TEST REPORT

For

144/430MHz DUAL BAND DIGITAL TRANSCEIVER

In conformity with

FCC CFR 47 Part15 Subpart B (CSR)

Model : FTM-500DR

FCC ID : K6620815X40

Test Item : 144/430MHz DUAL BAND DIGITAL TRANSCEIVER

Report No. : WE230120BB1-12

Issue Date : 27 Mar. 2023

Prepared for

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Prepared by

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History

Report No.	Date	Revisions	Issued By
WE230120BB1-11	14 Mar. 2023	Initial Issue	K. Onishi
WE230120BB1-12	27 Mar. 2023	Correction the tested frequencies (page.15)	K. Onishi

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1 General information

1.1 Product description from supplier

Test item	: 144/430MHz DUAL BAND DIGITAL TRANSCEIVER
Manufacturer	: YAESU MUSEN CO., LTD.
Address	: 43 Utsuroda, Morijuku, Sukagawa-shi, Fukushima-ken 962-0001 JAPAN
Model	: FTM-500DR
FCC ID	: K6620815X40
Serial number	: No. 5
Hardware version	: SPP
Software version	: 96.10 (Main), 70.67 (Sub), 93.18 (DSP)
Operating frequency range	: 108 - 999.995 MHz
Highest internal operating Freq.	: 944.15 MHz
Receipt date of EUT	: 20 Jan. 2023
Nominal power source voltages	: DC 13.8 V

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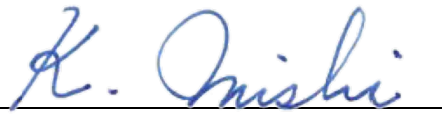
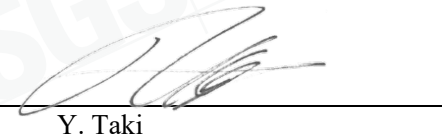
1.2 Test(s) performed/ Summary of test result

Test specification(s)	: FCC CFR 47 Part 15 Subpart B
Test method(s)	: ANSI C63.4: 2014
Test(s) started	: 03 Feb. 2023
Test(s) completed	: 03 Feb. 2023
Purpose of test(s)	: Certification as the scanning receiver
Summary of test result	: *Complied*

Note: The above judgment is only based on the measurement data and it does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.
The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the Laboratory.
Compliance of the EUT is more probable than non-compliance is case that the margin is less than the measurement uncertainty in the Laboratory.

Test engineer : 
K. Onishi
(Test Engineer, C&P Connectivity EMC Laboratory)

Reviewer : 
Y. Taki
(Manager, C&P Connectivity Wireless)

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1.3 Test facility

The Federal Communications Commission has reviewed the technical characteristics of the test facilities at SGS Japan Inc., located in 3-5-23, Kitayamata, Tsuzuki-ku, Yokohama, 224-0021, Japan, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.
The description of the test facilities has been filed under registration number 319924 at the Office of the Federal Communications Commission. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.
The list of all public test facilities is available on the Internet at http://www.fcc.gov.

Registered by Innovation, Science and Economic Development Canada (ISED):
The registered CAB identifier is JP0009.

Accredited by **National Voluntary Laboratory Accreditation Program** (NVLAP) for the emission tests stated in the scope of the certificate under Certificate Number 200780-0

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1.4 Measurement uncertainty

The treatment of uncertainty is based on the general matters on the definition of uncertainty in “Guide to the expression of uncertainty in measurement (GUM)” published by ISO. The Lab’s uncertainty is determined by referring UKAS Publication LAB34: 2002 “The Expression of Uncertainty in EMC Testing” and CISPR16-4-2: 2011 “Uncertainty in EMC Measurements”.
The uncertainty of the measurement results in the level of confidence of approximately 95% (k=2) is as follows;

AC conducted emission (150 kHz - 30 MHz)	: ± 3.3 dB
RF conducted emission (30 MHz - 6 GHz)	: ± 1.3 dB
Radiated emission (30 MHz - 1000 MHz)	: ± 5.9 dB
Radiated emission (1 GHz - 6 GHz)	: ± 4.0 dB

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1.5 Summary of test results

Requirement	Section in specification	Result	Section in this report
Radiated emissions (30 to 5000 MHz) (*1)	15.109	Complied	2.1
Conducted emission for receiver	15.111	Complied	2.2
AC power line conducted emissions	15.107	N/A (*2)	2.3
38 dB Rejection (cellular band)	15.121 (b)	N/A (*3)	-

(*1) The highest internal operating frequency is 944.15 MHz
(*2) The EUT is powered by the car battery.
(*3) This item was not tested in this report.

1.6 Setup of equipment under test (EUT)

1.6.1 Test configuration of EUT

Equipment(s) under test

No.	Item	Manufacture	Model No.	Serial No.
1	144/430MHz DUAL BAND DIGITAL TRANSCEIVER	YAESU MUSEN CO., LTD.	FTM-500DR	No. 5
-	-	-	-	-

Support Equipment(s)

No.	Item	Manufacture	Model No.	Serial No.
2	DTMF Microphone	YAESU MUSEN CO., LTD.	SSM-85D	-
3	External Speaker	YAESU MUSEN CO., LTD.	MLS-100	1F123

Connected cable(s)

No.	Item	From	To	Cable Shielded	Ferrite Core	Length [m]
A	Mic. Cable	1	2	No	No	0.5
B	Speaker Cable	1	3	No	No	1.8
C	DC Power Cable	1	DC	No	No	2.34

1.6.2 Operating condition:

- Rx 108.000 MHz
- Rx 553.9875 MHz
- Rx 999.995 MHz

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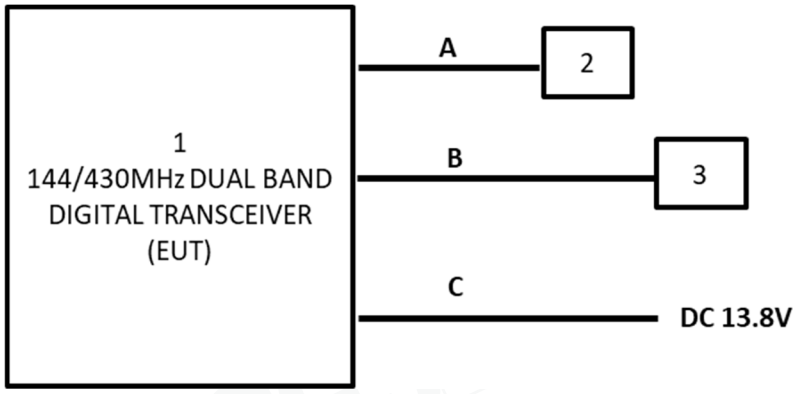
1.6.3 Setup diagram of tested system



1.7 Equipment modifications

No modifications have been made to the equipment in order to achieve compliance with the applicable standards described in clause 1.2.

1.8 Deviation from the standard

No deviations from the standards described in clause 1.2.

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2 Test procedure and test data

2.1 Radiated emissions

Test setup

Test setup was implemented according to the method of ANSI C63.4 clause 6 “General requirements for EUT equipment arrangements and operation”, clause 8.2 and Annex H.3 “Radiated emission measurements setup”.

Test procedure

Measurement procedures were implemented according to the method of ANSI C63.4 clauses 8.2.
The EUT is place on a non-conducted table which is 0.8 m height from a ground plane and the measurement antenna to EUT distance is 3 meters. The turn table is rotated for 360 degrees to determine the maximum emission level.
The antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.
The spectrum analyzer and receiver are set to the followings;

RBW=100 kHz (up to 1000 MHz) or 1 MHz (above 1000 MHz),
VBW= 300 kHz (up to 1000 MHz) or 3 MHz (above 1000 MHz)
Final measurement is carried out with a receiver RBW of 120 kHz (up to 1000 MHz), or 1 MHz (above 1000 MHz).

Applicable rule and limitation

FCC 15.109 Radiated emissions limits

Frequency [MHz]	Field Strength [μV/m]	Measurement Distance [m]	Field Strength [dBμV/m]
30 – 88	100	3	40.0
88 –216	150	3	43.5
216 – 960	200	3	46.0
Above 960	500	3	53.9

In the emission table above, the tighter limit applies at the band edges.
The emission limits shown in the above table are based on measurements employing a QP detector (up to 1000 MHz) or AVE/PEAK detector (above 1000 MHz).

Test results - *Complied with requirement*

Test equipment used (refer to List of utilized test equipment)

AC01 (EM)	AC01 (EG)	BA07	CL11	CL38	CL39	DH06
PR12	PR21	TR06	-	-	-	-

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Test software used

EMI1 Ver. 6.1

Calculation method

The Correction Factor and Result are calculated as followings.

Correction Factor [dB/m] = Ant. Factor [dB/m] + Loss [dB] – Gain [dB]
Result [dBµV/m] = Reading [dBµV] + Correction Factor [dB/m]

Test Data

Operating mode: Rx 108.000 MHz

Range: 30 - 1000 MHz

No.	Frequency [MHz]	Reading [dBµV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Ant.
1	30.000	22.9	22.9	6.8	30.4	22.2	40.0	17.8	Hori.
2	374.150	31.7	15.4	9.9	30.3	26.7	46.0	19.3	Hori.
3	823.750	30.5	20.0	12.2	29.9	32.8	46.0	13.2	Hori.
4	1000.000	20.6	21.7	12.9	28.2	27.0	53.9	26.9	Hori.

All other emissions were under noise floor.

Range: 1000 - 5000 MHz

No.	Frequency [MHz]	Reading PK [dBµV]	Reading AVE [dBµV]	C.Factor [dB/m]	Result PK [dBµV/m]	Result AVE [dBµV/m]	Limit PK [dBµV/m]	Limit AVE [dBµV/m]	Margin PK [dB]	Margin AVE [dB]	Ant.
1	2619.050	50.9	45.5	-3.7	47.2	41.8	73.9	53.9	26.7	12.1	Hori.
2	2993.200	51.2	46.1	-3.1	48.1	43.0	73.9	53.9	25.8	10.9	Hori.
3	3367.350	53.8	48.9	-1.1	52.7	47.8	73.9	53.9	21.2	6.1	Hori.
4	2619.050	52.0	47.2	-3.7	48.3	43.5	73.9	53.9	25.6	10.4	Vert.
5	2993.200	52.5	48.3	-3.1	49.4	45.2	73.9	53.9	24.5	8.7	Vert.
6	3367.350	53.2	47.6	-1.1	52.1	46.5	73.9	53.9	21.8	7.4	Vert.

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Operating mode: Rx 553.9875 MHz

Range: 30 - 1000 MHz

No.	Frequency [MHz]	Reading [dBµV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Ant.
1	280.594	34.6	13.0	9.3	30.2	26.7	46.0	19.3	Hori.
2	374.150	31.5	15.4	9.9	30.3	26.5	46.0	19.5	Hori.
3	392.832	30.8	15.9	10.1	30.3	26.5	46.0	19.5	Hori.
4	497.238	28.4	17.2	10.9	30.2	26.3	46.0	19.7	Hori.
5	1000.000	20.5	21.7	12.9	28.2	26.9	53.9	27.0	Hori.
6	374.150	27.8	15.4	9.9	30.3	22.8	46.0	23.2	Vert.

Range: 1000 - 5000 MHz

No.	Frequency [MHz]	Reading PK [dBµV]	Reading AVE [dBµV]	C.Factor [dB/m]	Result PK [dBµV/m]	Result AVE [dBµV/m]	Limit PK [dBµV/m]	Limit AVE [dBµV/m]	Margin PK [dB]	Margin AVE [dB]	Ant.
1	2619.050	51.1	45.9	-3.7	47.4	42.2	73.9	53.9	26.5	11.7	Hori.
2	2993.200	51.4	46.4	-3.1	48.3	43.3	73.9	53.9	25.6	10.6	Hori.
3	3367.350	54.2	49.0	-1.1	53.1	47.9	73.9	53.9	20.8	6.0	Hori.
4	2619.050	51.7	47.2	-3.7	48.0	43.5	73.9	53.9	25.9	10.4	Vert.
5	2993.200	52.5	48.4	-3.1	49.4	45.3	73.9	53.9	24.5	8.6	Vert.
6	3367.350	53.2	47.6	-1.1	52.1	46.5	73.9	53.9	21.8	7.4	Vert.

Operating mode: Rx 999.995 MHz

Range: 30 - 1000 MHz

No.	Frequency [MHz]	Reading [dBµV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Ant.
1	30.000	23.0	22.9	6.8	30.4	22.3	40.0	17.7	Hori.
2	38.438	22.9	18.5	6.9	30.4	17.9	40.0	22.1	Hori.
3	280.594	34.6	13.0	9.3	30.2	26.7	46.0	19.3	Hori.
4	374.150	30.9	15.4	9.9	30.3	25.9	46.0	20.1	Hori.
5	631.534	21.3	18.6	11.5	30.2	21.2	46.0	24.8	Hori.
6	1000.000	20.6	21.7	12.9	28.2	27.0	53.9	26.9	Hori.

Range: 1000 - 5000 MHz

No.	Frequency [MHz]	Reading PK [dBµV]	Reading AVE [dBµV]	C.Factor [dB/m]	Result PK [dBµV/m]	Result AVE [dBµV/m]	Limit PK [dBµV/m]	Limit AVE [dBµV/m]	Margin PK [dB]	Margin AVE [dB]	Ant.
1	2619.050	51.1	46.0	-3.7	47.4	42.3	73.9	53.9	26.5	11.6	Hori.
2	2993.200	51.4	46.4	-3.1	48.3	43.3	73.9	53.9	25.6	10.6	Hori.
3	**3367.350**	**54.1**	**49.0**	**-1.1**	**53.0**	**47.9**	**73.9**	**53.9**	**20.9**	**6.0**	**Hori.**
4	2619.046	52.7	48.0	-3.7	49.0	44.3	73.9	53.9	24.9	9.6	Vert.
5	2993.202	52.8	48.7	-3.1	49.7	45.6	73.9	53.9	24.2	8.3	Vert.
6	3367.349	53.4	47.2	-1.1	52.3	46.1	73.9	53.9	21.6	7.8	Vert.

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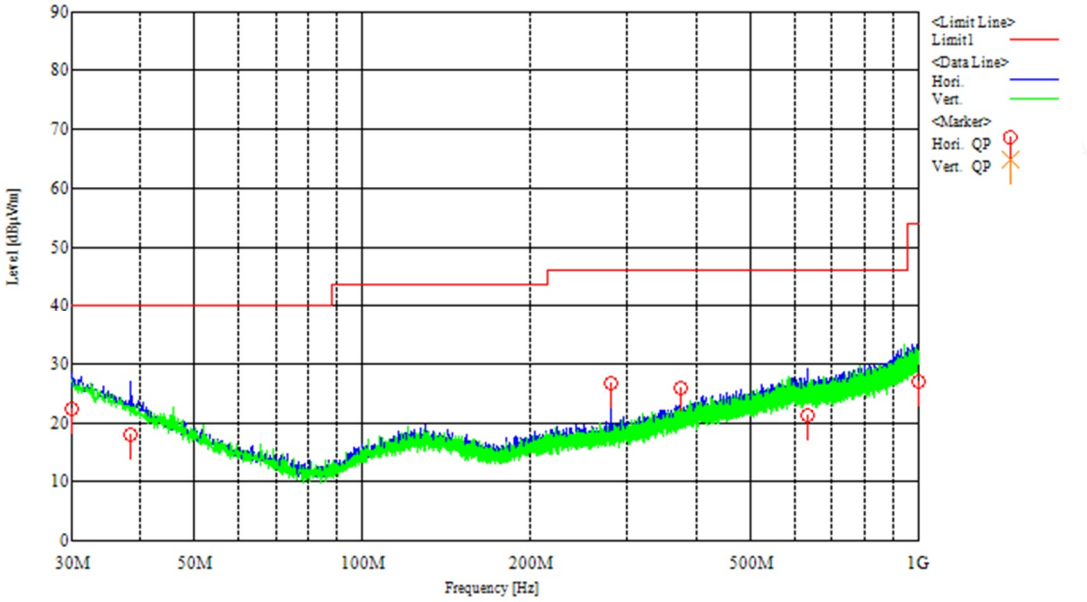
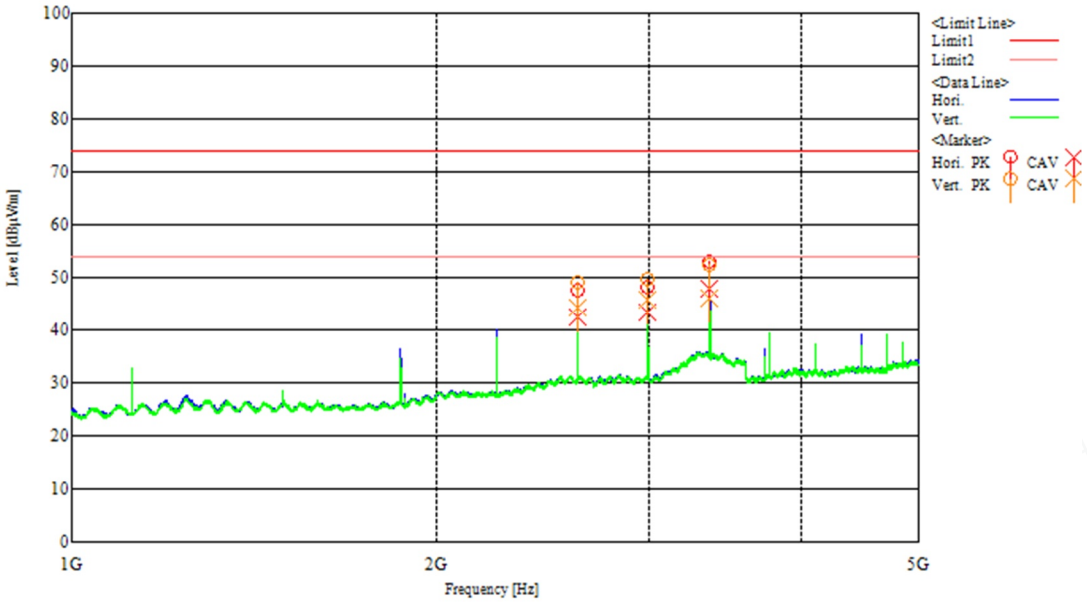
[Chart (Worst)]

Operating condition: Rx 999.995 MHz





[Test condition]

Tested Date:	3 Feb. 2023	Temperature:	22 deg. C
Humidity:	25 %	Atmos. Press:	1019 hPa

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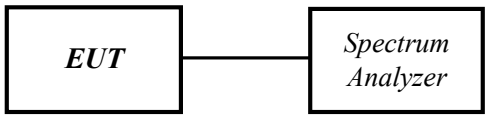
2.2 Conducted emissions for receiver

Test setup



Applicable rule and limitation

§15.111 (b) Antenna power conducted limit: 2 nW (= -57 dBm)

Test equipment used (refer to List of utilized test equipment)

CL31	TR06	-

Test results - *Complied with requirement*

Test Data

[The maximum spurious level]

Operating freq. [MHz]	Frequency range 30 - 1000 MHz		Frequency range 1000 - 5000 MHz	
	Freq. [MHz]	Level [dBm]	Freq. [MHz]	Level [dBm]
108.000	838.592	-71.00	2619.200	-62.13
553.9875	374.156	-73.54	2619.200	-59.39
999.995	374.156	-74.18	**2619.200**	**-58.81**

Note: No emission above noise floor was found.

[Test condition]

Tested Date: 03 Feb. 2023 Temperature: 22 deg. C
Humidity: 25 % Atmos. Press: 1019 hPa

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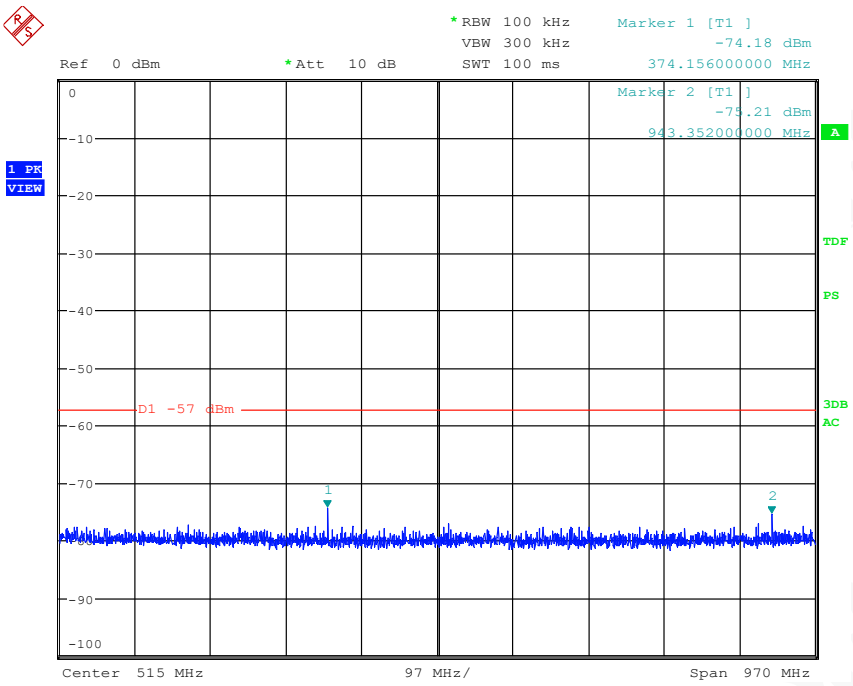
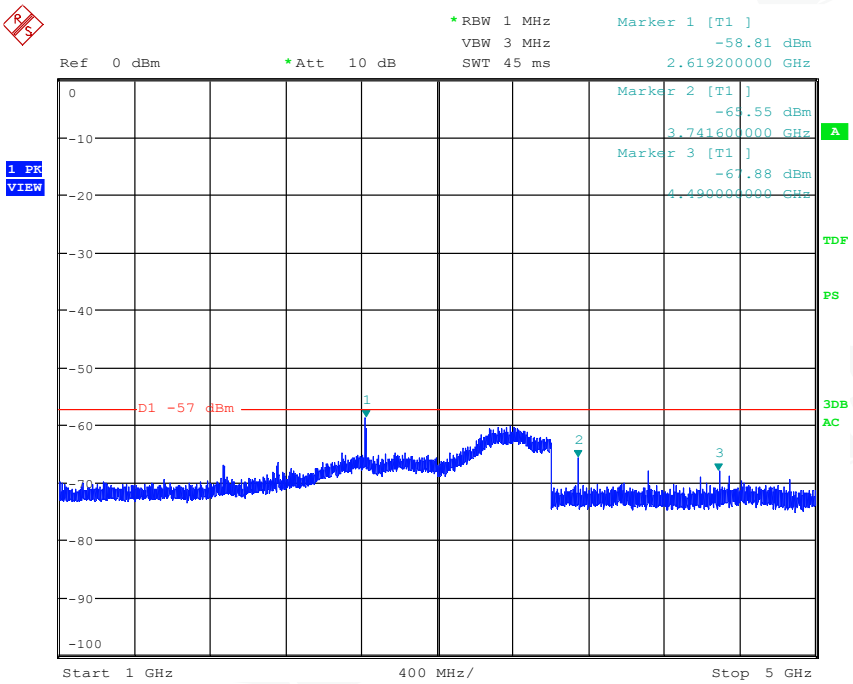
[Chart]

Operating mode: Rx 999.995 MHz (Worst)





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2.3 AC power line conducted emissions

Test setup

Test setup was implemented according to the method of ANSI C63.4 clause 6 “General requirements for EUT equipment arrangements and operation” and Annex H.1 “AC power line conducted emission measurements setup”.

Test procedure

Measurement procedures were implemented according to the method of ANSI C63.4 clauses 7, clause 13.1.3 and Annex H.2 “AC power line conducted emission measurements”.
Exploratory measurements were used the spectrum analyzer to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement.
Final ac power line conducted emission measurements were performed based on the exploratory tests.
The EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit are selected for the final measurement.
When the measurement value is greater than average limitation the average detection measurements were performed.

Applicable rule and limitation

§15.107 (b) AC power line conducted limits

Frequency of Emission [MHz]	Conducted emissions Limit [dBµV]	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency. The lower limit applies at the band edges.

Test equipment used (refer to List of utilized test equipment)

-	-	-	-

Test software used

EMI1 Ver. 6.1

Calculation method

The Correction Factor and Result are calculated as followings.

Correction Factor [dB] = ISN Factor [dB] + Loss [dB]
Result [dBµV] = Reading [dBµV] + Correction Factor [dB]

Test results - *This item was not tested.*

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Test Data

[Emission level]

Operating mode: -

	Freq. [MHz]	Reading QP [dBµV]	Reading Ave [dBµV]	Factor [dB]	Result QP [dBµV]	Result Ave [dBµV]	Limit QP [dBµV]	Limit Ave [dBµV]	Margin QP [dB]	Margin Ave [dB]	Line

[Chart]

Operating mode: -

[Test condition]

Tested Date: -
Humidity: - %
Temperature: - deg. C
Atmos. Press: - hPa

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4 List of utilized test equipment / calibration

RFT ID No.	Kind of Equipment and Precision	Manufacturer	Model No.	Serial Number	Calibration Date	Calibrated until
AC01 (EM)	Anechoic Chamber (Y1 test room)	JSE	203397C	-	2022/03/11	2023/03/31
AC01 (EG)	Anechoic Chamber (Y1 test room)	JSE	203397C	-	2022/03/25	2023/03/31
BA07	Bilogical Antenna	TESEQ	CBL6143A	26670	2022/03/23	2023/03/31
CL11	RF Cable for RE	RFT	-	-	2022/03/29	2023/03/31
CL31	RF Cable 1 m	Junkosha	MWX221	1303S118	2023/01/20	2024/01/31
CL38	RF Cable 2 m	Junkosha	MWX221	1603S626	2023/01/20	2024/01/31
CL39	RF Cable 5 m	SUHNER	SUCOFLEX126E	523222	2023/01/20	2024/01/31
DH06	DRG Horn Antenna	A.H. Systems	SAS-571	1339	2022/07/09	2024/07/31
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2023/01/23	2024/01/31
PR21	Pre. Amplifier	Anritsu	MH648A	6200467119	2022/03/23	2023/03/31
TR06	Test Receiver (F/W: 4.73 SP4)	Rohde & Schwarz	ESU26	100002	2022/12/06	2023/12/31

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

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