

## Report on the RF Testing of:

**FUJI TECOM INC.**  
**DIGITAL QUATRO CORRELATOR**  
Model: LC-5000 C\_RF  
FCC ID: 2AARD-LC50



**In accordance with FCC Part 15 Subpart C**

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## COMMERCIAL-IN-CONFIDENCE

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Hiroaki Suzuki	Deputy Manager of RF Group	Approved Signatory	31 JUL 2020

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Japan Ltd. document control rules.

### EXECUTIVE SUMMARY – Result: Complied

A sample of this product was tested and the result above was confirmed in accordance with FCC Part 15 Subpart C.

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## Contents

<b>1</b>	<b>Summary of Test .....</b>	<b>3</b>
1.1	Modification history of the test report .....	3
1.2	Standards .....	3
1.3	Test methods .....	3
1.4	Deviation from standards .....	3
1.5	List of applied test(s) of the EUT .....	3
1.6	Test information .....	3
1.7	Test set up .....	3
1.8	Test period .....	3
<b>2</b>	<b>Equipment Under Test .....</b>	<b>4</b>
2.1	EUT information .....	4
2.2	Modification to the EUT .....	5
2.3	Variation of family model(s) .....	5
2.4	Operating channels and frequencies .....	5
2.5	Operating mode .....	5
2.6	Operating flow .....	6
<b>3</b>	<b>Configuration of Equipment .....</b>	<b>7</b>
3.1	Equipment used .....	7
3.2	Cable(s) used .....	7
3.3	System configuration .....	7
<b>4</b>	<b>Test Result .....</b>	<b>8</b>
4.1	6dB Bandwidth / Occupied Bandwidth (99%) .....	8
4.2	Fundamental Emission Output Power .....	11
4.3	Band Edge Compliance of RF Conducted Emissions .....	13
4.4	Spurious Emissions - Conducted - .....	16
4.5	Spurious Emissions - Radiated - .....	19
4.6	Transmitter Power Spectral Density .....	23
4.7	AC Power Line Conducted Emissions .....	26
<b>5</b>	<b>Antenna requirement .....</b>	<b>29</b>
<b>6</b>	<b>Measurement Uncertainty .....</b>	<b>30</b>
<b>7</b>	<b>Laboratory Information .....</b>	<b>31</b>
<b>Appendix A. Test Equipment .....</b>		<b>32</b>
<b>Appendix B. Duty Cycle .....</b>		<b>33</b>

## 1 Summary of Test

### 1.1 Modification history of the test report

Document Number	Modification History	Issue Date
JPD-TR-20171-0	First Issue	Refer to the cover page

### 1.2 Standards

CFR47 FCC Part 15 Subpart C

### 1.3 Test methods

ANSI C63.10-2013,  
KDB 558074 D01 15.247 Meas Guidance v05r02

### 1.4 Deviation from standards

None

### 1.5 List of applied test(s) of the EUT

Test item section	Test item	Condition	Result	Remark
15.247(a)(2)	6dB Bandwidth / Occupied Bandwidth	Conducted	PASS	-
15.247(b)(3)	Maximum Peak Output Power	Conducted	PASS	-
15.247(d)	Band Edge Compliance of RF Conducted Emissions	Conducted	PASS	-
15.247(d) 15.205 15.209	Spurious Emissions	Conducted	PASS	-
		Radiated	PASS	-
15.247(d) 15.205 15.209	Restricted Bands of Operation	Radiated	PASS	-
15.247(e)	Transmitter Power Spectral Density	Conducted	PASS	-
15.207	AC Power Line Conducted Emissions	Conducted	PASS	-

### 1.6 Test information

None

### 1.7 Test set up

Table-top

### 1.8 Test period

3-July-2020 - 15-July-2020

## 2 Equipment Under Test

### 2.1 EUT information

Applicant	FUJI TECOM INC. 8-6-16 Nobidome, Niiza City, Saitama JAPAN 352-0011 Phone: +81-48-479-0585 Fax: +81-48-477-4724
Equipment Under Test (EUT)	DIGITAL QUATRO CORRELATOR
Model number	LC-5000 C_RF
Serial number	N/A Body: NO.15 Preamplifier: 1908028B
Trade name	FUJI TECOM
Number of sample(s)	1
EUT condition	Pre-Production
Power rating	Body: DC 11.25 V 2 A Preamplifier: DC 3.65 V 900 mA
Size	Body: (W) 273 × (D) 83 × (H) 176 mm Preamplifier: (φ) 73 × (H) 183 mm
Environment	Indoor and Outdoor use
Thermal limitation	-20 °C to 60 °C
Hardware version	2.0
Software version	Not applicable
Firmware version	13.01
RF Specification	
Frequency range	921.0 MHz - 921.8 MHz, 922.8 MHz – 923.0 MHz
Number of RF Channels	7 Channels
Modulation method/Data rate	2GFSK (500 kbps)
Channel separation	0.2 MHz
Conducted power	Body: 287.078 mW Preamplifier: 273.527 mW
Antenna type	External antenna
Antenna gain	2 dBi

## 2.2 Modification to the EUT

The table below details modifications made to the EUT during the test project.

Modification State	Description of Modification	Modification fitted by	Date of Modification
Model: LC-5000 C_RF, Serial Number: N/A			
0	As supplied by the applicant	Not Applicable	Not Applicable

## 2.3 Variation of family model(s)

### 2.3.1 List of family model(s)

Not applicable

### 2.3.2 Reason for selection of EUT

Not applicable

## 2.4 Operating channels and frequencies

Channel	Frequency [MHz]
1	921.0
2	921.2
3	921.4
4	921.6
5	921.8
6	922.8
7	923.0

## 2.5 Operating mode

The EUT had been tested under operating condition.

There are three channels have been tested as following:

Tested Channel	Frequency [MHz]
Low	921.0
Middle	921.8
High	923.0

The pre-test has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Tested Channel	Modulation Type	Data Rate
Low, Middle, High	2GFSK	500 kbps

The field strength of spurious emissions was measured at each position of all three axis X, Y and Z to compare the level, and the maximum noise.

The worst emission was found in Y axis (EUT is Body) and X axis (EUT is Preamplifier) the worst case recorded.

Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports.

## 2.6 Operating flow

### [Tx mode]

i) Test program setup to the Software

ii) Select a Test mode

Operating frequency: Channel Low: 921.0 MHz, Channel Middle: 921.8 MHz, Channel High: 923.0 MHz

iii) Start test mode

### [Rx mode]

i) Test program setup to the Software

ii) Select a Test mode

Operating frequency: Channel Low: 921.0 MHz, Channel Middle: 921.8 MHz, Channel High: 923.0 MHz

iii) Start test mode

### 3 Configuration of Equipment

Numbers assigned to equipment on the diagram in “3.3 System configuration” correspond to the list in “3.1 Equipment used” and “3.2 Cable(s) used”.

Cabling and setup(s) were taken into consideration and test data was taken under worse case condition.

#### 3.1 Equipment used

No.	Equipment	Company	Model No.	Serial No.	FCC ID/DoC	Comment
EUT1	DIGITAL QUATRO	FUJI TECOM	LC-5000 C_RF	N/A	NO.15 1908028B	2AARD-LC50 EUT
EUT2	CORRELATOR					
ACC1	Antenna	MAP ELECTRONICS	MEGAF-6551SA2X-P200-920	N/A	N/A	*Accessory
ACC2	AC Adapter	UNIFIVE	US318-09	J06-0352553	N/A	*Accessory

\*:AC power line Conducted Emission Test.

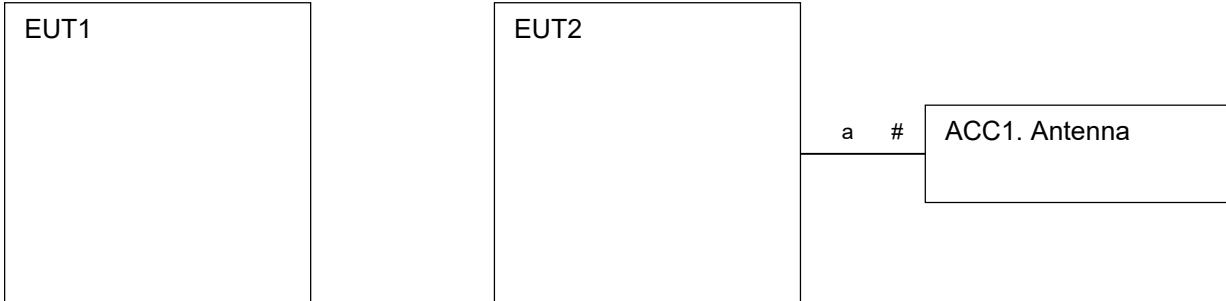
#### 3.2 Cable(s) used

No.	Equipment	Length[m]	Shield	Connector	Comment
a	Antenna cable	2.0	Yes	Metal	Accessory
b	DC cable (for AC Adapter)	1.9	No	Plastic	*Accessory

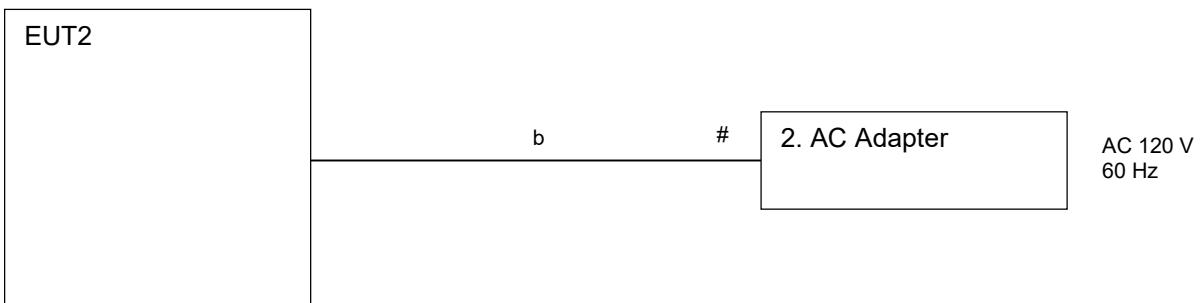
\*:AC power line Conducted Emission Test.

#### 3.3 System configuration

Radiated Emission



Conducted Emission



#: Un-detachable cable

## 4 Test Result

### 4.1 6dB Bandwidth / Occupied Bandwidth (99%)

#### 4.1.1 Measurement procedure

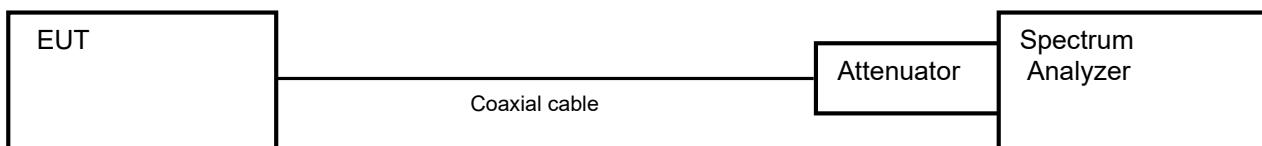
[FCC 15.247(a)(2), KDB558074 D01 v05r02]

The bandwidth at 6 dB down from the highest inband spectral density is measured with spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- a) RBW = 100 kHz
- b) VBW  $\geq$  3 x RBW
- c) Sweep time = auto-couple
- d) Detector = peak
- e) Trace mode = max hold

- Test configuration



#### 4.1.2 Limit

The minimum permissible 6dB bandwidth is 500kHz.

#### 4.1.3 Measurement result

Date : 15-July-2020  
 Temperature : 21.5 [°C]  
 Humidity : 59.2 [%]  
 Test place : Shielded room No.4

Test engineer : Chiaki Kanno

#### Body

Channel	Frequency [MHz]	6 dB bandwidth [MHz]	Occupied Bandwidth (99%) [MHz]
Low	921.0	0.506	0.6670
Middle	921.8	0.503	0.6570
High	923.0	0.502	0.6530

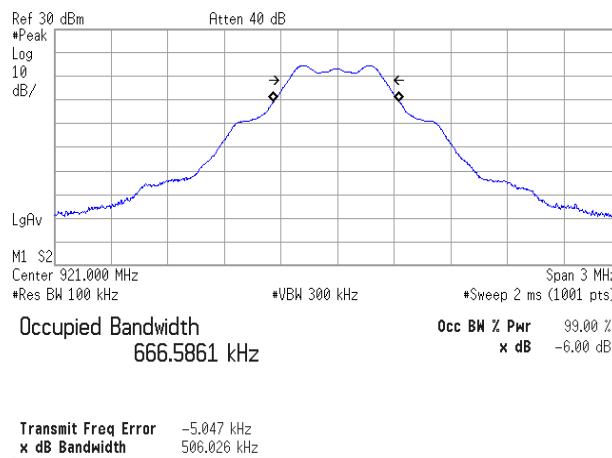
#### Preamplifier

Channel	Frequency [MHz]	6 dB bandwidth [MHz]	Occupied Bandwidth (99%) [MHz]
Low	921.0	0.505	0.6680
Middle	921.8	0.503	0.6600
High	923.0	0.504	0.6560

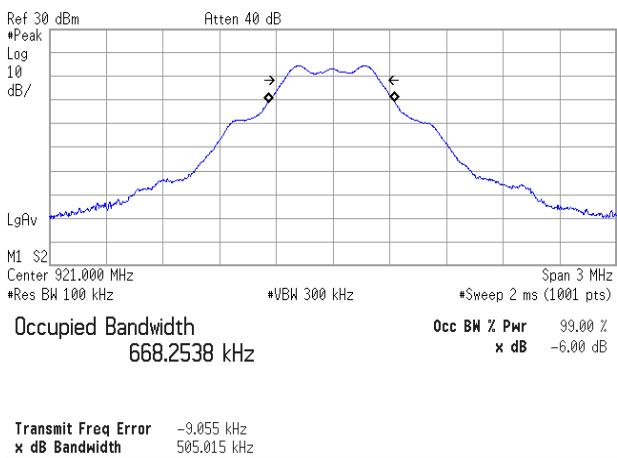
#### 4.1.4 Trace data

##### Channel Low

###### Body

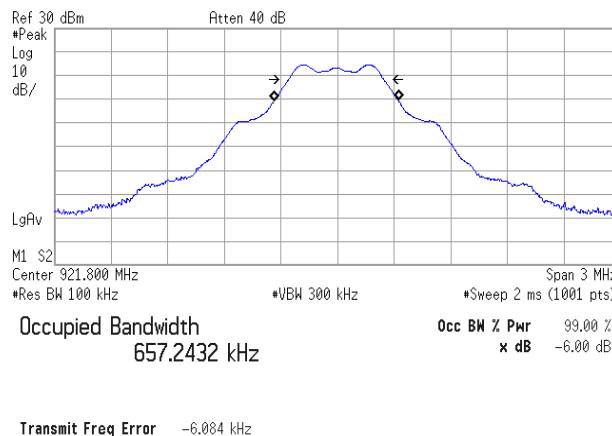



###### Preamplifier

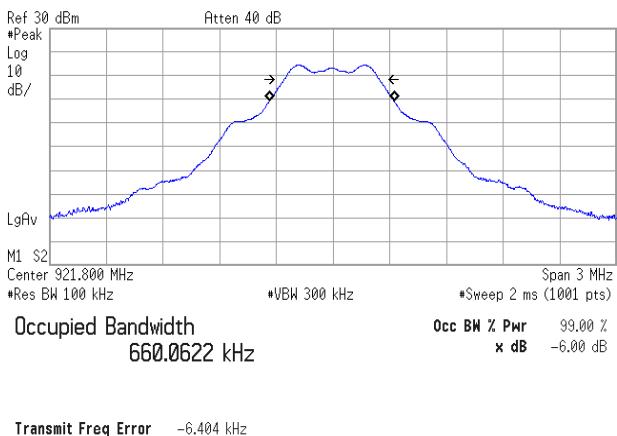



##### Channel Middle

###### Body

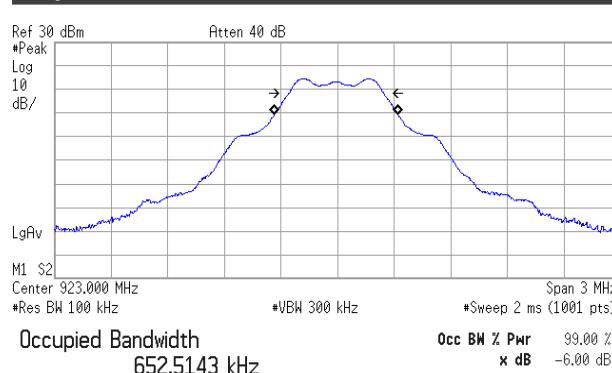



###### Preamplifier

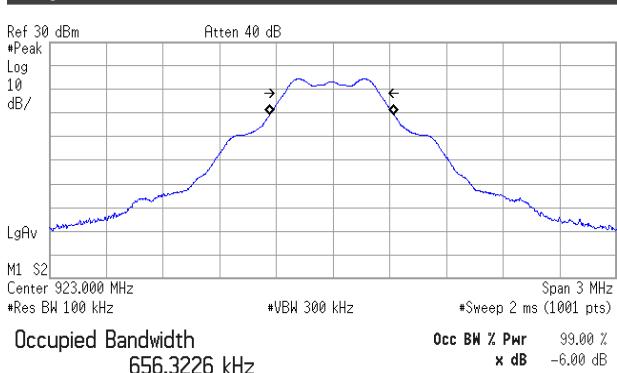



##### Channel High

###### Body

###### Preamplifier

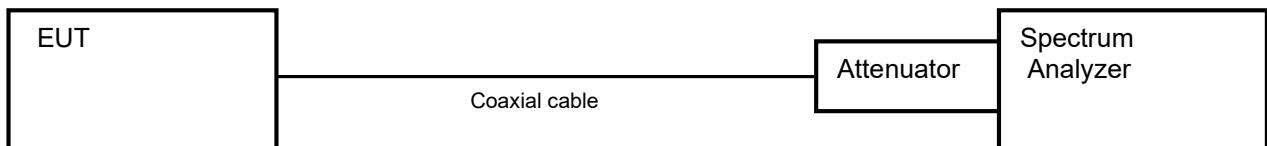
## 4.2 Fundamental Emission Output Power

### 4.2.1 Measurement procedure

[FCC 15.247(b)(3), KDB558074 D01 v05r02]

The power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

- Test configuration



### 4.2.2 Limit

1 W(1000 mW) or less

### 4.2.3 Measurement result

Date	:	15-July-2020				
Temperature	:	21.5 [°C]				
Humidity	:	59.2 [%]				
Test place	:	Shielded room No.4		Test engineer	:	Chiaki Kanno

#### Body

Channel	Center Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	921.0	14.32	9.94	24.26	266.686	≤1000	PASS
Middle	921.8	14.23	9.94	24.17	261.216	≤1000	PASS
High	923.0	14.21	9.94	24.15	260.016	≤1000	PASS

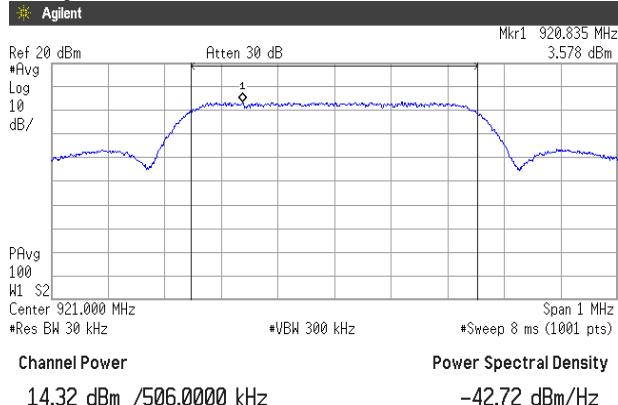
#### Preamplifier

Channel	Center Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	921.0	14.05	9.94	23.99	250.611	≤1000	PASS
Middle	921.8	13.98	9.94	23.92	246.604	≤1000	PASS
High	923.0	14.00	9.94	23.94	247.742	≤1000	PASS

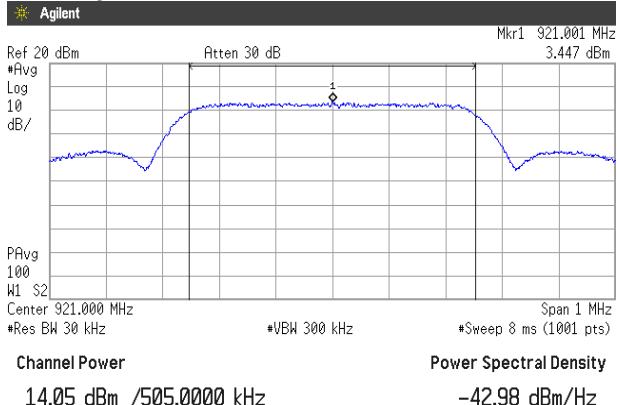
#### 4.2.4 Test data

##### Channel Low

###### Body

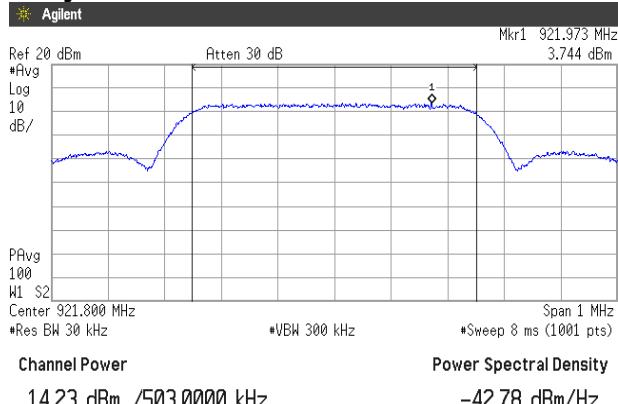


###### Preamplifier

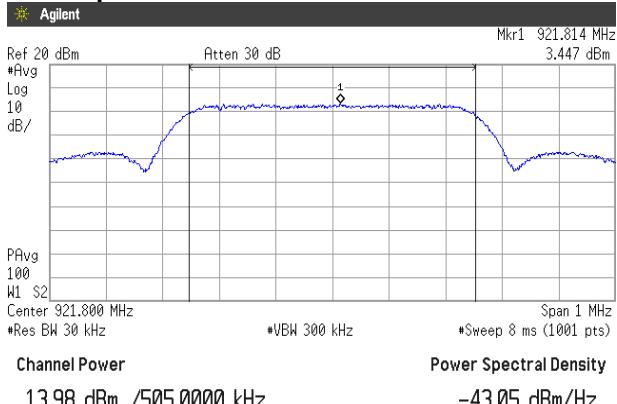


##### Channel Middle

###### Body

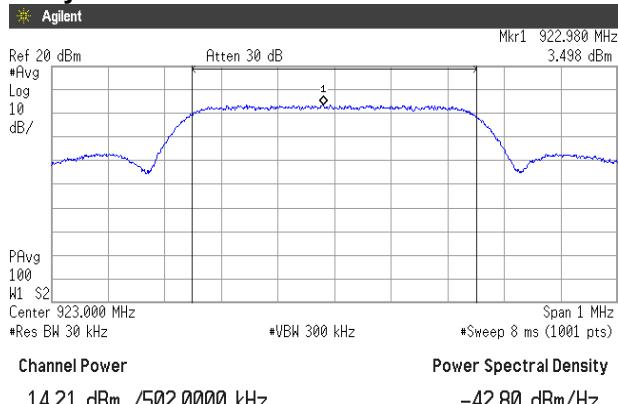


###### Preamplifier

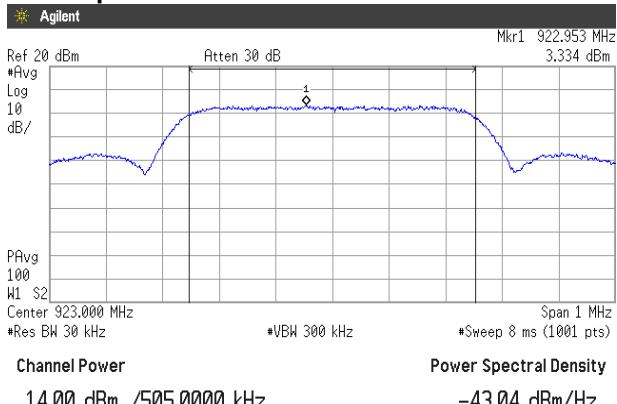


##### Channel High

###### Body



###### Preamplifier



## 4.3 Band Edge Compliance of RF Conducted Emissions

### 4.3.1 Measurement procedure

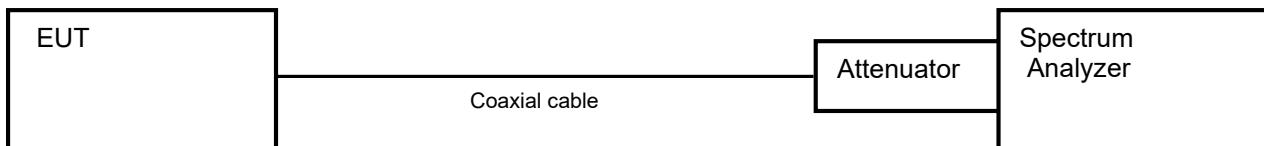
#### [FCC 15.247(d), KDB558074 D01 v05r02]

The Band Edge is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to;

- a) Span = Arbitrary setting. (Setting suitable for measurement.)
- b) RBW = 100 kHz
- c) VBW  $\geq 3 \times$  RBW
- d) Sweep time = auto-couple
- e) Detector = peak
- f) Trace mode = max hold

- Test configuration



### 4.3.2 Limit

In any 100kHz bandwidth outside the frequency band the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB ...

[15.247(d)]

#### 4.3.3 Measurement result

Date : 15-July-2020  
 Temperature : 21.5 [°C]  
 Humidity : 59.2 [%]  
 Test place : Shielded room No.4

Test engineer : Chiaki Kanno

##### Body

###### Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW

Notes: Maximum In Band Peak PSD in 100 kHz RBW

Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.8	14.64	9.94	24.58

##### Band Edge

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	Limit (dBm)	Margin (dB)	Result
921.0	-25.47	9.94	-15.53	-5.42	10.11	PASS
923.0	-23.29	9.94	-13.35	-5.42	7.93	PASS

##### Preamplifier

###### Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW

Notes: Maximum In Band Peak PSD in 100 kHz RBW

Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.0	14.43	9.94	24.37

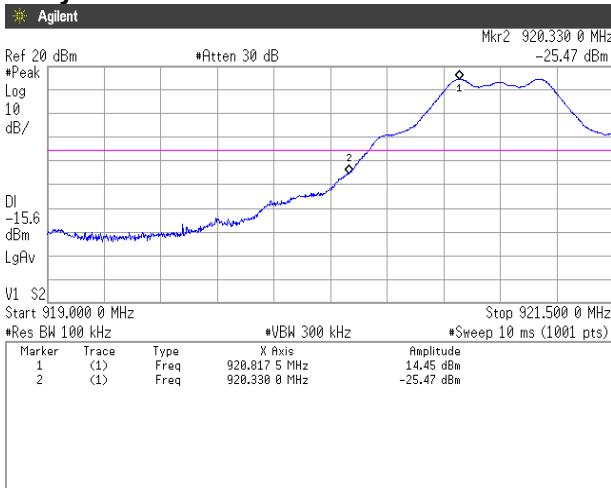
##### Band Edge

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	Limit (dBm)	Margin (dB)	Result
921.0	-25.24	9.94	-15.30	-5.63	9.67	PASS
923.0	-23.83	9.94	-13.89	-5.63	8.26	PASS

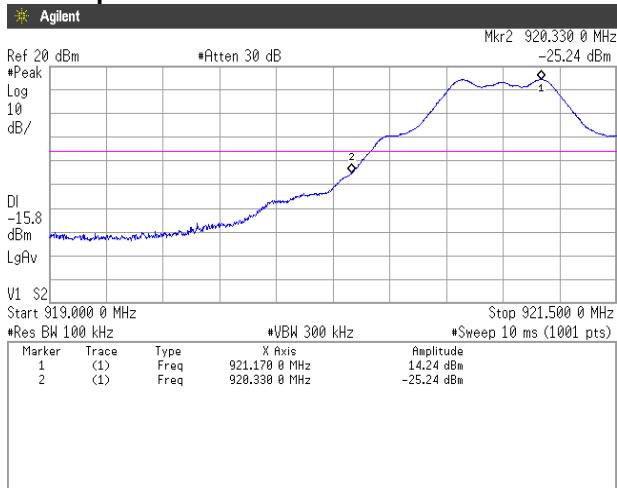
#### 4.3.4 Trace data

##### Channel: Low

###### Body

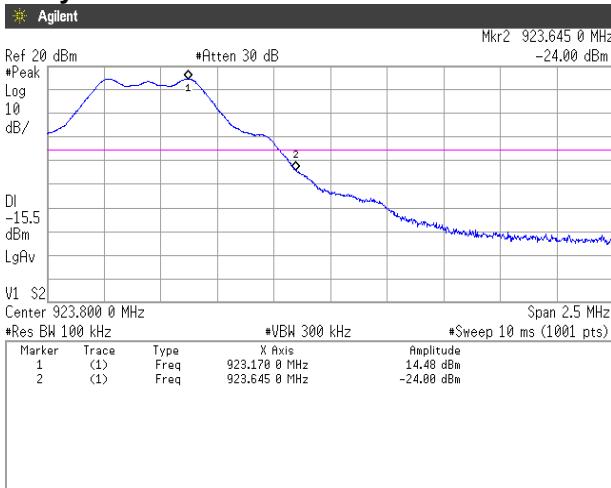


###### Preamplifier

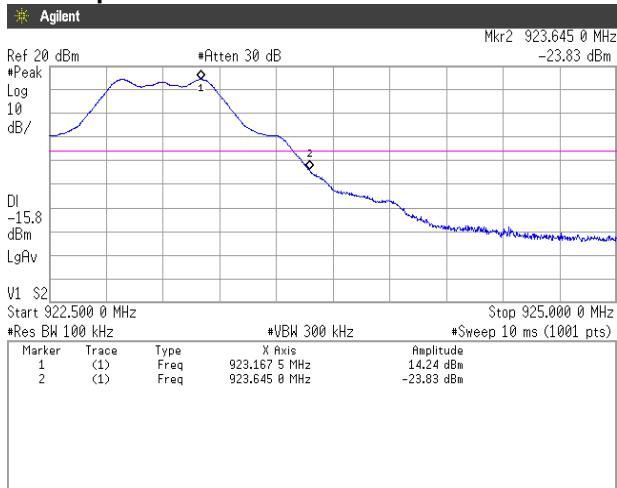


##### Channel: High

###### Body



###### Preamplifier



#### 4.4 Spurious Emissions - Conducted -

##### 4.4.1 Measurement procedure

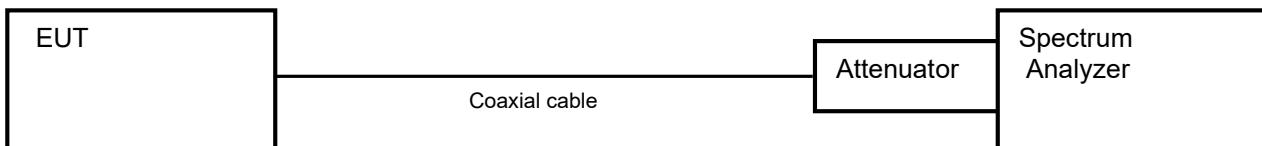
###### [FCC 15.247(d), KDB558074 D01 v05r02]

The spurious emissions (Conducted) are measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to;

- a) Span = wide enough to fully capture the emission being measured.
- b) RBW = 100 kHz
- c) VBW  $\geq$  RBW
- d) Sweep time = auto-couple
- e) Detector = peak
- f) Trace mode = max hold

- Test configuration



##### 4.4.2 Limit

In any 100kHz bandwidth outside the frequency band the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

#### 4.4.3 Measurement result

Date : 15-July-2020  
 Temperature : 21.5 [°C]  
 Humidity : 59.2 [%]  
 Test engineer :  
 Test place : Shielded room No.4 Chiaki Kanno

#### Body

##### Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW

Notes: Maximum In Band Peak PSD in 100 kHz RBW

##### Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.8	14.64	9.94	24.58

##### Conducted Spurious Emission

Notes: Tx on low channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

##### Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1841.0	-29.21	9.94	-19.27	-5.4	13.85	PASS

##### Conducted Spurious Emission

Notes: Tx on mid channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

##### Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1842.5	-29.13	9.94	-19.19	-5.4	13.77	PASS

##### Conducted Spurious Emission

Notes: Tx on High channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

##### Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1844.0	-29.20	9.94	-19.26	-5.4	13.84	PASS

**Preamplifier****Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW**

Notes: Maximum In Band Peak PSD in 100 kHz RBW

**Frequency Range: 921.0-921.8, 922.8- 923.0 MHz**

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.0	14.43	9.94	24.37

**Conducted Spurious Emission**

Notes: Tx on low channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

**Frequency Range: 921.0-921.8, 922.8- 923.0 MHz**

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1842.5	-29.41	9.94	-19.47	-5.6	13.84	PASS

**Conducted Spurious Emission**

Notes: Tx on mid channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

**Frequency Range: 921.0-921.8, 922.8- 923.0 MHz**

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1842.5	-29.42	9.94	-19.48	-5.6	13.85	PASS

**Conducted Spurious Emission**

Notes: Tx on High channel

The Limit here is set to -30dB from the max in-band peak PSD level in 100 kHz RBW(Attenuation factor included or 9.94dBm)

**Frequency Range: 921.0-921.8, 922.8- 923.0 MHz**

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Final Conducted (dBm)	FCC 15.247		
				Limit (dBm)	Margin (dB)	Result
1845.5	-29.36	9.94	-19.42	-5.6	13.79	PASS

## 4.5 Spurious Emissions - Radiated -

### 4.5.1 Measurement procedure

[FCC 15.247(d), 15.205, 15.209, KDB558074 D01 v05r02]

Test was applied by following conditions.

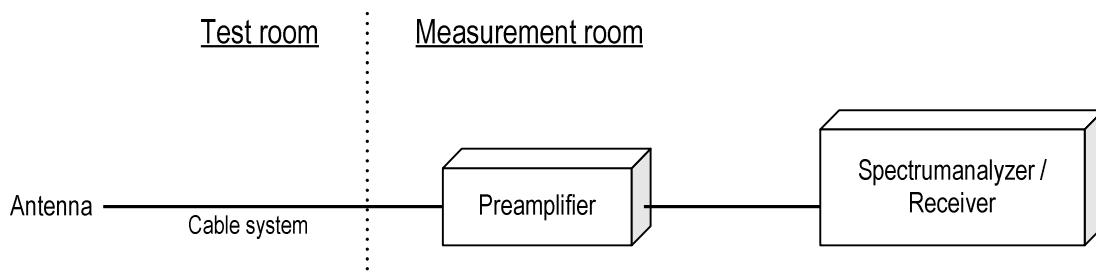
Test method	:	ANSI C63.10
Frequency range	:	9kHz to 10GHz
Test place	:	3m Semi-anechoic chamber
EUT was placed on	:	Styrofoam table / (W)1.0m × (D)1.0m × (H)0.8m (below 1GHz) Styrofoam table / (W)0.6m × (D)0.6m × (H)1.5m (above 1GHz)
Antenna distance	:	3m
Test receiver setting	:	Below 1GHz
- Detector	:	Average (9kHz-90kHz, 110kHz-490kHz), Quasi-peak
- Bandwidth	:	200Hz, 120kHz
Spectrum analyzer setting	:	Above 1GHz
- Peak	:	RBW=1MHz, VBW=3MHz, Span=0Hz, Sweep=auto
- Average	:	RBW=1MHz, VBW=10Hz, Span=0Hz, Sweep=auto Display mode=Linear

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

Radiated emission measurements are performed at 3m distance with the broadband antenna (Biconical antenna, Log periodic antenna, Double ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1m to 4m and stopped at height producing the maximum emission.

The EUT is Placed on a turntable, which is 0.8m/1.5m above ground plane. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. The test results represent the worst case emission for each emission with manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation. Sufficient time for the EUT, support equipment, and test equipment are allowed in order for them to warm up to their normal operating condition.

#### - Test configuration



#### 4.5.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). [15.247(d)]

#### 4.5.3 Test data

Date	: 3-July-2020	Test engineer	Chiaki Kanno
Temperature	: 22.1 [°C]		
Humidity	: 57.9 [%]		
Test place	: 3m Semi-anechoic chamber		
Date	: 15-July-2020	Test engineer	Chiaki Kanno
Temperature	: 21.5 [°C]		
Humidity	: 59.2 [%]		
Test place	: Shielded room No.4		

#### Body

##### Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW

Notes: Maximum In Band Peak PSD in 100 kHz RBW

Frequency Range: 921.0-921.8, 922.8- 923.0 MHz

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.8	14.64	9.94	24.58

##### Radiated Emissions Table - FCC 15.247(d) - non restricted band

Notes: All 3 channels (Low, Mid and High) were investigated and only the worst case recorded.

Adjusted FS readings compared to Peak Power Spectral Density (worst case) including the 2 dBi Antenna gain with the limit being 30dB below which corresponds to 91.8dB $\mu$ V/m

Frequency Range: 30-1000 MHz

Antenna Polarization (H/V)	Frequency (MHz)	Reading (dB $\mu$ V/m)	Factor (dB)	Level (dB $\mu$ V/m)	--			FCC 15.247 (d)		
					Limit (dBm)	Margin (dBm)	Result	Limit (dB $\mu$ V/m)	Margin (dB)	Result
V	570.0	53.60	-8.60	45.00	--	--	--	91.8	46.80	PASS
H	630.0	48.30	-7.10	41.20	--	--	--	91.8	50.60	PASS
H	690.0	52.60	-6.80	45.80	--	--	--	91.8	46.00	PASS
H	750.0	56.20	-6.00	50.20	--	--	--	91.8	41.60	PASS
H	780.0	59.20	-5.60	53.60	--	--	--	91.8	38.20	PASS
H	810.0	56.90	-5.10	51.80	--	--	--	91.8	40.00	PASS
H	843.7	56.70	-4.20	52.50	--	--	--	91.8	39.30	PASS

Note: No emissions found within 10dB of the limit, which was set -30dB down from the peak of Power Spectral Density of the Fundamental frequency (worst case). (See section 15.247(e) – Power Spectral Density) (i.e. Worst Case Conducted Power Spectral Density Reading + Antenna Gain = EIRP then calculated field strength based off of  $P = (Ed)^2/(30G)$ . Field Strength – 30dB = Adjusted Limit dB $\mu$ V/m).

**Radiated Emissions Table - FCC 15.247(d) - restricted band**

Notes: All 3 channels (Low, Mid and High) were investigated and only the worst case recorded.

**Frequency Range: 30-1000 MHz**

Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	--			FCC 15.247 (d)		
					Limit (dBm)	Margin (dBm)	Result	Limit (dBuV/m)	Margin (dB)	Result
H	330.0	51.50	-12.80	38.70	---	---	---	46.0	7.30	PASS
H	960.0	40.80	-2.40	38.40	---	---	---	46.0	7.60	PASS

**Radiated Emissions Table**

Notes: All 3 channels (Low, Mid and High).

**Frequency Range: 1-6 GHz**

Antenna Polarization (H/V)	Frequency (MHz)	Peak Reading (dBuV/m)	Average Reading (dBuV/m)	Factor (dB)	Peak Level (dBuV/m)	Average Level (dBuV/m)	FCC 15.247 (d) - Peak			FCC 15.247 (d) - Average		
							Limit (dBm)	Margin (dBm)	Result	Limit (dBuV/m)	Margin (dB)	Result
V	1842.0	66.00	62.10	4.40	70.40	66.50	91.8	21.4	PASS	71.8	5.30	PASS
V	1843.6	66.60	61.70	4.40	71.00	66.10	91.8	20.8	PASS	71.8	5.70	PASS
V	1846.0	66.40	61.60	4.40	70.80	66.00	91.8	21.0	PASS	71.8	5.80	PASS

Comment: No emission were detected in frequency range 6GHz to 10GHz at the 3 meters distance.

**Preamplifier****Spurious Conducted Emissions - Maximum In Band Peak PSD in 100 kHz RBW**

Notes: Maximum In Band Peak PSD in 100 kHz RBW

**Frequency Range: 921.0-921.8, 922.8- 923.0 MHz**

Frequency (MHz)	Reading (dBm)	Attenuation (dB)	Adjusted Reading (dBm)
921.0	14.43	9.94	24.37

**Radiated Emissions Table - FCC 15.247(d) - non restricted band**

Notes: All 3 channels (Low, Mid and High) were investigated and only the worst case recorded.

Adjusted FS readings compared to Peak Power Spectral Density (worst case) including the 2 dBi Antenna gain with the limit being 30dB below which corresponds to 91.6dB $\mu$ V/m**Frequency Range: 30-1000 MHz**

Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	--			FCC 15.247 (d)		
					Limit (dBm)	Margin (dBm)	Result	Limit (dBuV/m)	Margin (dB)	Result
H	160.0	45.40	-12.70	32.70	---	---	---	91.6	58.90	PASS
V	410.0	47.70	-11.30	36.40	---	---	---	91.6	55.20	PASS
V	430.0	49.10	-11.00	38.10	---	---	---	91.6	53.50	PASS
V	440.0	48.00	-10.80	37.20	---	---	---	91.6	54.40	PASS
V	460.0	47.20	-10.40	36.80	---	---	---	91.6	54.80	PASS
V	564.7	20.00	-8.80	11.20	---	---	---	91.6	80.40	PASS

Note: No emissions found within 10dB of the limit, which was set -30dB down from the peak of Power Spectral Density of the Fundamental frequency (worst case). (See section 15.247(e) – Power Spectral Density) (i.e. Worst Case Conducted Power Spectral Density Reading + Antenna Gain = EIRP then calculated field strength based off of  $P = (Ed)^2/(30G)$ . Field Strength – 30dB = Adjusted Limit dB $\mu$ V/m).

**Radiated Emissions Table - FCC 15.247(d) - restricted band**

Notes: All 3 channels (Low, Mid and High) were investigated and only the worst case recorded.

**Frequency Range: 30-1000 MHz**

Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	--			FCC 15.247 (d)		
					Limit (dBm)	Margin (dBm)	Result	Limit (dBuV/m)	Margin (dB)	Result
H	330.0	42.70	-12.80	29.90	---	---	---	46.0	16.10	PASS
H	610.0	35.80	-7.30	28.50	---	---	---	46.0	17.50	PASS

**Radiated Emissions Table**

Notes: All 3 channels (Low, Mid and High).

**Frequency Range: 1-6 GHz**

Antenna Polarization (H/V)	Frequency (MHz)	Peak Reading (dBuV/m)	Average Reading (dBuV/m)	Factor (dB)	Peak Level (dBuV/m)	Average Level (dBuV/m)	FCC 15.247 (d) - Peak			FCC 15.247 (d) - Average		
							Limit (dBm)	Margin (dBm)	Result	Limit (dBuV/m)	Margin (dB)	Result
V	1842.0	67.70	63.00	4.40	72.10	67.40	91.6	19.5	PASS	71.6	4.20	PASS
V	1843.6	68.40	63.40	4.40	72.80	67.80	91.6	18.8	PASS	71.6	3.80	PASS
V	1846.0	68.70	64.10	4.40	73.10	68.50	91.6	18.5	PASS	71.6	3.10	PASS

Comment: No emission were detected in frequency range 6GHz to 10GHz at the 3 meters distance.

## 4.6 Transmitter Power Spectral Density

### 4.6.1 Measurement procedure

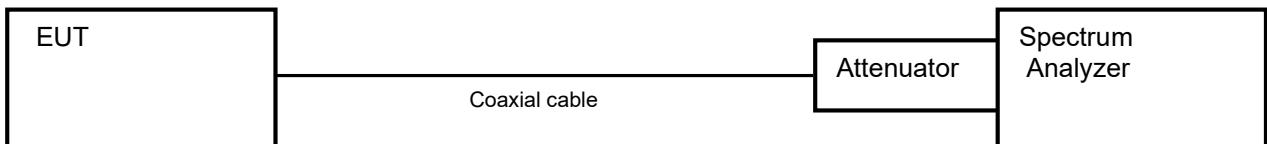
**[FCC 15.247(e), KDB558074 D01 v05r02]**

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to;

- a) Span = 1.5 times the 6 dB bandwidth.
- b) RBW = 3kHz - 100kHz.
- c) VBW  $\geq$  3 x RBW.
- d) Sweep time = auto-couple.
- e) Detector = peak.
- f) Trace mode = max hold.

- Test configuration



### 4.6.2 Limit

The peak power spectral density shall not be greater than 8dBm in any 3kHz band.

#### 4.6.3 Measurement result

Date : 15-July-2020  
 Temperature : 21.5 [°C]  
 Humidity : 59.2 [%]  
 Test place : Shielded room No.4

Test engineer : Chiaki Kanno

#### Body

##### Power Spectral Density

Channel	Center Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	FCC 15.247		
					Limit (dBm)	Margin (dB)	Result
Low	921.0	-6.65	9.94	3.29	8.00	4.71	PASS
Middle	921.8	-6.66	9.94	3.28	8.00	4.72	PASS
High	923.0	-6.56	9.94	3.38	8.00	4.62	PASS

#### Preamplifier

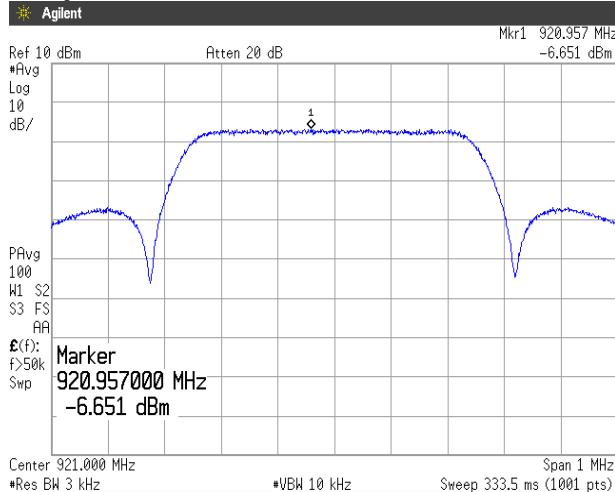
##### Power Spectral Density

Channel	Center Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	FCC 15.247		
					Limit (dBm)	Margin (dB)	Result
Low	921.0	-6.85	9.94	3.09	8.00	4.91	PASS
Middle	921.8	-6.70	9.94	3.24	8.00	4.76	PASS
High	923.0	-6.94	9.94	3.00	8.00	5.00	PASS

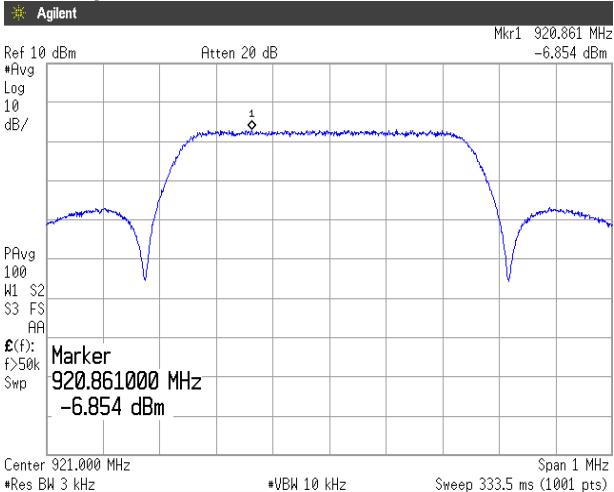
#### 4.6.4 Test data

##### Channel Low

###### Body

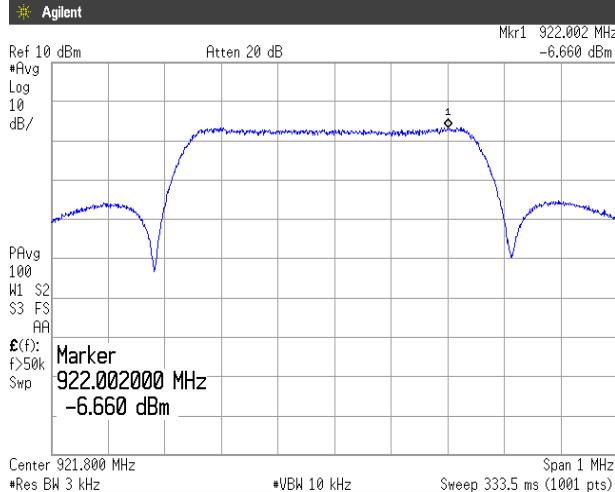


###### Preamplifier

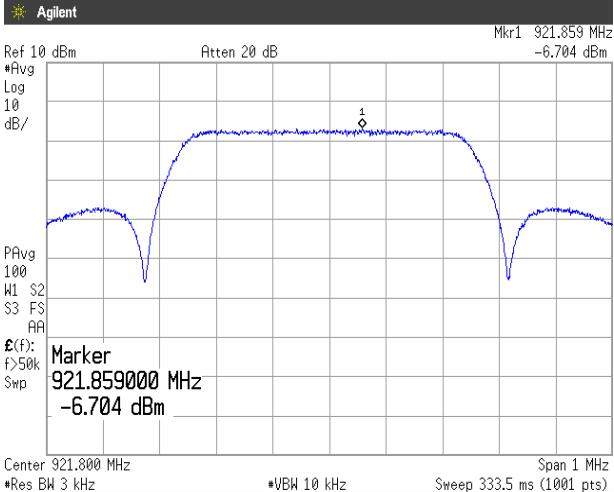


##### Channel Middle

###### Body

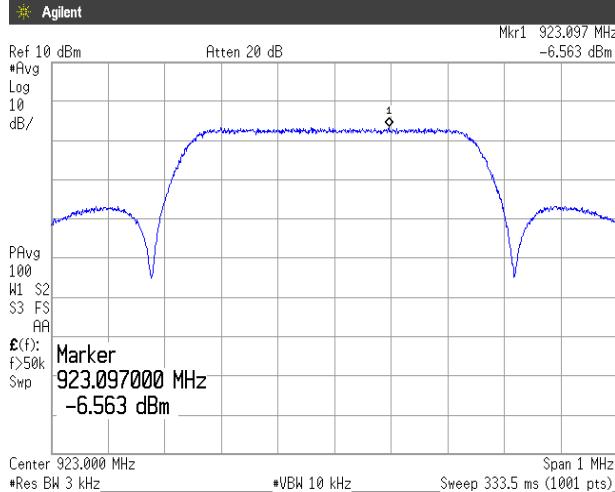


###### Preamplifier

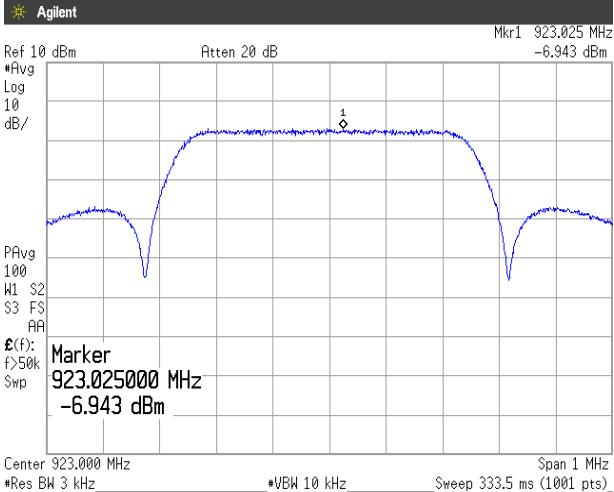


##### Channel High

###### Body



###### Preamplifier



## 4.7 AC Power Line Conducted Emissions

### 4.7.1 Measurement procedure

#### [FCC 15.207]

Test was applied by following conditions.

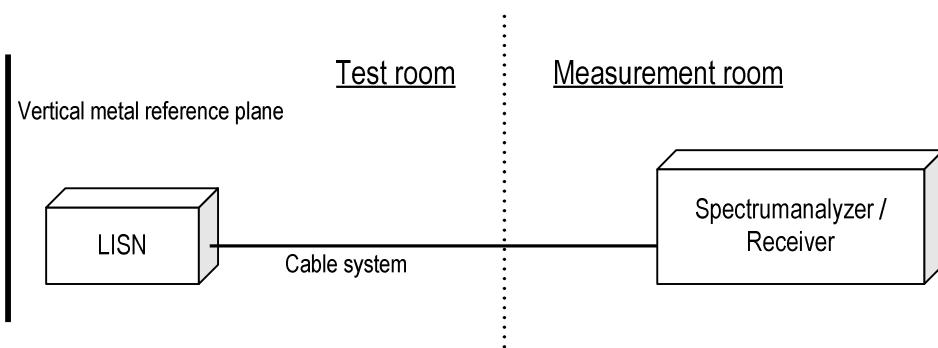
Test method	:	ANSI C63.10
Frequency range	:	0.15 MHz to 30 MHz
Test place	:	3 m Semi-anechoic chamber
EUT was placed on	:	FRP table / (W)2.0 m × (D)1.0 m × (H)0.8 m
Vertical Metal Reference Plane	:	(W)2.0 m × (H)2.0 m 0.4 m away from EUT
Test receiver setting		
- Detector	:	Quasi-peak, Average
- Bandwidth	:	9 kHz

EUT and peripherals are connected to  $50\Omega/50\mu\text{H}$  Line Impedance Stabilization Network (LISN) which are connected to reference ground plane, and are placed 80cm away from EUT. Excess of AC power cable is bundled in center.

LISN for peripheral is terminated in  $50\Omega$ .

EUT operating mode is selected to emit the maximum noise. Overall frequency range is investigated with spectrum analyzer using peak detector. Maximum emission configuration is determined by manipulating the EUT, peripherals, interconnecting cables. Then, emission measurements are performed with test receiver in above setting to each current-carrying conductor of the mains port. Sufficient time for EUT, peripherals and test equipment is provided in order for them to warm up to their normal operating condition. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits.

#### - Test configuration



#### 4.7.2 Calculation method

Emission level = Reading + (LISN. Factor + Cable system loss)

Margin = Limit – Emission level

Example:

Limit @ 6.770 MHz : 60.0 dB $\mu$ V(Quasi-peak)

: 50.0 dB $\mu$ V(Average)

(Quasi peak) Reading = 41.2 dB $\mu$ V c.f = 10.3 dB

Emission level = 41.2 + 10.3 = 51.5 dB $\mu$ V

Margin = 60.0 – 51.5 = 8.5 dB

(Average) Reading = 35.0 dB $\mu$ V c.f = 10.3 dB

Emission level = 35.0 + 10.3 = 45.3 dB $\mu$ V

Margin = 50.0 – 45.3 = 4.7 dB

#### 4.7.3 Limit

Frequency [MHz]	Limit	
	QP [dB $\mu$ V]	AV [dB $\mu$ V]
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

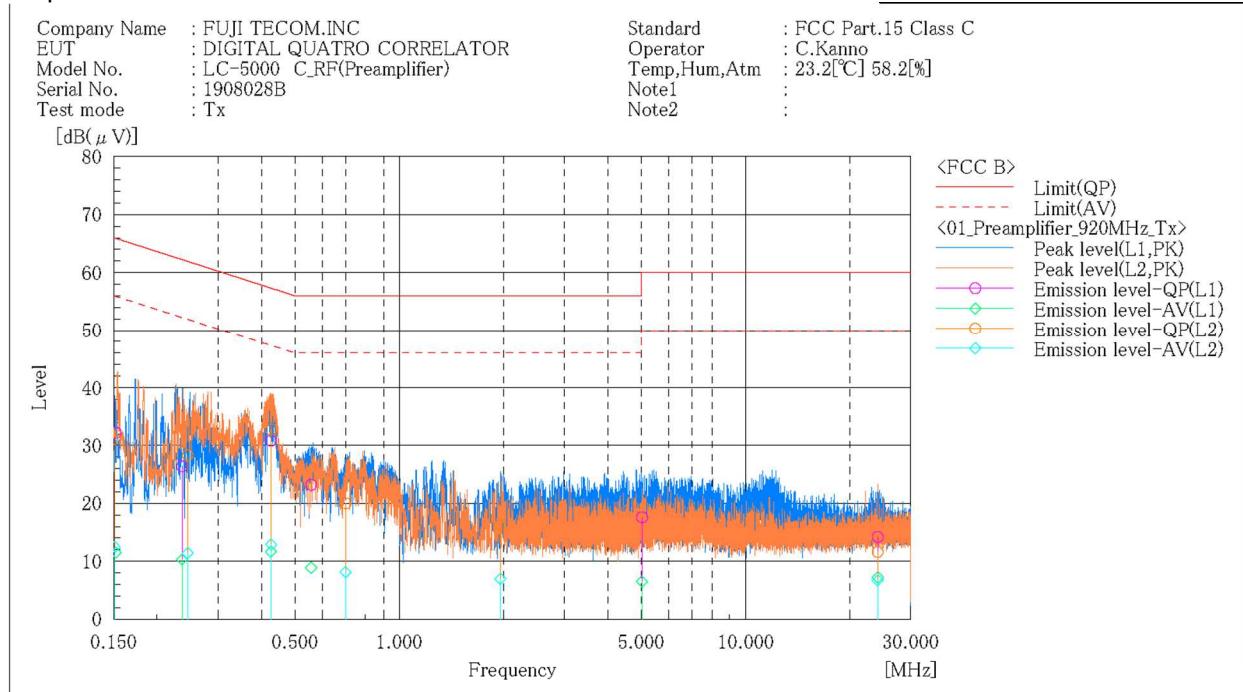
\*: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

#### 4.7.4 Test data

Date : 08-July-2020  
 Temperature : 23.2 [°C]  
 Humidity : 58.2 [%]  
 Test place : 3m Semi-anechoic chamber

Test engineer :

Chiaki Kanno



## Final Result

## --- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c. f	Result QP [dB]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]
1	0.152	21.7	1.0	10.5	32.2	11.5	65.9	55.9	33.7	44.4
2	0.236	16.0	-0.1	10.4	26.4	10.3	62.2	52.2	35.8	41.9
3	0.426	20.4	1.3	10.4	30.8	11.7	57.3	47.3	26.5	35.6
4	0.557	12.8	-1.5	10.4	23.2	8.9	56.0	46.0	32.8	37.1
5	5.018	6.9	-4.2	10.7	17.6	6.5	60.0	50.0	42.4	43.5
6	24.041	2.2	-4.8	12.0	14.2	7.2	60.0	50.0	45.8	42.8

## --- L2 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c. f	Result QP [dB]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]
1	0.151	20.6	2.0	10.5	31.1	12.5	65.9	55.9	34.8	43.4
2	0.245	17.9	1.0	10.4	28.3	11.4	61.9	51.9	33.6	40.5
3	0.427	22.4	2.5	10.4	32.8	12.9	57.3	47.3	24.5	34.4
4	0.700	9.6	-2.3	10.4	20.0	8.1	56.0	46.0	36.0	37.9
5	1.960	5.7	-3.5	10.5	16.2	7.0	56.0	46.0	39.8	39.0
6	24.056	-0.4	-5.3	12.0	11.6	6.7	60.0	50.0	48.4	43.3

## 5 Antenna requirement

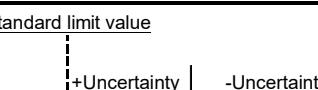
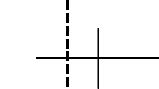
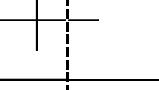
According to FCC section 15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

The antenna is a special antenna mounted inside of the EUT. Therefore, the EUT complies with the antenna requirement of FCC section 15.203.

## 6 Measurement Uncertainty

Expanded uncertainties stated are calculated with a coverage Factor k=2.  
 Please note that these results are not taken into account when measurement uncertainty considerations contained in ETSI TR 100 028 Parts 1 and 2 determining compliance or non-compliance with test result.

Test item	Measurement uncertainty
Conducted emission, AMN (9 kHz – 150 kHz)	±3.8 dB
Conducted emission, AMN (150 kHz – 30 MHz)	±3.4 dB
Radiated emission ( 9kHz – 30 MHz)	±3.9 dB
Radiated emission (30 MHz – 1000 MHz)	±4.9 dB
Radiated emission (1 GHz – 6 GHz)	±4.6 dB
Radiated emission (6 GHz – 18 GHz)	±4.9 dB
Radiated emission (18 GHz – 40 GHz)	±5.8 dB
Radio Frequency	±1.4 * 10 <sup>-8</sup>
RF power, conducted	±0.6 dB
Temperature	±0.6 °C
Humidity	±1.2 %
Voltage (DC)	±0.4 %
Voltage (AC, <10kHz)	±0.2 %

Judge	Measured value and standard limit value		
PASS	Case1		Even if it takes uncertainty into consideration, a standard limit value is fulfilled.
	Case2		Although measured value is in a standard limit value, a limit value won't be fulfilled if uncertainty is taken into consideration.
FAIL	Case3		Although measured value exceeds a standard limit value, a limit value will be fulfilled if uncertainty is taken into consideration.
	Case4		Even if it takes uncertainty into consideration, a standard limit value isn't fulfilled.

## 7 Laboratory Information

Testing was performed and the report was issued at:

### TÜV SÜD Japan Ltd. Yonezawa Testing Center

Address: 5-4149-7 Hachimanpara, Yonezawa-shi, Yamagata, 992-1128 Japan  
Phone: +81-238-28-2881  
Fax: +81-238-28-2888

#### Accreditation and Registration

A2LA  
Certificate #3686.03

VLAC  
Accreditation No.: VLAC-013

BSMI  
Laboratory Code: SL2-IN-E-6018, SL2-A1-E-6018

Innovation, Science and Economic Development Canada  
ISED#: 4224A

#### VCCI Council

Registration number	Expiration date
A-0166	03-July-2021

## Appendix A. Test Equipment

### Antenna port conducted test

Equipment	Company	Model No.	Serial No.	Cal. Due	Cal. Date
Spectrum analyzer	Agilent Technologies	E4440A	US44302655	31-Aug-2020	05-Aug-2019
Attenuator	Weinschel	56-10	J4180	31-Jul-2020	18-Jul-2019
Power meter	ROHDE&SCHWARZ	NRP2	103269	31-Jul-2020	18-Jul-2019
Power sensor	ROHDE&SCHWARZ	NRP-Z81	102467	31-Jul-2020	18-Jul-2019

### Radiated emission

Equipment	Company	Model No.	Serial No.	Cal. Due	Cal. Date
EMI Receiver	ROHDE&SCHWARZ	ESCI	100765	30-Sep-2020	25-Sep-2019
Spectrum analyzer	Agilent Technologies	E4447A	MY46180188	31-Mar-2021	27-Mar-2020
Spectrum analyzer	Agilent Technologies	E4440A	US40420937	30-Sep-2020	26-Sep-2019
Spectrum analyzer	ROHDE&SCHWARZ	FSV40	101732	28-Feb-2021	17-Feb-2020
Preamplifier	SONOMA	310	372170	30-Sep-2020	26-Sep-2019
Loop antenna	ROHDE&SCHWARZ	HFH2-Z2	100515	30-Apr-2021	15-Apr-2020
Attenuator	TOYO Connector	NA-PJ-6	N/A(S507)	31-Dec-2020	18-Dec-2019
Biconical antenna	Schwarzbeck	VHBB9124/BBA9106	1344	31-Dec-2020	04-Dec-2019
Log periodic antenna	Schwarzbeck	VUSLP9111B	345	31-Aug-2020	27-Aug-2019
Attenuator	TOYO Connector	NA-PJ-6	N/A(S507)	31-Dec-2020	18-Dec-2019
Attenuator	TAMAGAWA.ELEC	CFA-10/3dB	N/A(S503)	31-Jul-2020	17-Jul-2019
Preamplifier	TSJ	MLA-100M18-B02-40	1929118	31-Jan-2021	08-Jan-2020
Attenuator	AEROFLEX	26A-10	081217-08	31-Jan-2021	10-Jan-2020
Double ridged guide antenna	ETS LINDGREN	3117	00052315	30-Apr-2021	08-Apr-2020
Attenuator	HUBER+SUHNER	6803.17.B	N/A(2341)	31-Dec-2020	18-Dec-2019
Double ridged guide antenna	A.H.Systems Inc.	SAS-574	469	31-Aug-2020	28-Aug-2019
Preamplifier	TSJ	MLA-1840-B03-35	1240332	31-Aug-2020	28-Aug-2019
Band rejection filter	Micro-Tronics	BRC50702	045	31-May-2021	15-May-2020
Microwave cable	HUBER+SUHNER	SUCOFLEX104/9m	MY30037/4	31-Jan-2021	08-Jan-2020
		SUCOFLEX104/1m	my24610/4	31-Jan-2021	08-Jan-2020
		SUCOFLEX104/8m	SN MY30031/4	31-Jan-2021	09-Jan-2020
		SUCOFLEX104	MY32976/4	31-Jan-2021	08-Jan-2020
		SUCOFLEX104/1.5m	MY19309/4	31-Jan-2021	08-Jan-2020
		SUCOFLEX104/7m	41625/6	31-Jan-2021	08-Jan-2020
PC	DELL	DIMENSION E521	75465BX	N/A	N/A
Software	TOYO Corporation	EP5/RE-AJ	0611193/V5.6.0	N/A	N/A
Absorber	RIKEN	PFP30	N/A	N/A	N/A
3m Semi an-echoic Chamber	TOKIN	N/A	N/A(9002-NSA)	31-May-2021	29-May-2020
3m Semi an-echoic Chamber	TOKIN	N/A	N/A(9002-SVSWR)	31-May-2020	13-May-2019
3m Semi an-echoic Chamber	TOKIN	N/A	N/A(9002-SVSWR)	31-May-2021	29-May-2020

### Conducted emission at mains port

Equipment	Company	Model No.	Serial No.	Cal. Due	Cal. Date
EMI Receiver	ROHDE&SCHWARZ	ESCI	100765	30-Sep-2020	25-Sep-2019
Attenuator	HUBER+SUHNER	6810.01.A	N/A (S411)	31-Jan-2021	08-Jan-2020
Line impedance stabilization network	Kyoritsu Electrical Works, Ltd.	TNW-407F2	12-17-110-2	30-Jun-2021	03-Jun-2020
Coaxial cable	FUJIKURA	5D-2W/4m	N/A (S350)	31-Jan-2021	08-Jan-2020
Coaxial cable	FUJIKURA	5D-2W/1m	N/A (S193)	31-Jan-2021	08-Jan-2020
Coaxial cable	HUBER+SUHNER	RG214/U/10m	N/A (S194)	31-Jan-2021	08-Jan-2020
PC	DELL	DIMENSION	75465BX	N/A	N/A
Software	TOYO Corporation	EP5/CE-AJ	0611193/V5.4.11	N/A	N/A

\*: The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.

## Appendix B. Duty Cycle

### [Plot & Calculation]

