

TEST REPORT



Test Report Number: N2404R-0691-01

Applicant: MTS

Address of Applicant: #607, 200, Gieopdosi-ro, Jijeong-myeon, Wonju-si, Gangwon-do, Republic of Korea

Manufacturer: MTS

Address of Manufacturer/Factory: #607, 200, Gieopdosi-ro, Jijeong-myeon, Wonju-si, Gangwon-do, Republic of Korea

Equipment Under Test (EUT)

Product Name: Endoscope Auto Leak Tester

Model No.: ELT-2000

■ FCC ID : 2BFWV-ELT-2000 □ IC

Applicable standards: FCC CFR Title 47 Part 15 Subpart C (15.225)
ANSI C63.10-2013

Date of Test: April 04, 2024 to April 25, 2024

Date of report issued: June 10, 2024

Test Result: Compliance *

* In the configuration tested, the EUT complied with the standards specified above.

Prepared By:



Date:

June 10, 2024

YURA OH
(TEST ENGINEER)

Check By:



Date:

June 10, 2024

DONGJIN SEO
(Reviewer)

Laboratory Manager

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REPORT REVISION HISTORY

Date	Revision	Page No
2024-04-25	Originally Issued	-
2024-06-10	Revised Voltage	4

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1. General Information

1.1 General Description of EUT

Product Name:	Endoscope Auto Leak Tester
Model No.:	ELT-2000
Variant Model No.:	N/A
Operation Frequency:	13.56 MHz 2 402 ~ 2 480 MHz
Channel numbers:	NFC: 1 Channel Bluetooth: 40ch
Modulation technology:	NFC: ASK Bluetooth: F1D
Antenna Specification:	PCB Pattern Antenna
Power source	AC 100 ~ 220 V (and DC 3.7 V Battery)

* ELT-2000 uses certified Bluetooth module.

1.2 Channel list

Operation Frequency each of channel	
Channel	Frequency
1	13.560 MHz

1.3 Test condition

	Normal voltage
AC Power	100 ~ 220

1.4 Test Summary

Section in FCC Part 15 & 2	Parameter	Test results
15.225(a)	The field strength of fundamental	Pass
15.225(b)(c)	The field strength of spurious emission (In-band)	Pass
15.225(d) 15.209	The field strength of spurious emission (Out-band)	Pass
2.1049	20 dB bandwidth	Pass
15.225(e)	Frequency stability	Pass
15.207(a)	AC Power Line Conducted Emission	Pass
Notice. Bluetooth module has a certification already. Therefore, Bluetooth test is exempted, except spurious emission.		

1.5 Test Perfomed

RRA Designation No.: KR0157

KOLAS Accreditation No. : KT511

Laboratory NTREE Co., Ltd.

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Telephone : +82-33-747-4499

Facsimile : +82-70-5176-2117

SITE MAP

1st laboratory



2nd laboratory



1.6 Test Instruments list

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal.Due date (yy-mm-dd)
1	Temp/Humid Chamber	LABHOUSE	S-P-THC-81R-G	220830-00019-02	2023-12-13	2024-12-13
2	Test Receiver	ROHDE & SCHWARZ	ESW44	101583	2024-03-19	2025-03-19
3	AMPLIFIER	TESTEK	TK-PA01S	200103-L	2023-11-01	2024-11-01
4	Tri-Log Antenna	Schwarzbeck	VULB 9168	9168-578	2023-10-13	2024-10-13
5	LOOP ANTENNA	Schwarzbeck	FMZB1519	1519-051	2024-03-24	2026-03-24
6	Signal Analyzer	ROHDE & SCHWARZ	FSV40	101580	2024-02-27	2025-02-27
7	DOUBLE RIDGED BROADBAND HORN ANTENNA	ROHDE & SCHWARZ	BBHA 9120D	02083	2023-10-13	2024-10-13
8	AMPLIFIER	TESTEK	TK-PA18H	160006-L	2024-03-07	2025-03-07
9	AMPLIFIER	TESTEK	TK-PA1840H	140003	2024-03-08	2025-03-08
10	BROADBAND HORN ANTENNA	Schwarzbeck	BBHA 9170	BBHA9170 574	2024-03-08	2025-03-08

1.7 Measurement uncertainty

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR100028-1 [2] and shall correspond to an expansion factor (coverage factor) $k=1.96$ or $k=2$ (which provide confidence levels of respectively 95% and 95.5% in the case where the distributions characterizing the actual measurement uncertainties are normal.

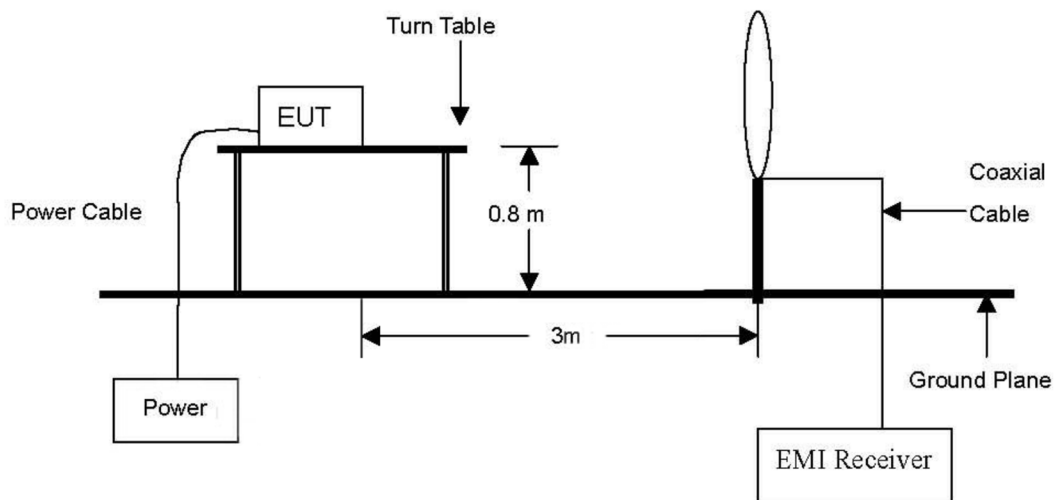
Parameter	Uncertainty
Transmitter output power (Conducted)	± 1.77 dB
AC Conducted emission	± 2.0 dB
Radiated spurious emission (Below 1 GHz)	± 5.1 dB
Radiated spurious emission (Above 1 GHz)	± 5.1 dB

2. Test Result

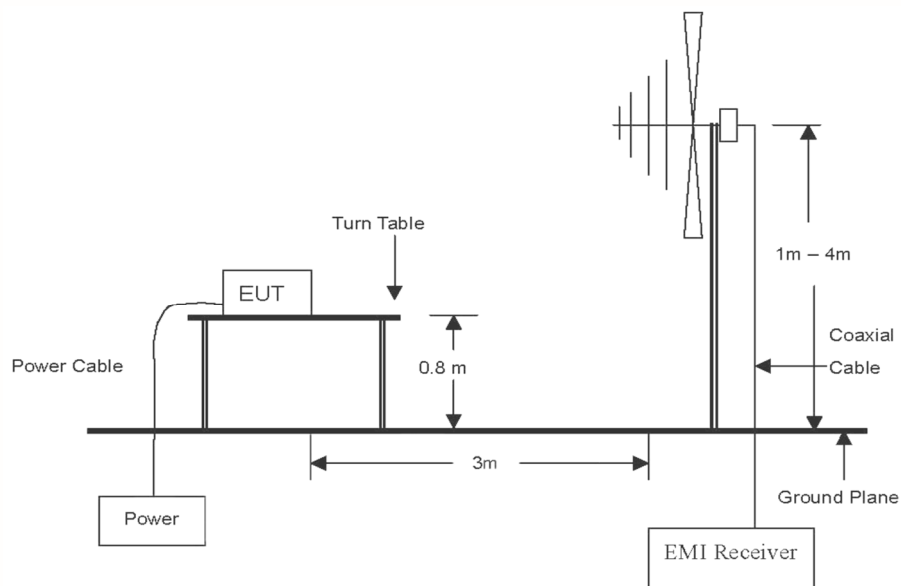
2.1 Spurious Emissions

Test setup

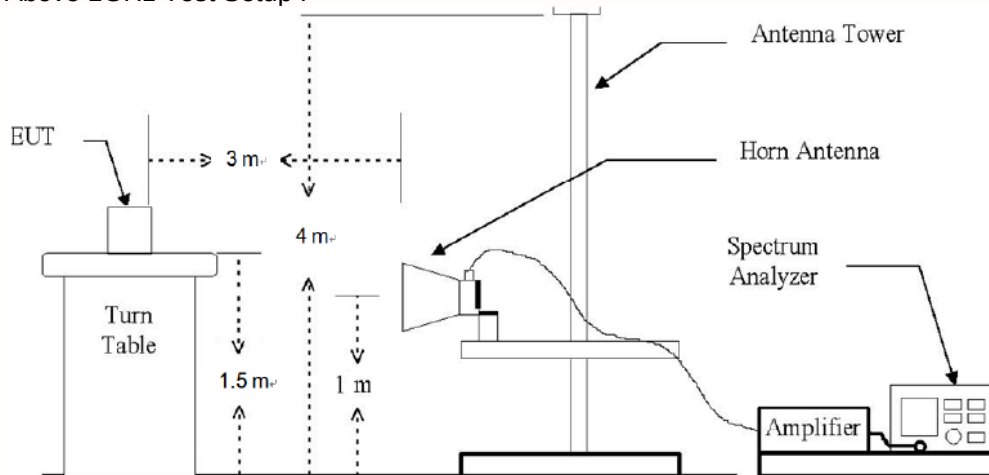
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



Above 1GHz Test Setup :



Test procedure

[9 kHz to 30 MHz]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 Hz for Quasi-peak detection (QP) at frequency below 9 kHz~ 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 kHz for Quasi-peak detection (QP) at frequency below 150 kHz~ 30 MHz.

[30 MHz to 1 GHz]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.

[1 GHz to 26.5 GHz]

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements. (Restricted bandedge, Final detection of spurious harmonic emissions)

Duty cycle factor = $10 \log(1/x)$. For this sample: DCF = $10\log(1/0.62)=2.06$ dB(Spectrum Analyzer round it up to 2.06 dB).

$1/T$ minimum VBW = $1/\text{Duty cycle}$. For this sample: minimum VBW = $1/0.38 = 0.01$ kHz

Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.

The spectrum from 1 GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

(From 30 MHz to 1 GHz, test was performed with the EUT set to transmit at the channel with highest output power)

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth.

The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Note.

According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz.

Although these test were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area 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 414788.

Limit

FCC Part 15 Subpart C paragraph 15.247(a) Limit

Fundamental Frequency (MHz)	Field Strength of Harmonics (3 m)		
	(mV/m)	(dBuV/m)	
2400 - 2483.5	500	54 (Avg.)	74 (Peak)

Note : 1. RF Field Strength (dBuV) = 20log RF Voltage(uV)

2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

3. The emission limit in this paragraph is based on measurement instrumentation employing an average detector

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated ($\mu\text{V/m}$)
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**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., Sections 15.231 and 15.241.

In the section 15.225:

- (a) The field strength of any emissions within the band 13.553 ~ 13.567 MHz shall not exceed 15,848 microvolts/meter (= 84 dB $\mu\text{V/m}$) at 30 meters.
- (b) Within the bands 13.410 ~ 13.553 MHz and 13.567 ~ 13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter (=50.5 dB $\mu\text{V/m}$) at 30 meters.
- (c) Within the bands 13.110 ~ 13.410 MHz and 13.710 ~ 14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter (=40.5 dB $\mu\text{V/m}$) at 30 meters.
- (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.

Test results for fundamental

Operating frequency: 13.560 MHz

Distance of measurement: 3 meter

Test results for in-band (9 kHz to 30 MHz)

Radiated emissions		Ant.	Total factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Pol.	Correction factor (dB/m)	Distance factor (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
13.359	10.87	H	19.80	40	-9.33	40.50	49.83
13.519	10.15	H	20.00	40	-9.85	50.50	60.35
13.558**	35.54	H	20.00	40	15.54	840	68.46
13.662	9.75	H	20.10	40	-10.15	50.50	60.65
13.864	8.92	H	20.20	40	-10.88	40.50	51.38

Note.

1. " ** " is fundamental.
2. All measurements were performed using a loop antenna. The antenna was positioned in three orthogonal positions (H : parallel, V : perpendicular, G : ground-parallel)
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. Measurements were performed at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)(2). Extrapolation Factor = $20 \log_{10}(30/3)^2 = 40$ dB.
5. All measurements were recorded using a spectrum analyzer employing a peak detector.
6. Actual = Reading + Correction factors(Ant. factor + Cable loss) - Distance factor
7. Margin [dB] = Limit [dB μ V/m] - Field Strength Level [dB μ V/m]

Test results (9 kHz to 30 MHz)

Parallel

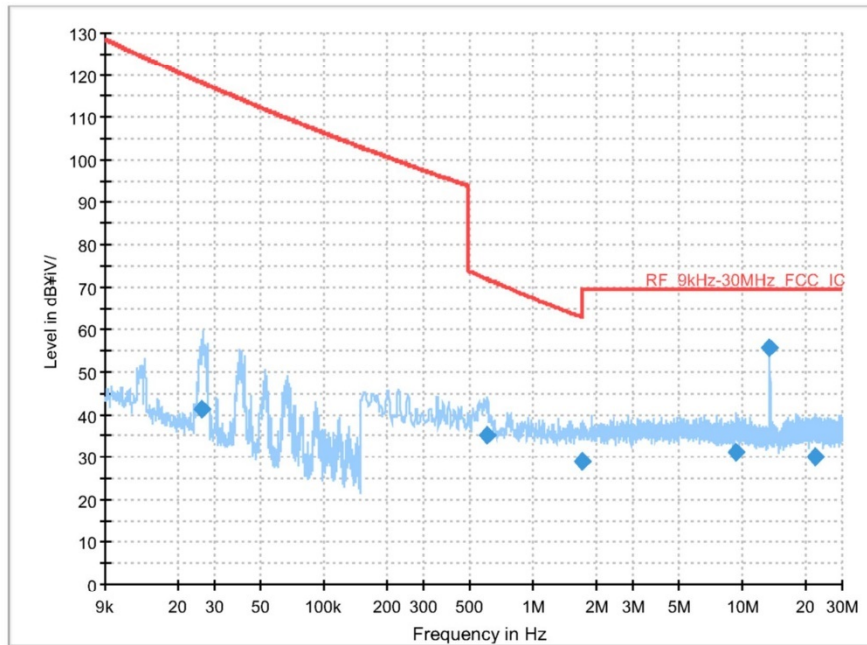
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description:	A2023-14190
Test Mode:	Operating Mode
Environment Conditions:	Input AC 220 V / Temp 21.8 Humi 54.6
Operator Name:	YURA OH
Comment:	Parallel



Final Result

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Comment
0.026164	41.39	118.14	76.75	1000.0	0.200	H	281.0	3:29:36 PM - 4/4/2024
0.604639	35.12	71.86	36.74	1000.0	9.000	H	2.0	3:30:23 PM - 4/4/2024
1.703348	29.07	63.01	33.94	1000.0	9.000	H	208.0	3:30:58 PM - 4/4/2024
9.364466	31.15	69.50	38.35	1000.0	9.000	H	6.0	3:31:33 PM - 4/4/2024
13.559539	55.81	69.50	13.69	1000.0	9.000	H	259.0	3:32:15 PM - 4/4/2024
22.237852	30.10	69.50	39.40	1000.0	9.000	H	130.0	3:32:40 PM - 4/4/2024

Test results (9 kHz to 30 MHz)

Perpendicular

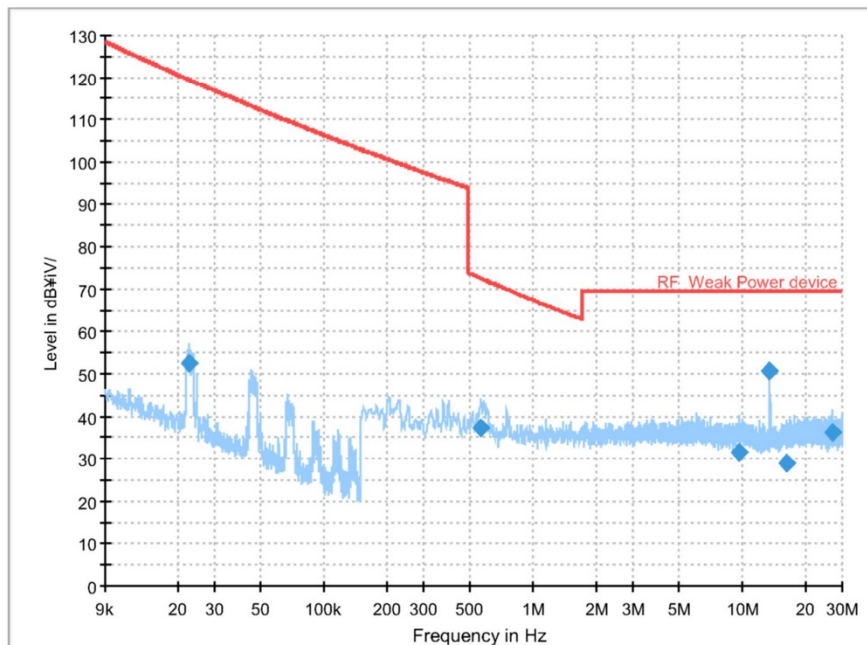
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Environment Conditions: Input AC 220 V / Temp 21.8 Humi 54.6
 Operator Name: Perpendicular
 Comment:



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Comment
0.022612	52.38	119.47	58.57	1000.0	0.200	H	305.0	3:41:05 PM - 4/4/2024
0.561012	37.14	72.53	35.39	1000.0	9.000	H	253.0	3:41:22 PM - 4/4/2024
9.576860	31.59	69.50	37.91	1000.0	9.000	H	1.0	3:42:03 PM - 4/4/2024
13.558390	50.67	69.50	18.83	1000.0	9.000	H	353.0	3:42:58 PM - 4/4/2024
16.310331	29.15	69.50	40.35	1000.0	9.000	H	97.0	3:43:40 PM - 4/4/2024
27.117179	36.07	69.50	33.43	1000.0	9.000	H	5.0	3:44:01 PM - 4/4/2024

Test results (9 kHz to 30 MHz)

Ground-parallel

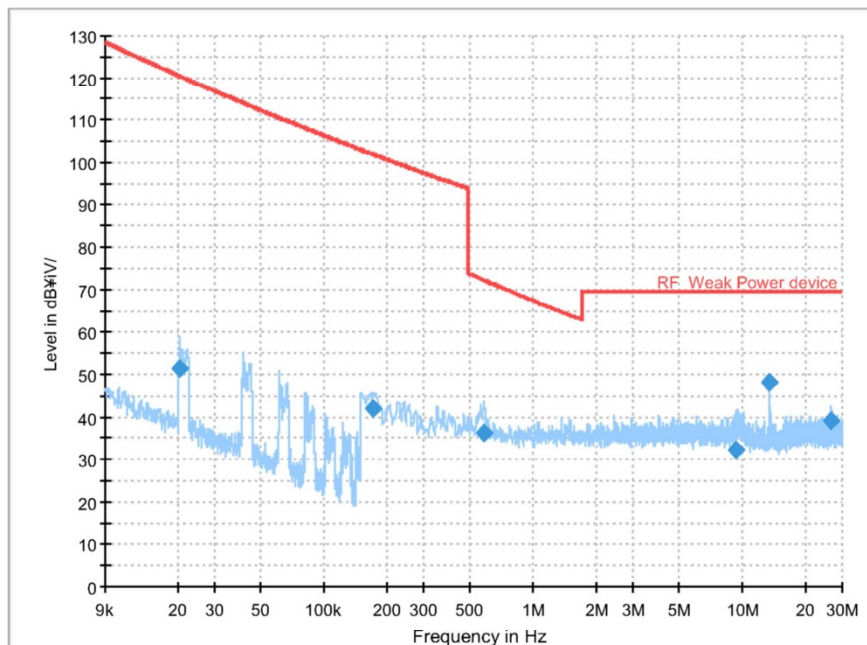
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Environment Conditions: Input AC 220 V / Temp 21.8 Humi 54.6
 Operator Name: Ground
 Comment:



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Comment
0.020459	51.55	120.44	68.89	1000.0	0.200	H	263.0	4:09:58 PM - 4/4/2024
0.172962	41.92	101.87	59.95	1000.0	9.000	H	275.0	4:10:09 PM - 4/4/2024
0.585121	36.18	72.14	35.96	1000.0	9.000	H	85.0	4:10:42 PM - 4/4/2024
9.352985	32.07	69.50	37.43	1000.0	9.000	H	333.0	4:11:24 PM - 4/4/2024
13.558390	48.08	69.50	21.42	1000.0	9.000	H	252.0	4:11:42 PM - 4/4/2024
26.609729	39.19	69.50	30.31	1000.0	9.000	H	260.0	4:11:51 PM - 4/4/2024

Test results (In band)

Parallel

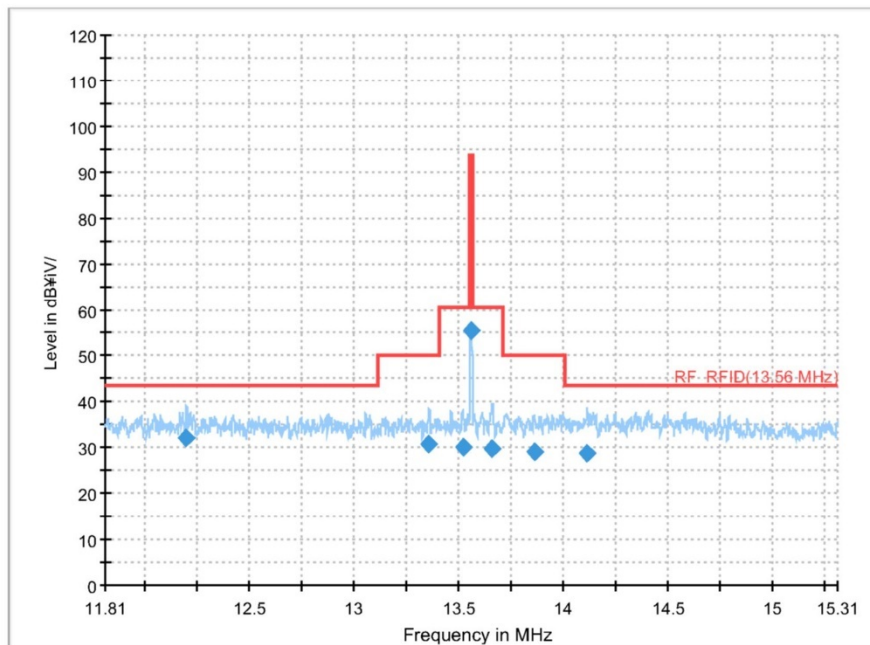
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description:	A2023-14190
Test Mode:	Operating Mode
Environment Conditions:	Input AC 220 V / Temp 21.8 Humi 54.6
Operator Name:	YURA OH
Comment:	Parallel, Inband



Final Result

Frequency (MHz)	Quasi Peak (dBμV/ m)	Limit (dBμV/ m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Po I	Azimuth (deg)	Corr. (dB/m)	Comment
12.1991	31.94	43.50	11.56	1000.0	9.000	H	3.0	20.0	4:31:39 PM - 4/4/2024
13.3586	30.67	50.00	19.33	1000.0	9.000	H	180.0	19.8	4:32:11 PM - 4/4/2024
13.5194	30.15	60.50	30.35	1000.0	9.000	H	114.0	20.0	4:32:27 PM - 4/4/2024
13.5584	55.54	93.50	37.96	1000.0	9.000	H	268.0	20.0	4:32:55 PM - 4/4/2024
13.6617	29.85	60.50	30.65	1000.0	9.000	H	99.0	20.1	4:33:25 PM - 4/4/2024
13.8638	29.12	50.00	20.88	1000.0	9.000	H	0.0	20.2	4:33:46 PM - 4/4/2024
14.1129	28.80	43.50	14.70	1000.0	9.000	H	276.0	20.4	4:34:31 PM - 4/4/2024

Test results (In band)

Perpendicular

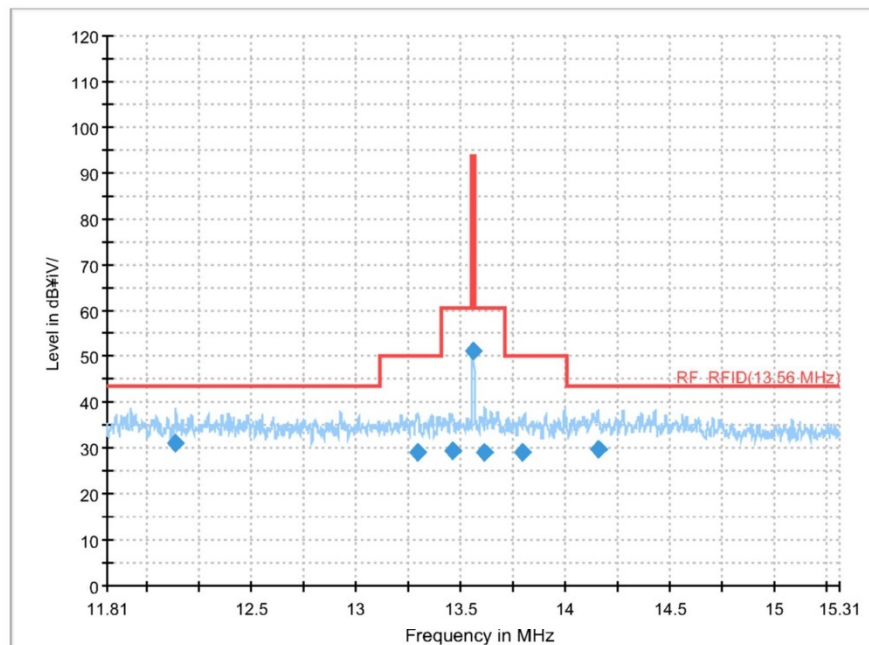
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Environment Conditions: Input AC 220 V / Temp 21.8 Humi 54.6
 Operator Name: YURA OH
 Comment: Perpendicular, Inband



Final Result

Frequency (MHz)	Quasi Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Azimuth (deg)	Corr. (dB/m)	Comment
12.1348	30.98	43.50	12.52	1000.0	9.000	H	160.0	20.1	4:42:50 PM - 4/4/2024
13.2955	28.97	50.00	21.03	1000.0	9.000	H	0.0	19.8	4:43:19 PM - 4/4/2024
13.4585	29.36	60.50	31.14	1000.0	9.000	H	102.0	19.9	4:43:40 PM - 4/4/2024
13.5584	51.03	93.50	42.47	1000.0	9.000	H	353.0	20.0	4:44:21 PM - 4/4/2024
13.6158	29.15	60.50	31.35	1000.0	9.000	H	168.0	20.0	4:44:53 PM - 4/4/2024
13.7960	28.98	50.00	21.02	1000.0	9.000	H	288.0	20.2	4:45:17 PM - 4/4/2024
14.1554	29.73	43.50	13.77	1000.0	9.000	H	325.0	20.4	4:45:29 PM - 4/4/2024