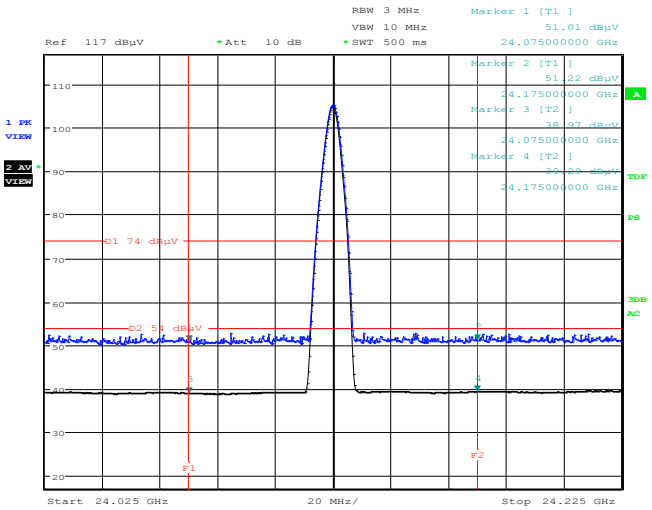

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Table 10: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A (24.125GHz) at DC 5V with configuration 2

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 [°]
44.403	X / V	50.8	-21.1	29.7	40.0	10.3	100	201
48.629	X / V	53.5	-21.2	32.3	40.0	7.7	105	239
55.936	X / V	43.6	-21.5	22.1	40.0	17.9	100	263
70.647	X / V	49.0	-22.9	26.1	40.0	13.9	101	213
75.648	X / V	50.9	-23.7	27.2	40.0	12.8	101	116
149.998	X / H	53.9	-20.5	33.4	43.5	10.1	220	75
159.998	X / H	50.3	-20.2	30.1	43.5	13.4	209	81
190.000	X / V	48.1	-22.1	26.0	43.5	17.5	100	131
393.330	X / V	34.6	-15.9	18.7	46.0	27.3	100	199

Note: Level QP = Reading QP + Factor

Table 11: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (24.125GHz) at DC 5V with configuration 1

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 [°]
19244.694	Z / V	39.2	-5.6	33.6	54.0	20.4	140	359
20560.446	Z / H	38.5	-4.4	34.1	54.0	19.9	101	263
21908.176	Z / H	38.9	-4.3	34.6	54.0	19.4	102	113
23681.840	Z / V	40.4	-5.7	34.7	54.0	19.3	102	239
26052.660	Z / V	41.3	-6.2	35.1	54.0	18.9	190	74

Note: Level AV = Reading AV + Factor

Table 12: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (24.125GHz) at DC 5V with configuration 1

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 [°]
19244.694	Z / V	52.8	-5.6	47.2	74.0	26.8	140	359
20560.446	Z / H	51.8	-4.4	47.4	74.0	26.6	101	263
21908.176	Z / H	52.3	-4.3	48.0	74.0	26.0	102	113
23681.840	Z / V	54.2	-5.7	48.5	74.0	25.5	102	239
26052.660	Z / V	55.2	-6.2	49.0	74.0	25.0	190	74

Note: Level PK = Reading PK + Factor

5.2.2 20dB Bandwidth

RESULT: **PASS**

Date of testing: 2017-03-16

Ambient temperature: 25°C
Relative humidity: 59%
Atmospheric pressure: 1012hPa

Requirements:

FCC 15.215(c)

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band.

Test procedure:

ANSI C63.10-2013 §6.9
The 20dB bandwidth was measured with a spectrum analyzer using a peak detector.

The resolution bandwidth was in the range of 1% to 5% of the observed OBW. Calculated percentage is described at the following each spectra.

Note:

Frequency stability is not required in the regulations section 15.245. Therefore 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. Then center frequency was observed and reported in this test item.

Table 13: 20dB Bandwidth

Nominal Operating Frequency [GHz]	Conf.	DC input [V]	EUT / Antenna Orientation	Actual Center Frequency [GHz]	20dB Bandwidth [kHz]
24.125	1	3.3	Y / V	24.124557	20.913
24.125	2	3.3	Y / V	24.124463	826.923
24.125	1	5	Y / V	24.124406	16.346
24.125	2	5	Y / V	24.124478	830.128

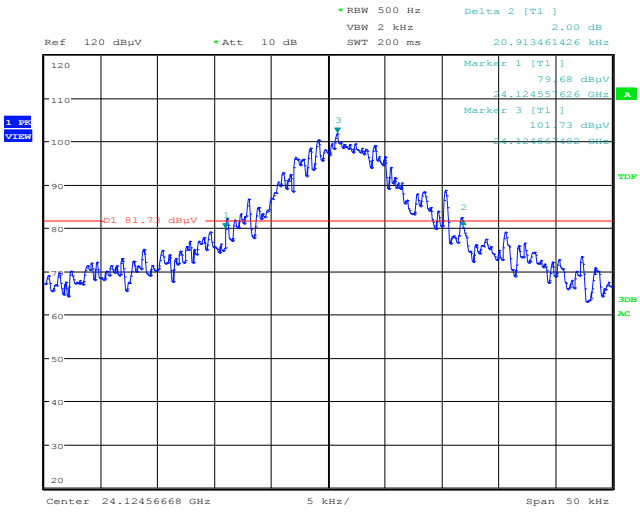
Note:

Gray shading condition shows the observed maximum bandwidth.

Maximum selectable duty cycle (conf.2) was additionally measured in this test item to ensure the influence of bandwidth with or without controlled function to the EUT.

80% of the permitted band (i.e. 24.075 to 24.175GHz) is from 24.085 to 24.165GHz. Each actual center frequency listed here above is within 80% of the band.

Figure 3: Radiated Emissions at 20dB Bandwidth, Spectral Diagram, Mode A (24.125GHz) at DC 3.3V with configuration 1

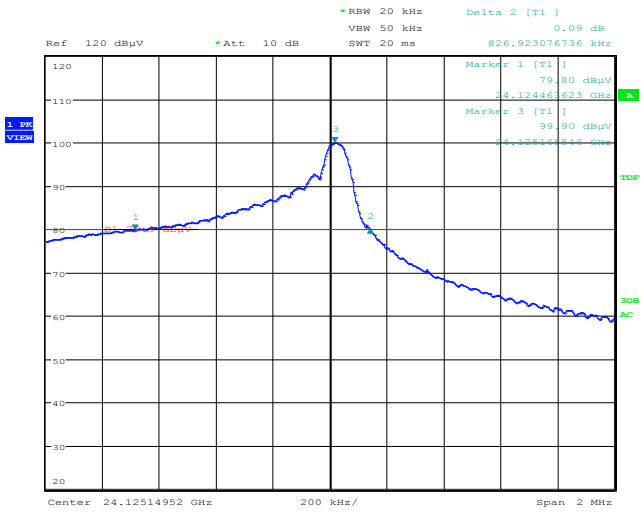


Date: 16.MAR.2017 15:04:29

Note: RBW was set to 2.39% of the observed OBW. (0.5 kHz / 20.913 kHz) × 100 = 2.39 %

This 20 dB bandwidth of the emission is contained within the permitted frequency band.

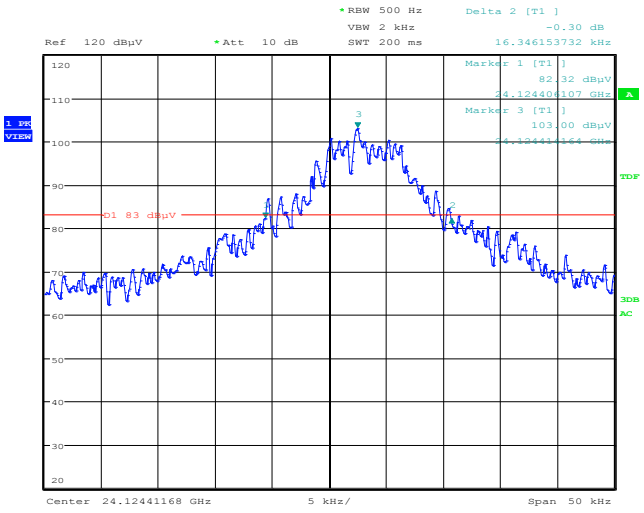
Figure 4: Radiated Emissions at 20dB Bandwidth, Spectral Diagram, Mode A (24.125GHz) at DC 3.3V with configuration 2



Note: RBW was set to 2.41% of the observed OBW. (20 kHz / 826.923 kHz) × 100 = 2.41 %

This 20 dB bandwidth of the emission is contained within the permitted frequency band.

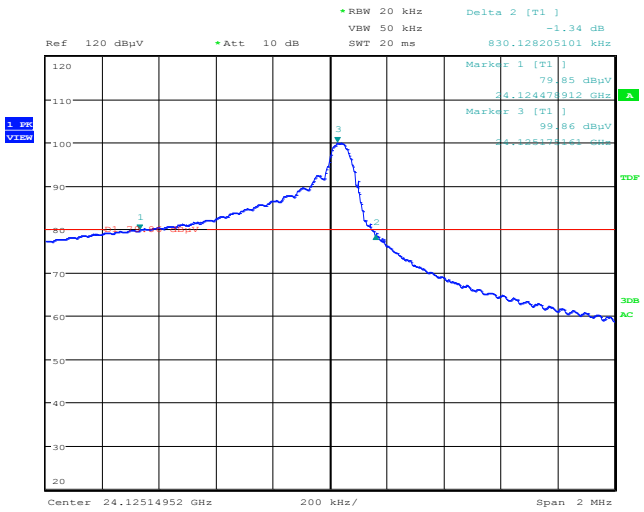
Figure 5: Radiated Emissions at 20dB Bandwidth, Spectral Diagram, Mode A (24.125GHz) at DC 3.3V with configuration 1



Note: RBW was set to 3.06% of the observed OBW. (0.5 kHz / 16.346 kHz) × 100 = 3.06 %

This 20 dB bandwidth of the emission is contained within the permitted frequency band.

Figure 6: Radiated Emissions at 20dB Bandwidth, Spectral Diagram, Mode A (24.125GHz) at DC 3.3V with configuration 2



Date: 16.MAR.2017 14:46:16

Note: RBW was set to 2.41% of the observed OBW. (20 kHz / 830.128 kHz) × 100 = 2.41 %

This 20 dB bandwidth of the emission is contained within the permitted frequency band.

5.2.3 99% Bandwidth

Date of testing:	2017-03-16
Ambient temperature:	25°C
Relative humidity:	59%
Atmospheric pressure:	1012hPa

Requirements:

RSS-Gen §6.6 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.

Test procedure:

ANSI C63.10 §6.9.3 and RSS-Gen §6.6

The EUT was placed on a nonconductive turntable 1.5m above the ground plane. 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 3 EUT orientations (X, Y, Z). The results corresponding to the worst case antenna polarization and EUT orientation are recorded in this report.

Final measurements were performed using a spectrum analyzer with the resolution bandwidth (RBW) set to in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW. The 99% bandwidth was measured by using the OBW function of the analyzer with a 99% coverage setting. Sample detector was used for this test item.

Table 14: 99% Bandwidth

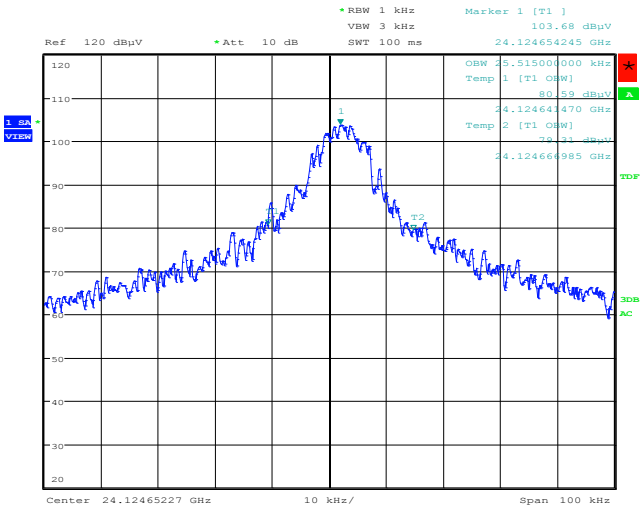
Nominal Operating Frequency [GHz]	Conf.	DC input [V]	EUT / Antenna Orientation	Actual Center Frequency [GHz]	99% Bandwidth [kHz]
24.125	1	3.3	Y / V	24.124654	25.515000
24.125	2	3.3	Y / V	24.125138	1808.500
24.125	1	5	Y / V	24.124638	24.475000
24.125	2	5	Y / V	24.125014	1744.000

Note:

Gray shading condition shows the observed maximum bandwidth.

Maximum selectable duty cycle (conf.2) was additionally measured in this test item to ensure the influence of bandwidth with or without controlled function to the EUT.

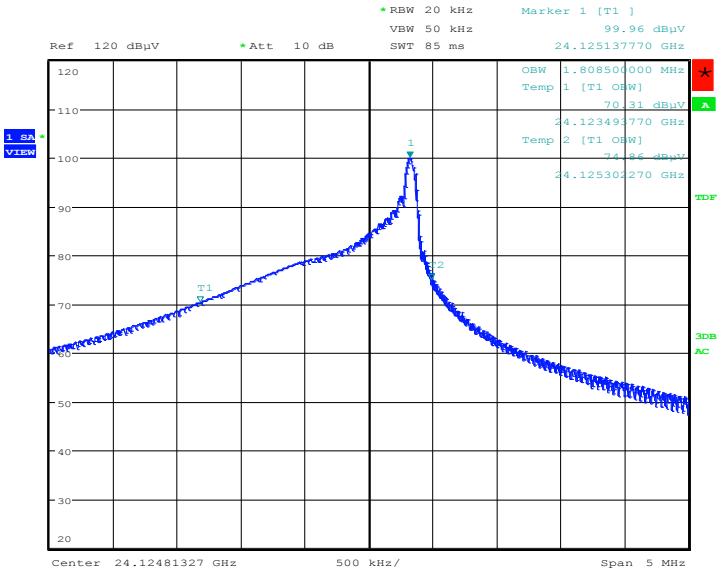
Figure 7: 99% Bandwidth, Mode A (24.125GHz) at DC 3.3V with configuration 1



Date: 16.MAR.2017 14:19:10

Note: RBW was set to 3.92% of the observed OBW. (1 kHz / 25.515 kHz) × 100 = 3.92 %

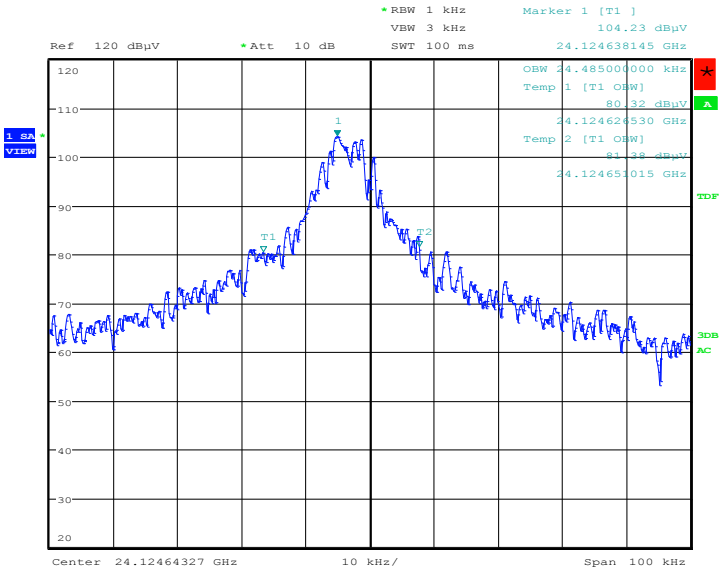
Figure 8: 99% Bandwidth, Mode A (24.125GHz) at DC 3.3V with configuration 2



Date: 16.MAR.2017 14:36:09

Note: RBW was set to 1.11% of the observed OBW. (20 kHz / 1808.500 kHz) × 100 = 1.11 %

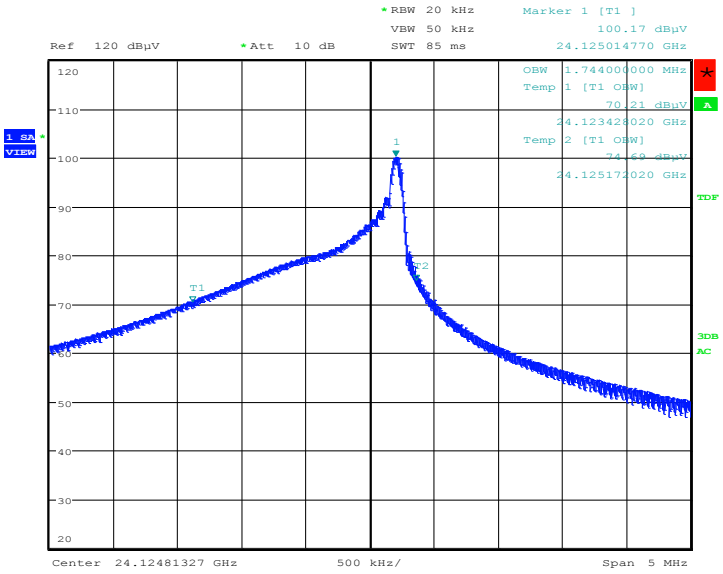
Figure 9: 99% Bandwidth, Mode A (24.125GHz) at DC 5V with configuration 1



Date: 16.MAR.2017 14:27:24

Note: RBW was set to 4.08% of the observed OBW. (1 kHz / 24.485 kHz) × 100 = 4.08 %

Figure 10: 99% Bandwidth, Mode A (24.125GHz) at DC 5V with configuration 2



Date: 16.MAR.2017 14:33:33

Note: RBW was set to 1.15% of the observed OBW. (20 kHz / 1744.000 kHz) × 100 = 1.15 %

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT: **PASS**

Date of testing:	2017-03-21
Ambient temperature:	25°C
Relative humidity:	46%
Atmospheric pressure:	998hPa
Frequency range:	0.15 - 30MHz
Kind of test site:	Shielded Room

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 3).

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. Commercial available AC adapter 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.

Prechecks have been performed with the all configurations listed in the section 4.2 to determine which mode produces the highest emission level. Final measurement was performed for the worst case configuration only (configuration 1).

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

Disturbances other than those mentioned are small or not detectable.

Table 15: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), Mode A (24.125GHz) with configuration 1

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]
0.16996	N	39.5	25.1	9.6	49.1	34.7	65.0	55.0	15.9	20.3
0.20636	N	33.1	17.9	9.6	42.7	27.5	63.4	53.4	20.7	25.9
0.23957	N	29.1	9.7	9.6	38.7	19.3	62.1	52.1	23.4	32.8
0.28212	N	24.0	11.4	9.6	33.6	21.0	60.8	50.8	27.2	29.8
0.40026	N	19.1	9.8	9.6	28.7	19.4	57.8	47.8	29.1	28.4
0.47879	N	22.9	14.0	9.6	32.5	23.6	56.4	46.4	23.9	22.8
9.99912	N	32.5	29.4	10.0	42.5	39.4	60.0	50.0	17.5	10.6
0.16258	L1	42.5	24.1	9.6	52.1	33.7	65.3	55.3	13.2	21.6
0.17177	L1	40.9	21.0	9.6	50.5	30.6	64.9	54.9	14.4	24.3
0.21370	L1	23.4	2.9	9.6	33.0	12.5	63.1	53.1	30.1	40.6
0.24903	L1	25.5	7.4	9.6	35.1	17.0	61.8	51.8	26.7	34.8
0.31835	L1	23.4	11.9	9.6	33.0	21.5	59.7	49.7	26.7	28.2
0.42062	L1	25.1	14.3	9.6	34.7	23.9	57.4	47.4	22.7	23.5
10.00228	L1	30.8	27.7	10.0	40.8	37.7	60.0	50.0	19.2	12.3

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

7. List of Tables

8. List of Figures

9. List of Photographs