

TEST REPORT



DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1904-0078
2. Customer
 - Name : COMMAX Co., Ltd.
 - Address : 494 Dunchon-Daero, Jungwon-Gu, Seongnam-si, Gyeonggi-do, South Korea 13229
3. Use of Report : Verification for simultaneous transmission
4. Product Name / Model Name : Microwave Sensor / EZ-HS301
FCC ID : CCEEZ-HS301
5. Test Method Used : ANSI C63.10-2013
Test Specification : FCC Part 15.225, Part 15.247, Part 15.245
6. Date of Test : 2018.03.18 ~ 2019.04.03
7. Testing Environment : Refer to appended test report.
8. Test Result : Refer to the attached test result.

Affirmation	Tested by	Technical Manager
	Name : SunGeun Lee (Signature)	Name : GeunKi Son (Signature)

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2019 . 04 . 04 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRTFCC1904-0078	Apr. 04, 2019	Initial issue

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1. GENERAL INFORMATION

FCC Equipment Class	Field Disturbance Sensor(FDS)
EUT	Microwave Sensor
Model Name	EZ-HS301
Model name for host device - 1	CIOT-L7FM
Model name for host device - 2	CIOT-L20M
Serial Number	Identical prototype
Power Supply(Host device)	DC 14V

2. INTRODUCTION

2.1 EUT DESCRIPTION

The module was installed into host product during test. And the host product is integrated other granted modules(FCC ID: CCEMD8107F70001, FCC ID: CCECRM-1356B).

2.2. HOST DEVICE CAPABILITIES

The host device contains the following capabilities:

Model name for host device	Capabilities		
CIOT-L7FM	Microwave sensor (FCC ID: CCEEZ-HS301)	Bluetooth LE (FCC ID: CCEMD8107F70001)	NFC (FCC ID: CCECRM-1356B)
CIOT-L20M	Microwave sensor (FCC ID: CCEEZ-HS301)	Bluetooth LE (FCC ID: CCEMD8107F70001)	NFC (FCC ID: CCECRM-1356B)

2.3. Scenario for simultaneous operations

CIOT-L7FM: Microwave sensor + Bluetooth LE + NFC

CIOT-L20M: Microwave sensor + Bluetooth LE + NFC

2.4. Test mode description and Worst case

The EUT has been tested in a combination of simultaneous operation based on module worst case data. And the worst case data was reported.

2.5. TESTING ENVIRONMENT

Ambient Condition	
▪ Temperature	+20 °C ~ +24 °C
▪ Relative Humidity	38 % ~ 43 %

2.6 MEASURING INSTRUMENT CALIBRATION

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.

2.7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
Radiated Disturbance (Below 1 GHz)	5.1 dB (The confidence level is about 95 %, $k = 2$)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, $k = 2$)
Radiated Disturbance (Above 18 GHz)	5.3 dB (The confidence level is about 95 %, $k = 2$)

2.8. TEST FACILITY

DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The site is constructed in conformance with the requirements.

- FCC MRA Accredited Test Firm No. : KR0034

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3. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit Note 2	Test Condition	Status Note 1
15.225(d) 15.245 15.247(d) 15.205 15.209	Radiated spurious emissions	15.225(d), 15.245, 15.247(d), 15.209 limits	Radiated	C
Note 1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable Note 2: The limit was applied the highest level allowed by other rule part.				

4. DESCRIPTION OF TESTS

4.1 Radiated spurious emissions

Requirements, §15.225, §15.247, §15.245, §15.205, §15.209

- Part 15.225

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

- Part 15.247

(d) 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)).

- Part 15.245

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency (MHz)	Limit @ 3m	
	Field strength of fundamental(mV/m)	Field strength of harmonics(mV/m)
902 ~ 908	500	1.6
2435 ~ 2465	500	1.6
5785 ~ 5815	500	1.6
10500 ~ 10550	2500	25.0
24075 ~ 24175	2500	25.0

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

- (i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.
 - (ii) For all other field disturbance sensors, 7.5 mV/m.
 - (iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).
- (2) Field strength limits are specified at a distance of 3 meters.
- (3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

- Part 15.209

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

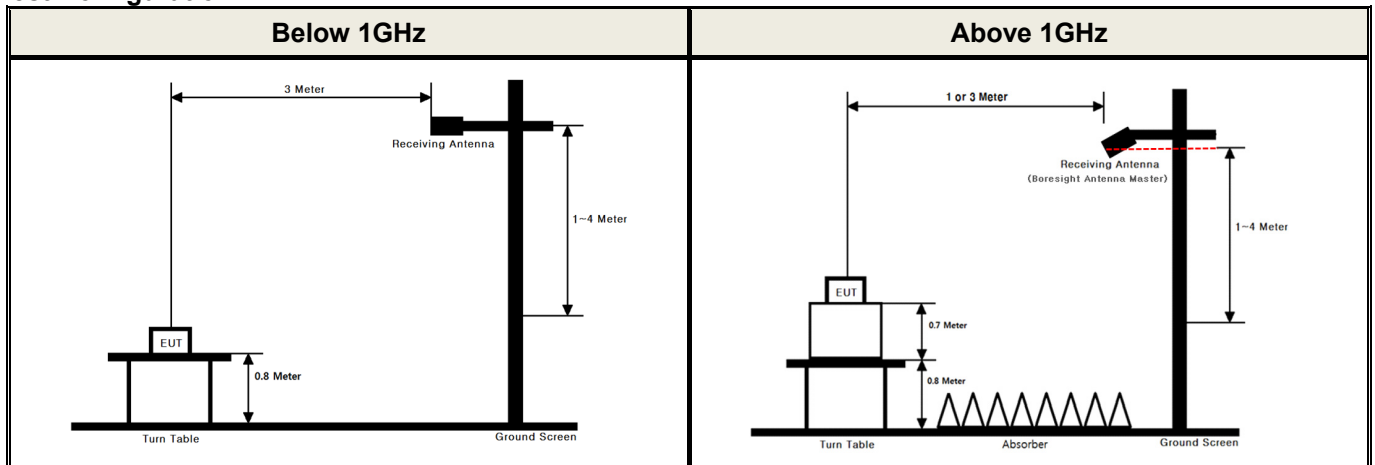
- Part 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.25	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
6.215 ~ 6.218	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.26775 ~ 6.26825	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.31175 ~ 6.31225	123 ~ 138	2200 ~ 2300	14.47 ~ 14.5
8.291 ~ 8.294	149.9 ~ 150.05	2310 ~ 2390	15.35 ~ 16.2
8.362 ~ 8.366	156.52475 ~ 156.52525	2483.5 ~ 2500	17.7 ~ 21.4
8.37625 ~ 8.38675	156.7 ~ 156.9	2690 ~ 2900	22.01 ~ 23.12
8.41425 ~ 8.41475	162.0125 ~ 167.17	3260 ~ 3267	23.6 ~ 24.0
12.29 ~ 12.293	167.72 ~ 173.2	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	240 ~ 285	3345.8 ~ 3358	36.43 ~ 36.5
12.57675 ~ 12.57725	322 ~ 335.4	3600 ~ 4400	Above 38.6
13.36 ~ 13.41			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

Test Configuration



Test Procedure

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The table was rotated 360 degrees to determine the position of the highest radiation.
3. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
4. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
5. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
6. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
7. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
8. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note: Measurement Instrument Setting for Radiated Emission Measurements.

1. Frequency Range Below 1GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak
2. Frequency Range Range > 1 GHz
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes
Average Measurement> 1GHz
RBW = 1MHz, VBW $\geq 1/T$, Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes

TM1 (CIOT-L7FM)

	Capability	Operation mode
Simultaneous operation mode	Microwave sensor	Continuous transmitting at 10.525GHz
	Bluetooth LE	Continuous transmitting at 2480MHz
	NFC	Continuous transmitting at 13.56MHz

Test Results: Comply

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
134.76	V	Y	QP	44.00	-7.00	N/A	N/A	37.00	43.50	6.50
197.81	H	Y	QP	44.70	-9.20	N/A	N/A	35.50	43.50	8.00
296.75	H	Y	QP	45.33	-5.30	N/A	N/A	40.03	46.00	5.97
335.55	H	Y	QP	44.70	-4.30	N/A	N/A	40.40	46.00	5.60
351.07	H	Y	QP	42.04	-4.10	N/A	N/A	37.94	46.00	8.06
405.39	V	Y	QP	42.94	-2.80	N/A	N/A	40.14	46.00	5.86
8044.17	H	Y	PK	49.50	7.67	N/A	N/A	57.17	74.00	16.83
8043.94	H	Y	AV	45.34	7.67	N/A	N/A	53.01	54.00	0.99
10496.08	H	Y	PK	44.62	10.74	N/A	N/A	55.36	74.00	18.64
10495.67	H	Y	AV	33.91	10.74	N/A	N/A	44.65	54.00	9.35
10558.72	H	Y	PK	44.98	10.83	N/A	N/A	55.81	74.00	18.19
10558.20	H	Y	AV	33.94	10.83	N/A	N/A	44.77	54.00	9.23
13003.19	H	Y	PK	44.86	14.73	N/A	N/A	59.59	74.00	14.41
13003.39	H	Y	AV	36.32	14.73	N/A	N/A	51.05	54.00	2.95
18567.04	V	Y	PK	42.70	1.86	N/A	-9.54	35.02	74.00	38.98
18567.25	V	Y	AV	32.40	1.86	N/A	-9.54	24.72	54.00	29.28
21046.76	H	Y	PK	53.85	6.93	N/A	-9.54	51.24	97.50	46.26
21046.00	H	Y	AV	53.51	6.93	N/A	-9.54	50.90	77.50	26.60
23526.56	V	Y	PK	41.50	7.19	N/A	-9.54	39.15	74.00	34.85
23526.25	V	Y	AV	33.27	7.19	N/A	-9.54	30.92	54.00	23.08
-	-	-	-	-	-	-	-	-	-	-

Note.

1. The radiated emissions were investigated 9 kHz to 53 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, above 18GHz measurements were performed at a distance closer than the specified distance.

In this case, the distance factor is applied to the result. Calculation of distance factor = $20 \log(d_{\text{test}} / d_{\text{limit}})$

$20 \log(1 \text{ m} / 3 \text{ m}) = -9.54 \text{ dB}$, $20 \log(0.35 \text{ m} / 3 \text{ m}) = -18.66 \text{ dB}$

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + DCCF + DCF / T.F = AF + CL – AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

= Duty Cycle Correction Factor, DCF = Distance Correction Factor

TM2 (CIOT-L20M)

	Capability	Operation mode
Simultaneous operation mode	Microwave sensor	Continuous transmitting at 10.525GHz
	Bluetooth LE	Continuous transmitting at 2480MHz
	NFC	Continuous transmitting at 13.56MHz

Test Results: Comply

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
296.75	H	Y	QP	47.70	-5.30	N/A	N/A	42.40	46.00	3.60
351.07	H	Y	QP	44.60	-4.10	N/A	N/A	40.50	46.00	5.50
405.39	H	Y	QP	46.00	-2.80	N/A	N/A	43.20	46.00	2.80
567.03	V	Y	QP	42.91	0.40	N/A	N/A	43.31	46.00	2.69
720.63	H	Y	QP	29.30	3.20	N/A	N/A	32.50	46.00	13.50
8043.03	H	Y	PK	46.88	7.67	N/A	N/A	54.55	74.00	19.45
8043.14	H	Y	AV	40.08	7.67	N/A	N/A	47.75	54.00	6.25
10491.43	H	Y	PK	44.30	10.73	N/A	N/A	55.03	74.00	18.97
10491.40	H	Y	AV	33.71	10.73	N/A	N/A	44.44	54.00	9.56
10569.18	H	Y	PK	45.16	10.85	N/A	N/A	56.01	74.00	17.99
10570.74	H	Y	AV	34.12	10.85	N/A	N/A	44.97	54.00	9.03
13002.02	H	Y	PK	44.27	14.73	N/A	N/A	59.00	74.00	15.00
13002.49	H	Y	AV	34.14	14.73	N/A	N/A	48.87	54.00	5.13
18565.76	H	Y	PK	43.54	1.85	N/A	-9.54	35.85	74.00	38.15
18566.44	H	Y	AV	34.98	1.85	N/A	-9.54	27.29	54.00	26.71
21046.05	V	Y	PK	54.80	6.93	N/A	-9.54	52.19	97.50	45.31
21046.14	V	Y	AV	53.75	6.93	N/A	-9.54	51.14	77.50	26.36
23525.69	V	Y	PK	42.41	7.19	N/A	-9.54	40.06	74.00	33.94
23525.74	V	Y	AV	35.72	7.19	N/A	-9.54	33.37	54.00	20.63
-	-	-	-	-	-	-	-	-	-	-

Note.

1. The radiated emissions were investigated 9 kHz to 53 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, above 18GHz measurements were performed at a distance closer than the specified distance.

In this case, the distance factor is applied to the result. Calculation of distance factor = $20 \log(d_{\text{test}} / d_{\text{limit}})$

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3. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + DCCF + DCF / T.F = AF + CL – AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

5. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/07/09	19/07/09	MY46471251
Spectrum Analyzer	Agilent Technologies	N9030A	18/07/09	19/07/09	MY53310140
Spectrum Analyzer	Rohde Schwarz	FSW67	18/08/16	19/08/16	104037
EMI Test Receiver	Rohde Schwarz	ESR7	19/01/30	20/01/30	101061
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
Signal Generator	ANRITSU	MG3695C	18/12/20	19/12/20	173501
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-2
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	18/07/13	20/07/13	3359
HORN ANT	ETS	3117	18/05/10	20/05/10	00140394
HORN ANT	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
HORN ANT	MI Wave	RX ANT-5 261U + 410U	17/08/31	19/08/31	4
High-pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	18/07/05	19/07/05	3
High-pass filter	Wainwright	WHNX8.5/26.5G-6SS	18/07/03	19/07/03	1
PreAmplifier	H.P	8447D	18/12/18	19/12/18	2944A07774
PreAmplifier	Agilent	8449B	18/07/05	19/07/05	3008A02108
PreAmplifier	tsj	MLA-1840-J02-45	18/07/06	19/07/06	16966-10728
PreAmplifier	Norden Millimeter Inc	NA4060G50N8P12	18/12/21	19/12/21	1003
Cable	Radiall	TESTPRO3	18/07/06	19/07/06	M-01
Cable	HUBER+SUHNER	SUCOFLEX 104	18/07/06	19/07/06	M-03
Cable	Junkosha	MWX315	18/11/19	19/11/19	M-05
Cable	Junkosha	MWX221	18/11/19	19/11/19	M-06
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-4
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-7
Cable	DT&C	CABLE	18/07/06	19/07/06	G-13
Cable	DT&C	CABLE	18/07/06	19/07/06	G-14
Cable	HUBER+SUHNER	SUCOFLEX104	18/07/06	19/07/06	G-15
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-8
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-10

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

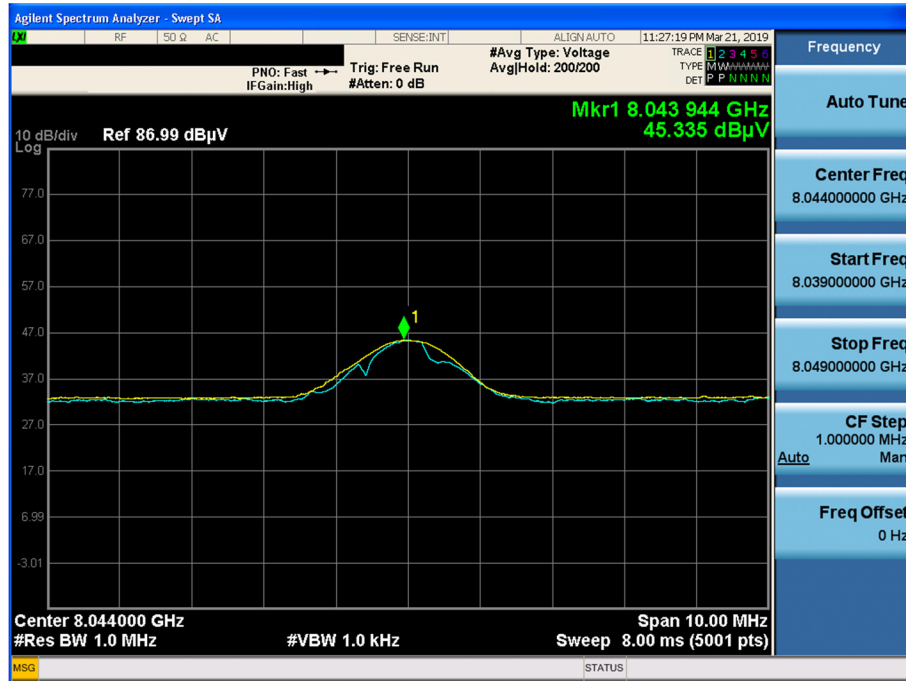
Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

APPENDIX I

Worst-case plots(Reading Value)

Unwanted emission & TM 1(CIOT-L7FM) & Y axis & Hor

Detector Mode : AV



Unwanted emission & TM 2(CIOT-L20M) & Y axis & Ver

Detector Mode : QP

