TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**50149844 001**	**Seite 1 von 37** *Page 1 of 37*

Auftraggeber: *Client:*	**New Japan Radio Co.,Ltd.** 1-1, Fukuoka 2-Chome, Fujimino-City, Saitama, 356-8510 Japan
Gegenstand der Prüfung: *Test Item:*	**K-Band Doppler Sensing Device (Movement Sensor)**

Bezeichnung: *Identification:*	**NJR4266F2B2**	**Serien-Nr.:** *Serial No.:*	**Sample01**
Wareneingangs-Nr.: *Receipt No.:*	**A000747067**	**Eingangsdatum:** *Date of Receipt:*	**2018-06-06**

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, Section 15.249** 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:*

Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*
2018-08-01	Quek Liang Wee / Inspector	Q. Wee.

kontrolliert/ *reviewed by:*

Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*
2018-08-01	Pin Zhang / Reviewer	P. Zhang

Sonstiges / *Other Aspects:*

Abkürzungen:	***P(ass)***	***=***	***entspricht Prüfgrundlage***	***Abbreviations:***	***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 DUTY CYCLE

5.2.2 20DB BANDWIDTH
RESULT: PASS

5.2.3 FIELD STRENGTH OF FUNDAMENTAL
RESULT: Pass

5.2.4 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER
RESULT: PASS

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 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 Transmitter and Receiver Radiated Spurious Emission (above 40GHz)							
Spectrum Analyzer	Agilent	E4447A	MY48250005	BT-8267	1 year	2018-01-23	2019-01-23
Harmonic Mixer 40-60GHz	Agilent	11970U	MY30030222	BT-8348	1 year	2017-12-27	2018-12-27
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	2018-01-10	2019-01-10
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	2018-01-10	2019-01-10
Horn Antenna 75-110GHz (RX)	Custom Microwave Inc.	HO10R	-	BT-8338	N/A	N/A	N/A
52GHz LPF	Spacek Labs	LPF1-45-11	1H02	BT-8346	1 year	2017-07-30	2018-07-30
For Power Port Conducted Emission (CE)							
Conducted Emission Measurement Software	Toyo Corporation	EP5/CE	Ver. 5.0.20	RF-0025	1 year	2018-03-30	2019-03-30
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2017-07-30	2018-07-30
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	1 year	2018-05-24	2019-05-24
LISN	Rohde & Schwarz	ENV216	101958	RF-0708	1 year	2018-05-24	2019-05-24
For Radiated Emission (RE)							
Radiated Emission Measurement Soft-ware (below 30MHz)	Toyo Corporation	EP5/ME	Ver. 5.0.10	RF-0172	1 year	2018-03-30	2019-03-30
Radiated Emission Measurement Soft-ware (above 30MHz)	Toyo Corporation	EP7/RE	Ver. 5.0.2	RF-0026	1 year	2018-03-30	2019-03-30
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2018-04-23	2019-04-23
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2017-07-30	2018-07-30
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	1 year	2018-03-30	2019-03-30
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2018-05-18	2019-05-18
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2018-04-24	2019-04-24

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2018-01-16	2019-01-16
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2018-01-18	2019-01-18
Low Pass Filter, DC-1GHz	R&K	LP1000CH3	12104001	RF-0515	1 year	2018-01-16	2019-01-16
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2018-05-31	2019-05-31
Microwave Preamplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	1 year	2018-01-18	2019-01-18
Band Reject Filter, 1-8GHz	Nitsuki	NF-49BT	027	RF-0131	1 year	2018-01-18	2019-01-18
Horn Antenna with Preamplifier, 8-18GHz (RX)	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2018-05-31	2019-05-31
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2018-05-31	2019-05-31
Horn Antenna with Preamplifier, 18-26.5GHz (RX)	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2018-06-01	2019-06-01
Horn Antenna with Preamplifier, 26.5 -40GHz (RX)	Toyo Corporation	HAP26-40N	00000007	RF-0069	1 year	2018-06-01	2019-06-01
Preamplifier, 26.5-40GHz	Toyo Corporation	HAP2640-S	-	RF-0258	1 year	2018-03-16	2019-03-16
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
DC Power Supply	Hewlett Packard	6653A	3640A03102	RF-0004	N/A	N/A	N/A
DC Power Supply	Agilent	E3646A	MY50350007	RF-0412	N/A	N/A	N/A
True RMS Multimeter	Fluke	87V	16110176	RF-0414	1 year	2018-06-27	2019-06-27

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
Antenna Port Conducted Emission	20Hz - 40GHz	±1.5dB
Radiated Emission	150kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±4.8dB
	> 1GHz	±3.8dB
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 (Equipment Under Test) is a K-band movement sensor module based on the Doppler effect. Although 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 signal is directly derived from the difference between the emitted and received frequency (homodyne system).

The radio product is designed to be used in vending machine, home security system, automatic on/off switch for luminarias etc. to detect some moving objects. It incorporates a MCU which processes the radar output to improve detection accuracy and stability and enable communication with the host. The EUT emits un-modulated carrier and has 5 types of duty cycle (1%, 2%, 3%, 8%, 100%) to meet requirement of different detection distances and power consumption.

3.2 System Details

Carrier Field Strength:	103.28dBμV/m@3m
Antenna gain:	+7.2dBi
Antenna type:	Pattern antenna (printed on PCB)
Antenna mounting type:	Internal
Frequency range:	24.15 – 24.25GHz
Nominal Frequency:	24.20GHz
Number of channels:	1(Fixed)
Modulation type:	No modulation (5 types of duty cycle)
FCC classification:	FDS
Rated voltage:	DC 3.3 – 5.25V
Rated current:	50mA
Protection class:	III
Test voltage:	For AC Power Line Conducted Emission of Transmitter: AC 120V for AC Adaptors DC Output of AC Adaptors for EUT: 3.3V and 5.0V (*) For Other Test Items: DC 5.0V
Test frequency:	60Hz for AC Adaptors

Note: (*) Two typical rating of off-the-shelf AC adaptors were used.

3.3 Clock Frequencies

The highest frequency generated or used by the EUT is 24.20GHz for radio and digital interface.

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, 15.209 and 15.249.

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 basic operation mode used for testing is:

A. Intended operation: transmission and receiving at Nominal Frequency while communicating with host.

With Configuration:
1. Continuous transmission (duty cycle: 100%)
2. Intermittent transmission (duty cycle: 8%, period: 143us, On-time: 11us) (*)

Note (*): For the 4 types of intermittent transmission (1%, 2%, 3% and 8%), they transmit the same burst (same power, same burst duration), with the only difference being the repetition time. Duty cycle of 8% is chosen as the representative because the highest the duty cycle facilitates faster testing.

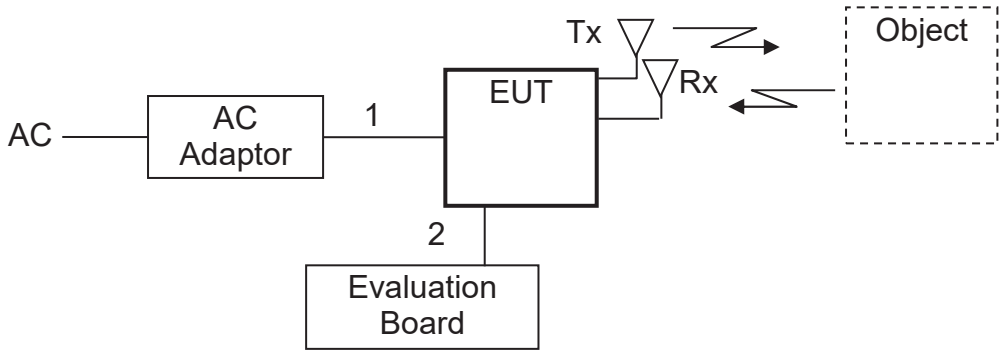
4.3 Physical Configuration for Testing

The EUT was tested in a stand-alone configuration.

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

1) Configuration for AC Power Line Conducted Emission of Transmitter



2) Configuration for other test items

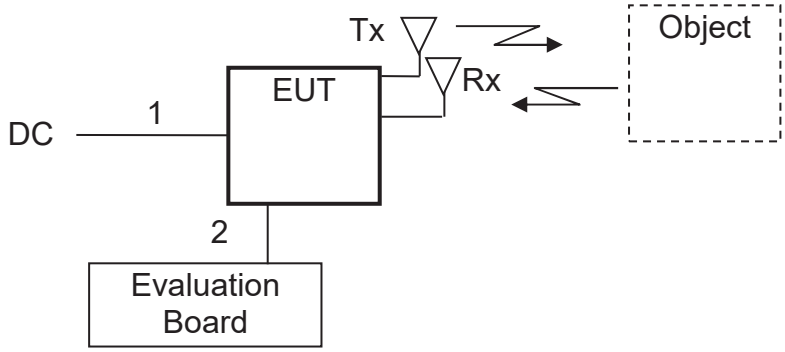


Table 3: Interfaces present on the EUT

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	DC Input	2.6m, un-shielded	DC input power port
2.	Signal Interface (*)	2.0m, un-shielded	Signal port

Notes:

(*) Normally the EUT is to be connected on the host PCB (Evaluation Board for testing purpose) directly without any extension cable. However extension cable (Interface No. 2) was used for testing as FCC part 15, section 15.212 requires the module be tested in a stand-alone configuration for Modular Approval.

For more details, refer to section: 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 Adaptor for DC5.0V
   Manufacturer: UNIFIVE
   Model: UI318-05
   Rated Voltage: AC100-240V
   Input Current: 0.4A
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: E01-0005228

2. Product: AC Adaptor for DC3.3V
   Manufacturer: GO FORWARD ENTERPRISE CORP.
   Model: GF12-US03320
   Rated Voltage: AC100-240V
   Input Current: 0.3A
   Frequency: 50/60Hz
   Protection Class: II

3. Product: Evaluation Board
   Manufacturer: New Japan Radio
   Model: NJR4266K
   Rated Voltage: DC 5V
   Protection Class: III

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 not able to be replaced. Hence it complies with the antenna requirements.

5.1.3 Restricted Bands of Operation

RESULT: **PASS**

Requirements:

FCC 15.205

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

Verdict:

The EUT operation frequency range is 24.15-24.25GHz. 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

Date of testing: 2018-05-28

Ambient temperature: 24°C
Relative humidity: 60%
Atmospheric pressure: 1008hPa

Requirements:

N/A (this test item was performed as reference.)

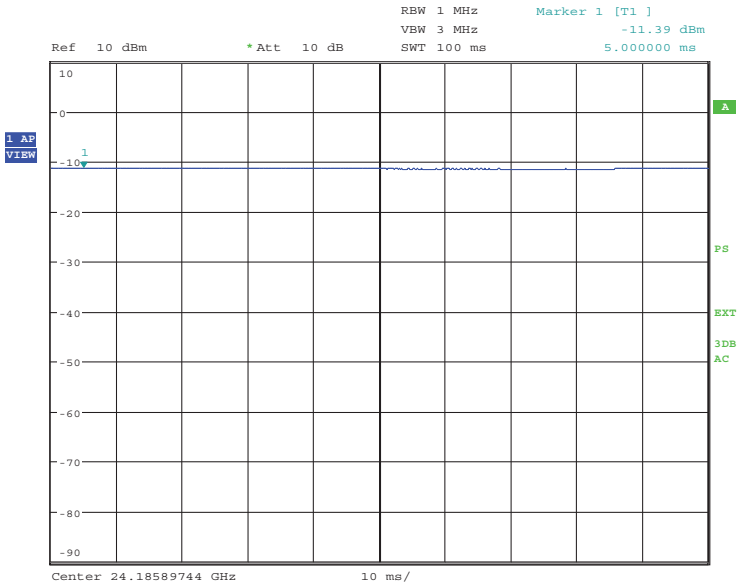
Test procedure:

ANSI C63.10-2013

Table 4: Duty Cycle

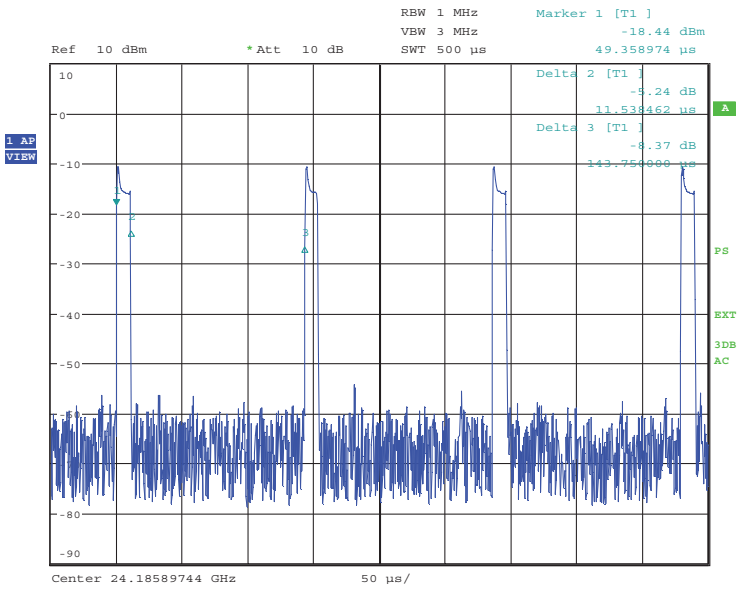
Operation Mode	On Time Duration [us]	Period of the Pulse Train [us]	Total On Time [%]
A config. 1	100,000.00	100,000.00	100.00
A config. 2	11.54	143.75	8.02

Figure 2: Duty Cycle, Mode A config. 1



DC Cycle, CW 100%
Date: 28.MAY.2018 12:52:21

Figure 3: Duty Cycle, Mode A config. 2



DC Cycle, 7kHz
Date: 28.MAY.2018 12:56:25

5.2.2 20dB Bandwidth

RESULT: **PASS**

Date of testing:	2018-06-12, 2018-06-13
Ambient temperature:	26, 23°C
Relative humidity:	69, 63%
Atmospheric pressure:	990, 997hPa

Requirements:

FCC 15.215(c) and FCC 15.249

The 20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §6.9.2

The EUT was placed on a nonconductive turntable 0.8m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a horn antenna connected to a spectrum using a peak detector with the following settings: RBW = 500Hz, VBW = 2kHz for Mode A config. 1; RBW = 20kHz, VBW = 50kHz for Mode A config. 2. Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

Table 5: 20dB Bandwidth Edge Frequencies

20dB Bandwidth Edge Side	Edge Frequency [GHz]	Limit [GHz]	Margin [MHz]
Lower freq.	24.185	24.00	185
Upper freq.	24.187	24.25	63

Table 6: 20dB Bandwidth

Operation Mode	20dB Bandwidth [MHz]
A config. 1	0.031
A config. 2	1.330

Figure 4: 20dB Bandwidth, Mode A config. 1

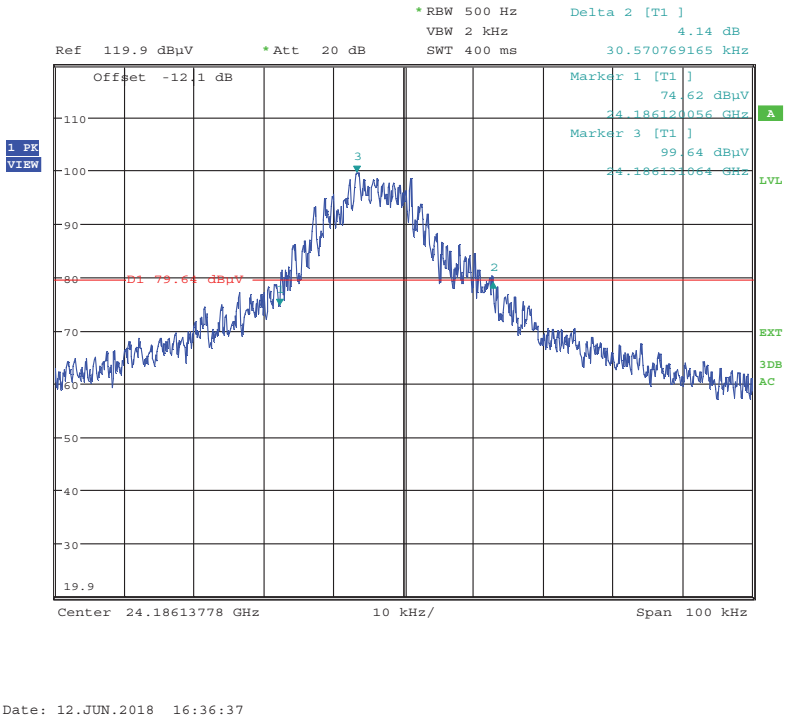
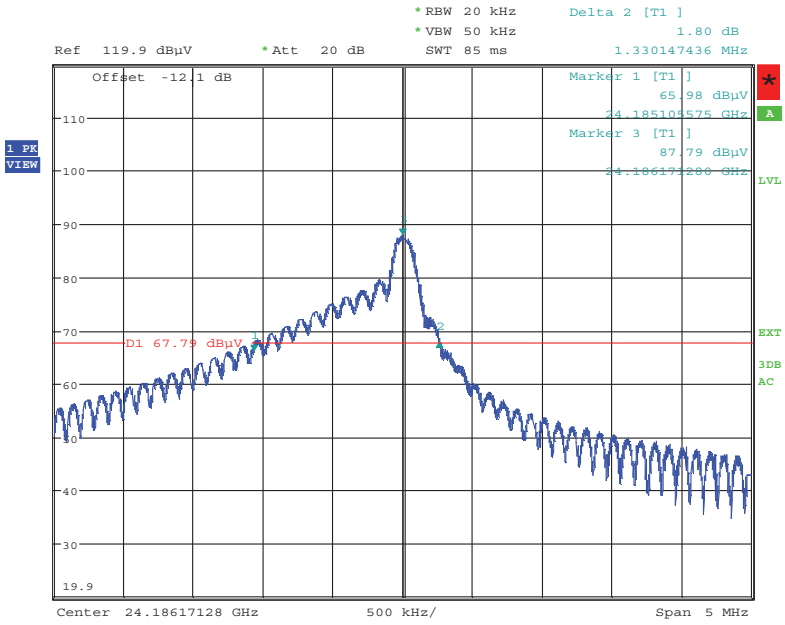


Figure 5: 20dB Bandwidth, Mode A config. 2



Date: 13.JUN.2018 13:41:41

5.2.3 Field Strength of Fundamental

RESULT: **Pass**

Date of testing:	2018-06-12, 2018-06-13
Ambient temperature:	26, 23°C
Relative humidity:	69, 63%
Atmospheric pressure:	990, 997hPa
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC 15.249(a)(c)(e)

The field strength of fundamental shall not exceed the level specified in FCC 15.249(a)(e).

Test procedure:

ANSI C63.10 §6.3 and 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 and Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: Peak: RBW = 1MHz, VBW = 3MHz; Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. In the spectra here below, the upper trace corresponds to the peak measurement and the lower trace corresponds to the average measurement.

Table 7: Field Strength of Fundamental

Operational Mode	EUT / Antenna Orient.	Average Level [dBµV/m]	Peak Level [dBµV/m]	Average Limit [dBµV/m]	Peak Limit [dBµV/m]	Average Margin [dB]	Peak Margin [dB]
A config. 1	Y/V	103.12	103.28	108	128	4.88	24.72
A config. 2	Y/V	100.57	100.72	108	128	7.43	27.28

Notes: 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 x log(250000µV/m).
Peak limit in dBµV/m is calculated as follows: Peak limit = Average limit + 20dB.

Figure 6: Field Strength of Fundamental, Spectral Diagram, Mode A config. 1

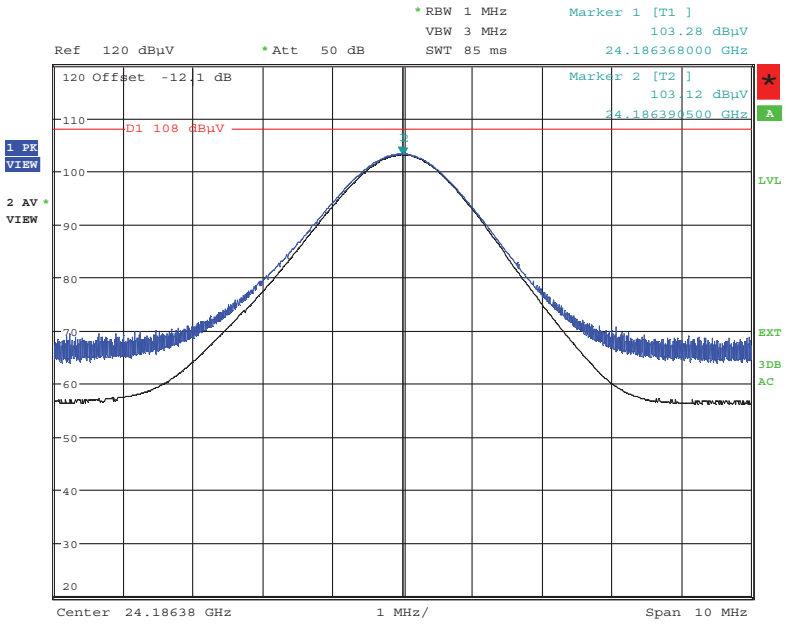
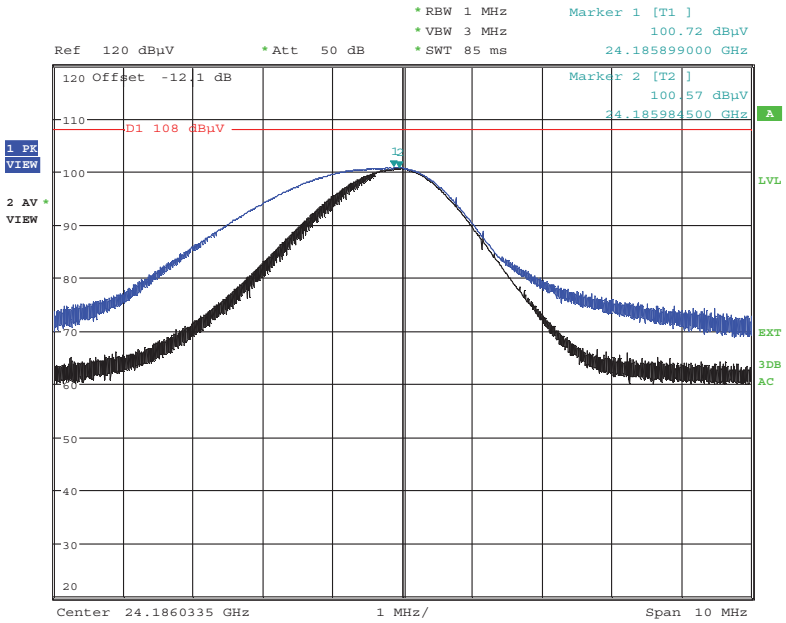


Figure 7: Field Strength of Fundamental, Spectral Diagram, Mode A config. 2



Date: 13.JUN.2018 13:17:45

5.2.4 Radiated Spurious Emissions of Transmitter

RESULT: **PASS**

Date of testing:	2018-06-07, 2018-06-11, 2018-06-12, 2018-06-13, 2018-07-13
Ambient temperature:	24, 22, 26, 23, 19°C
Relative humidity:	65, 57, 69, 63, 60%
Atmospheric pressure:	1007, 993, 990, 997, 1004hPa
Frequency range:	9kHz - 100GHz
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC 15.209 and FCC 15.249(a)(c)(d)(e)

Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209 and FCC 15.249(a)(d)(e).

Test procedure:

ANSI C63.10 §6.3, 6.4, 6.5, 6.6 and 6.10

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 associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

Only Mode A config. 1 was tested as it has the highest field strength of fundamental.

The spectrum was examined from 9kHz to the 10th harmonic of the highest fundamental transmitter frequency or 100GHz, whichever is lower frequency (100GHz in this case). Final radiated emission measurements were made at 3m distance for the frequency range of 9kHz - 40GHz, and the distance was reduced to 0.3m for the frequency range of 40 - 100GHz.

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 in the range 30MHz - 40GHz, 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. Above 40GHz, the

RBW and VBW were reduced to achieve low noise floor. This approach is feasible because the carrier is single frequency un-modulated signal.

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 9kHz - 30MHz.

Table 8: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A config. 1

Frequency [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
45.858	Y/V	27.1	-21.3	5.8	40.0	34.2	398	327
48.016	Y/H	29.7	-21.2	8.5	40.0	31.5	295	98
144.694	Y/V	29.7	-21.2	8.5	43.5	35.0	361	247
153.008	Y/H	29.7	-20.9	8.8	43.5	34.7	140	225
454.105	Y/V	28.9	-15.1	13.8	46.0	32.2	247	143
944.042	Y/H	32.0	-7.6	24.4	46.0	21.6	229	328
952.730	Y/V	32.0	-7.2	24.8	46.0	21.2	270	359

Note: Level QP = Reading QP + Factor

Table 9: Radiated Emissions, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A config. 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 [°]
19792.702	Y/V	39.6	-11.0	28.6	54.0	25.4	113	113
20500.774	Y/H	39.7	-10.5	29.2	54.0	24.8	138	103
23563.038	Y/H	41.0	-11.6	29.4	54.0	24.6	179	348
25877.002	Y/V	42.1	-12.0	30.1	54.0	23.9	178	171

Note: Level AV = Reading AV + Factor

Table 10: Radiated Emissions, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A config. 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 [°]
19792.702	Y/V	53.0	-11.0	42.0	74.0	32.0	113	113
20500.774	Y/H	53.4	-10.5	42.9	74.0	31.1	138	103
23563.038	Y/H	54.9	-11.6	43.3	74.0	30.7	179	348
25877.002	Y/V	55.7	-12.0	43.7	74.0	30.3	178	171

Note: Level PK = Reading PK + Factor

Table 11: Radiated Emissions of the Harmonics of Carrier, Average Data, Mode A config. 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]
48371.661	Z/V	76.1 **(*)** at 0.3m	-20	56.1	68	11.9
72557.683	Z/V	86.0 **(*)** at 0.3m	-20	66.0	68	2.0 **(**)**
96743.970	Z/V	80.0 **(*)** at 0.3m	-20	60.0	68	8.0

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

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

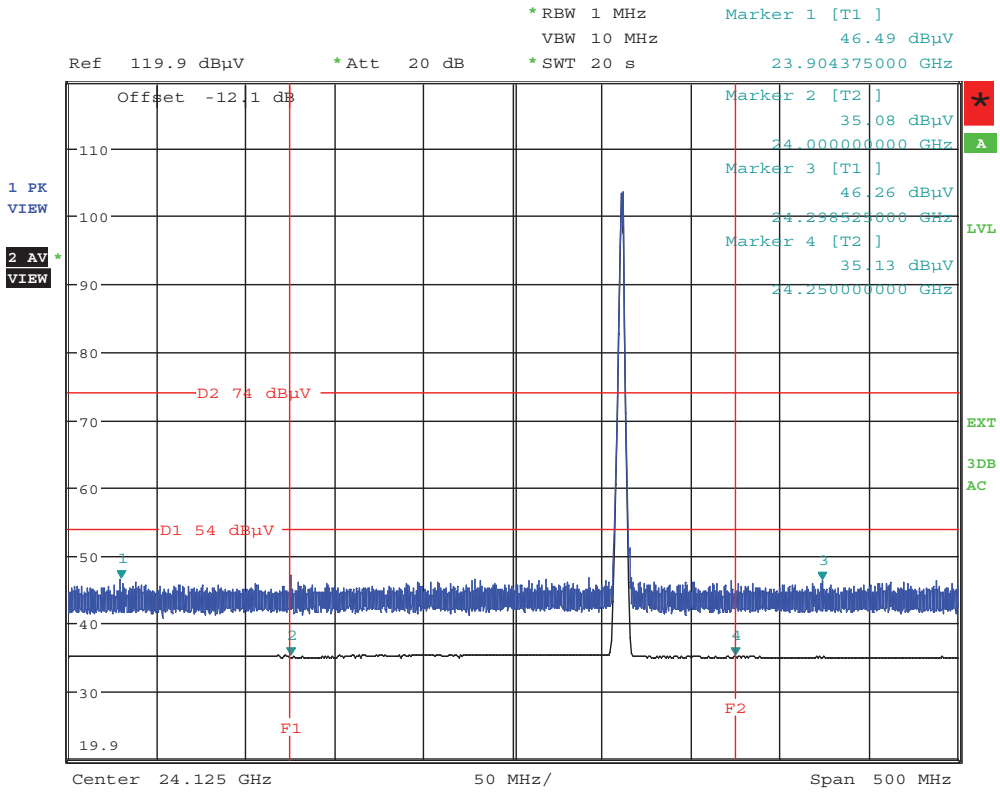
Each Distance Conversion Factor was considered for 2^{nd}, 3^{rd} and 4^{th} harmonics measurement by the following formula.

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

– Distance conversion factor = $20 \times \text{Log}_{10}$ (0.3 / 3) = -20 [dB] for 2^{nd}, 3^{rd} and 4^{th} harmonics.

(**) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

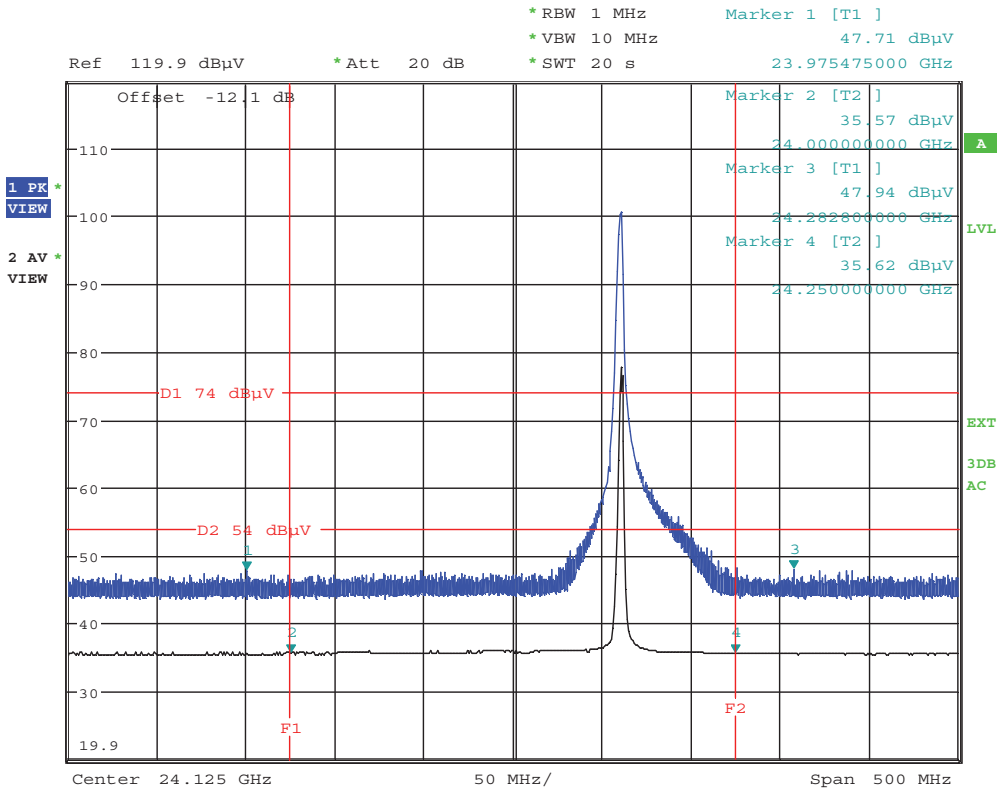
Figure 8: Radiated Emissions at Band Edge, Spectral Diagram, Mode A config. 1



Date: 12.JUN.2018 16:27:26

Note: The upper trace shows the peak value and the lower trace shows the average value.

Figure 9: Radiated Emissions at Band Edge, Spectral Diagram, Mode A config. 2



Date: 13.JUN.2018 13:31:13

Note: The upper trace shows the peak value and the lower trace shows the average value.

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT: **PASS**

Date of testing:	2018-06-28
Ambient temperature:	21°C
Relative humidity:	69%
Atmospheric pressure:	1001hPa
Frequency range:	0.15 - 30MHz
Kind of test site:	Shielded Room

Requirements:

FCC 15.207

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.

Test procedure:

ANSI C63.10 §6.2

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. An off-the-shelf AC adaptor was connected to the EUT to provide DC power. The 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.

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.

Only Mode A config. 1 was tested as it has the highest field strength of fundamental.

Table 12: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), AC Adaptor Output DC 5.0V, Mode A config. 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]
0.15818	N	26.9	10.3	9.7	36.6	20.0	65.6	55.6	29.0	35.6
0.18097	L1	23.9	8.9	9.7	33.6	18.6	64.4	54.4	30.8	35.8
0.42716	N	20.5	11.8	9.7	30.2	21.5	57.3	47.3	27.1	25.8
0.77432	L1	14.7	7.0	9.7	24.4	16.7	56.0	46.0	31.6	29.3
1.56803	L1	12.6	4.7	9.7	22.3	14.4	56.0	46.0	33.7	31.6
2.06913	N	11.9	3.9	9.8	21.7	13.7	56.0	46.0	34.3	32.3
9.83551	L1	7.9	-0.1	10.0	17.9	9.9	60.0	50.0	42.1	40.1
17.23608	N	6.3	-1.3	10.3	16.6	9.0	60.0	50.0	43.4	41.0
19.31852	L1	4.5	-2.8	10.2	14.7	7.4	60.0	50.0	45.3	42.6

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

Table 13: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), AC Adaptor Output DC 3.3V, Mode A config. 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]
0.23513	N	17.8	7.2	9.7	27.5	16.9	62.3	52.3	34.8	35.4
0.28104	N	17.2	6.7	9.7	26.9	16.4	60.8	50.8	33.9	34.4
0.30365	N	17.5	6.6	9.7	27.2	16.3	60.1	50.1	32.9	33.8
0.53680	N	23.2	6.6	9.7	32.9	16.3	56.0	46.0	23.1	29.7
0.56957	N	30.3	9.9	9.7	40.0	19.6	56.0	46.0	16.0	26.4
0.57047	N	30.3	9.9	9.7	40.0	19.6	56.0	46.0	16.0	26.4
0.57669	L1	30.0	11.0	9.7	39.7	20.7	56.0	46.0	16.3	25.3
0.59034	N	26.9	8.1	9.7	36.6	17.8	56.0	46.0	19.4	28.2
0.68627	N	15.0	4.1	9.7	24.7	13.8	56.0	46.0	31.3	32.2
0.73199	N	13.8	3.8	9.7	23.5	13.5	56.0	46.0	32.5	32.5
0.90366	N	14.6	3.4	9.7	24.3	13.1	56.0	46.0	31.7	32.9
1.54971	N	12.0	1.4	9.8	21.8	11.2	56.0	46.0	34.2	34.8
2.16175	N	12.7	0.5	9.8	22.5	10.3	56.0	46.0	33.5	35.7
3.05524	N	12.5	-0.1	9.8	22.3	9.7	56.0	46.0	33.7	36.3
3.67292	N	13.3	0.1	9.8	23.1	9.9	56.0	46.0	32.9	36.1
4.44043	N	13.2	-0.2	9.9	23.1	9.7	56.0	46.0	32.9	36.3
10.07072	L1	20.2	2.2	10.1	30.3	12.3	60.0	50.0	29.7	37.7
20.01164	N	8.6	-1.0	10.3	18.9	9.3	60.0	50.0	41.1	40.7

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

7. List of Tables

8. List of Figures

9. List of Photographs