

47 CFR Part 15 Subpart C

Section 15.249

Test Report

Product : Transmitter

Trade Name : N/A

Model Number : CARF-LR4; SLRF-LR4

FCC ID : ELVMTUF

Prepared for

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Remark:

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The test result in this report is only subjected to the test sample.

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Statement of Compliance

Applicant: Nutek Corporation
Manufacturer: Nutek Corporation
Product: Transmitter
Model No.: CARF-LR4; SLRF-LR4
Tested Power Voltage: DC 3V
Date of Final Test: Apr. 28, 2021
Revision of Report: Rev. 02

Configuration of Measurements and Standards Used :

FCC Rules and Regulations Part 15 Subpart C

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.10, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

- Note:**
1. The result of the testing report relate only to the item tested.
 2. This report shall not be partial reproduced without written approval by Interocean EMC Technology Corporation.
 3. Judgment of conformity is based on test result, regardless of measurement uncertainty.

Report Issued: 2021/05/17

Prepared by: Ivan Wang Approved: Jerry Chang
Ivan Wang Jerry Chang

1 General Information

1.1 Description of Equipment Under Test

Product	: Transmitter
Model Number	: CARF-LR4; SLRF-LR4
Applicant	: Nutek Corporation No.167, Lane 235, Bauchiau Rd., Xindian District, New Taipei City 23145, Taiwan
Manufacturer	: Nutek Corporation No.167, Lane 235, Bauchiau Rd., Xindian District, New Taipei City 23145, Taiwan
Power Supply	: DC 3V
Operating Frequency	: 909.6 MHz
Output Power	: 85.10 dBμV/m
Channel Number	: 1 channel
Type of Modulation	: LoRa
Antenna Description	: PCB Antenna. maximum Peak gain: 0dBi.
Measurement Software	: e3; Ver: 8.120803a7-2
Receipt Date of EUT	: Apr. 09, 2021
Date of Test	: Apr. 19 ~ 28, 2021
Additional Description	: 1) The test model is “ CARF-LR4 ”, designated by the applicant and included in this report. 2) The differences of all models included in this report are provided by the applicant, and the lab disclaims any liability related to reporting, if incorrect, from such provision. The difference of all models is only for different market. 3) For more detailed specification about EUT, please refer to the user's manual.

1.2 Test Facility

- Site Description** : ☒Chamber 3
- Name of Firm** : Interocean EMC Technology Corp.
- Company web** : <http://www.ietc.com.tw>
- Location** : No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City, Taiwan 244, R.O.C.
- Site Filing** : ● Federal Communication Commissions – USA
Designation No.: TW1020 (Test Firm Registration #: 651092)
Designation No.: TW1113 (Test Firm Registration #: 959554)
● Innovation, Science and Economic Development Canada (ISED)
CAB identifier: TW1113 (Ref. No 14962756)
● Voluntary Control Council for Interference by Information Technology Equipment (VCCI) – Japan
Member No.: 1349
Registration No. (Conducted Room): C-11094
Registration No. (Conducted Room): T-11562
Registration No. (OATS 1): R-11040
Registration No. (Chamber 3): G-20080
- Site Accreditation** : ● Bureau of Standards and Metrology and Inspection (BSMI) – Taiwan, R.O.C.
Accreditation No.:
SL2-IN-E-0026 for CNS 13438 / CISPR 22
SL2-R1-E-0026 for CNS 13439 / CISPR 13
SL2-R2-E-0026 for CNS 13439 / CISPR 13
SL2-L1-E-0026 for CNS 14115 / CISPR 15
● Taiwan Accreditation Foundation (TAF)
Accreditation No.: 1113
● American Association for Laboratory Accreditation (A2LA)
Certificate Number: 4891.01
● Vehicle Safety Certification Center (VSCC)
Approval No.: TW16-11

1.3 Test Equipment

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
EMI Test Receiver	R&S	ESI7	830154/002	2021/05/05
Spectrum Analyzer	R&S	FSP30	100002	2021/05/12
Loop Antenna	Electro-Metrics	EM-6879	261	2021/09/16
Bilog Antenna	ETC	MCTD 2786B	BLB17S04020	2021/05/04
Horn Antenna	Schwarzbeck	BBHA9120	9120D-1051	2021/08/03
Pre-Amplifier	EMCI	EMC001150	980130	2021/08/02
Pre-Amplifier	EMCI	EMC051845	980110	2021/07/02
RF Cable	HARBOUR	27478LL142	CBL65	2021/07/28
RF Cable	Marvelous Microwave	MCBL-LL266.50	CBL70	2021/07/28
Measurement Software	AUDIX-e3			

Note: The above equipments are within the valid calibration period.

1.4 Measurement Uncertainty

Item	Value
Chamber 3:	
Radiated Emission Test (9 kHz to 30 MHz)	3.2 dB
Radiated Emission Test (30 MHz to 200 MHz)	4.6 dB
Radiated Emission Test (200 MHz to 1 GHz) (Antenna: without tilting)	5.9 dB
Radiated Emission Test (1 GHz to 18 GHz)	5.0 dB
Radiated Emission Test (18 GHz to 40 GHz)	5.4 dB
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%	

1.5 Summary of Measurement

Test Parameter	Reference Document CFR47 Part15	Results
RF Radiated spurious emission test	§15.205, §15.209 §15.249	Pass
Emission on the Band Edge	§15.249(d)	Pass
AC Power Line Conducted Emission test	§15.207(a)	N/A
20 dB Bandwidth	§15.215(c)	Pass
Note: N/A is an abbreviation for Not Applicable.		

2 Test Specifications

2.1 Test Standard

The EUT was performed according to FCC Part 15 Subpart C Section 15.249 procedure and setup followed by ANSI C63.10-2013 requirements.

2.2 Operation Mode

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Y axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

2.3 Test Step of EUT

- 2.3.1 Set the fixture to EUT for power supplying.
- 2.3.2 Turn on the power of all equipments.
- 2.3.3 Let the EUT continuous transmission.
- 2.3.4 Execute the test.

3 20dB Bandwidth test

3.1 Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

3.2 Test Procedure

The 20dB bandwidth per FCC §15.215 was measured using spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth \geq RBW, and the SPAN may equal to approximately 2 to 3 time the 20 dB bandwidth.

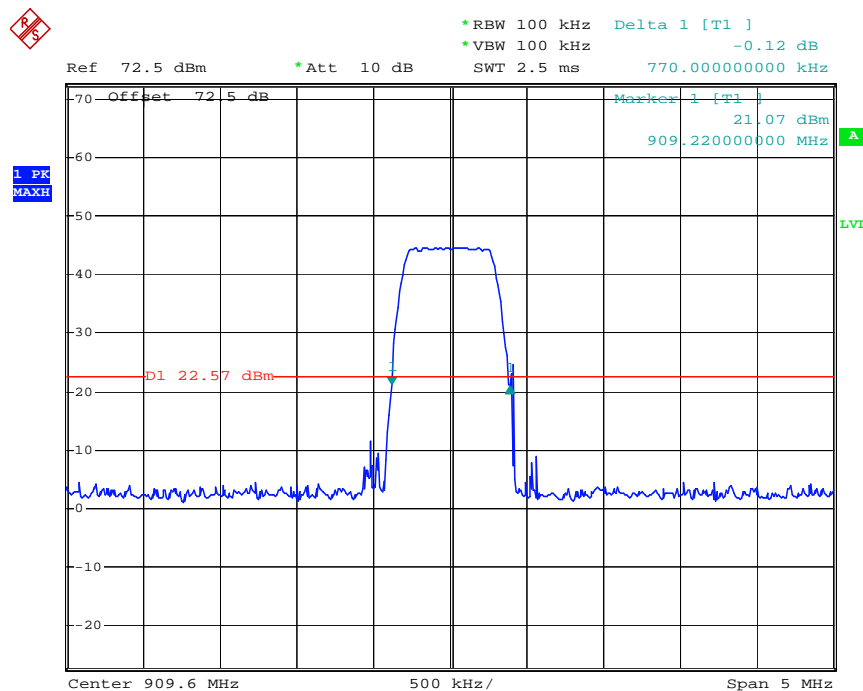
3.3 Test Result

PASS.

The final test data is shown as following pages.

Test CH		20dB Bandwidth (MHz)
Modulation	Frq. (MHz)	
LoRa	909.6	0.770

Plot:



Date: 28.APR.2021 17:19:43

4 RF Radiated spurious emission test

4.1 Limit

According to §15.249 (a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

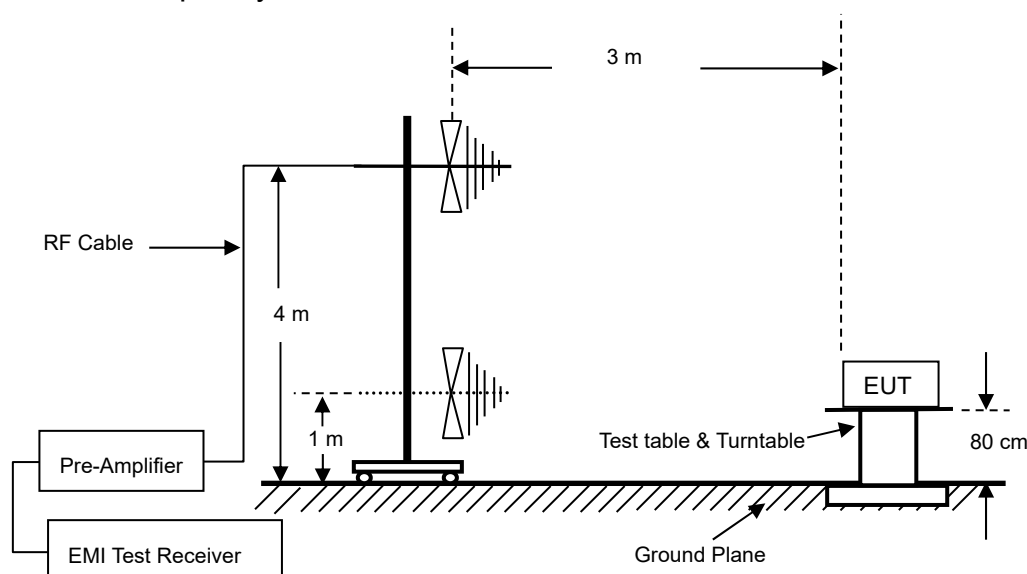
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902 - 928 MHz	50	500
2400 - 2483.5 MHz	50	500
5725 - 5875 MHz	50	500
24.0 - 24.25 GHz	250	2500

For intentional radiator, the radiated emission shall comply with §15.209(a).

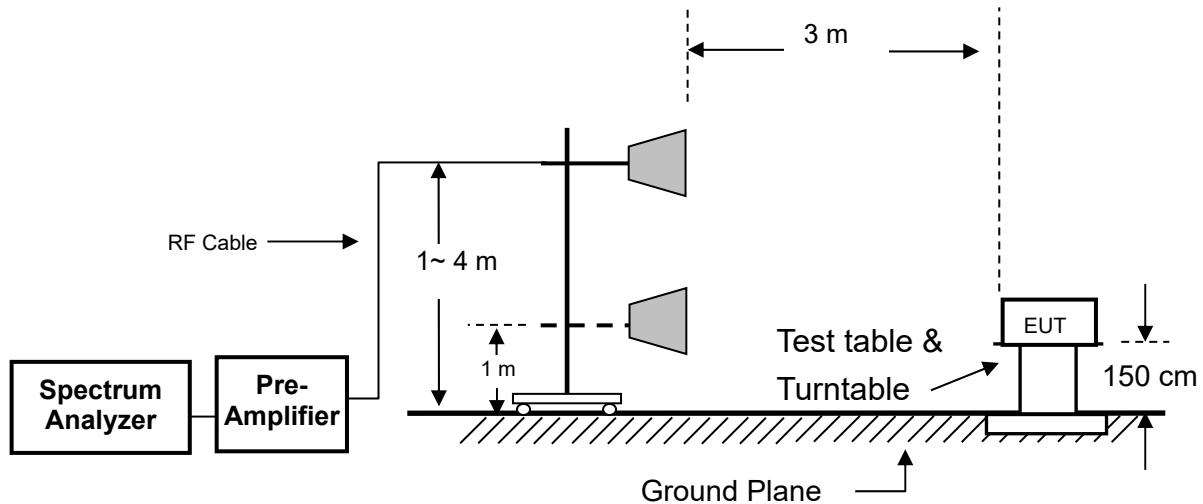
Frequency (MHz)	Field strength dB(μ V/m)	Measurement distance (meters)
1.705 - 30.0	29.5	30
30 - 88	40	3
88 - 216	43.5	3
216 - 960	46	3
Above 960	54	3

4.2 Configuration of Measurement

Measurement Frequency under 1 GHz



Measurement Frequency above 1 GHz



4.3 Test Procedure

The EUT was setup to ANSI C63.10-2013.

Radiated emission measurements were performed from 30 MHz to 25 GHz. Spectrum Analyzer set as below: For frequency range from 30 MHz to 1 GHz: RBW=100 kHz or greater. For frequencies above 1 GHz: set RBW=VBW=1 MHz for peak detector and RBW=1 MHz, VBW=10 Hz for average detector.

The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meter and down to 1 meter.

4.4 The description of operation mode

Setup EUT to continuously transmit signal with 100% duty cycle during the test period.

4.5 Test Result

PASS.

The frequency range from 9 kHz to 30 MHz was pre-scanned and the results were 20 dB lower than the limit line which according to FCC 15.31(o) needs not be recorded.

The final test emission data is shown as following tables.

Radiated Emission Below 1 GHz

CLIENT: Nutek Corporation

EUT: Transmitter

MODEL: CARF-LR4

RATING: DC 3V

COMMENT: 909.6 MHz

Data:123

OPERATOR : Scott

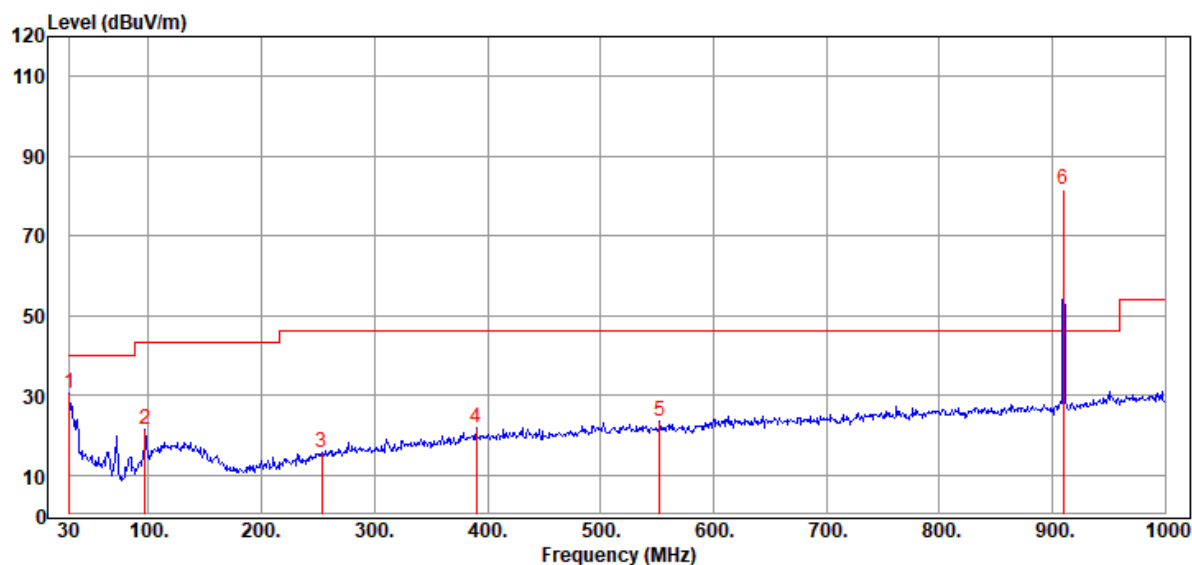
TEST SITE : Chamber 3

TEST DISTANCE : 3 m

POLARIZATION : HORIZONTAL

TEMP/HUM : 24.4°C/45%

2021-04-22



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	30.000	61.49	-30.97	30.52	40.00	-9.48	Peak
2	96.930	55.04	-33.52	21.52	43.50	-21.98	Peak
3	253.100	47.44	-31.66	15.78	46.02	-30.24	Peak
4	389.870	49.65	-27.76	21.89	46.02	-24.13	Peak
5	552.830	49.68	-26.10	23.58	46.02	-22.44	Peak
* 6	909.790	101.96	-20.45	81.51	94.00	-12.49	Peak

Remark : Corrected Level = Reading + Correction Factor – Preamp

Correction Factor = Antenna Factor + Cable Loss

Margin = Corrected Level – Limits

“ * ” Mark indicated Background Noise Level

CLIENT: Nutek Corporation

EUT: Transmitter

MODEL: CARF-LR4

RATING: DC 3V

COMMENT: 909.6 MHz

Data:122

OPERATOR : Scott

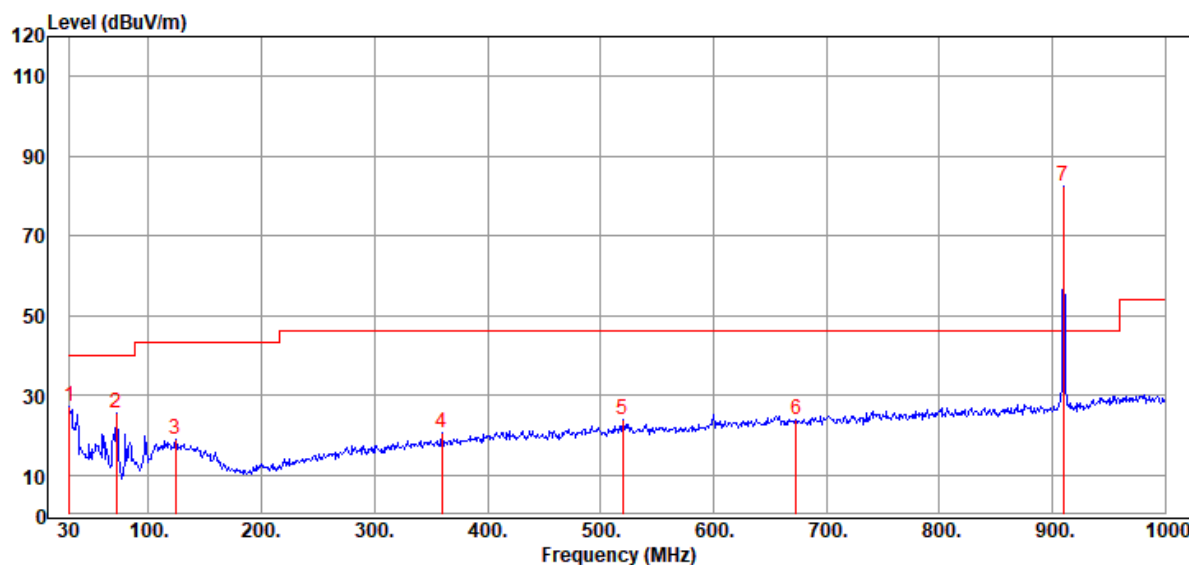
TEST SITE : Chamber 3

TEST DISTANCE : 3 m

POLARIZATION : VERTICAL

TEMP/HUM : 24.4°C/45%

2021-04-22



Item	Freq.	Reading	Factor	Level	Limit	Margin	Remark
Mark	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	30.000	58.10	-30.97	27.13	40.00	-12.87	Peak
2	71.710	64.44	-38.71	25.73	40.00	-14.27	Peak
3	124.090	48.59	-29.43	19.16	43.50	-24.34	Peak
4	359.800	49.36	-28.71	20.65	46.02	-25.37	Peak
5	519.850	50.11	-26.23	23.88	46.02	-22.14	Peak
6	673.110	48.58	-24.59	23.99	46.02	-22.03	Peak
* 7	909.790	102.81	-20.45	82.36	94.00	-11.64	Peak

Remark : Corrected Level = Reading + Correction Factor – Preamp

Correction Factor = Antenna Factor + Cable Loss

Margin = Corrected Level – Limits

“ * ” Mark indicated Background Noise Level

Radiated Emission Above 1 GHz

CLIENT: Nutek Corporation

EUT: Transmitter

MODEL: CARF-LR4

RATING: DC 3V

COMMENT: 909.6 MHz

Data:45

OPERATOR : Scott

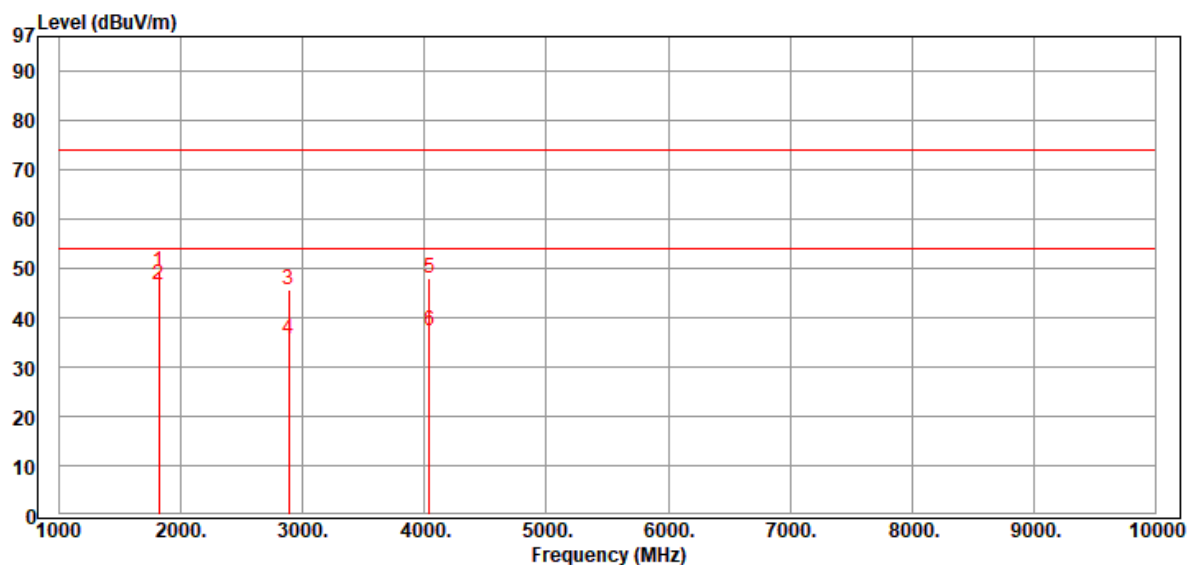
TEST SITE : Chamber 3

TEST DISTANCE : 3 m

POLARIZATION : HORIZONTAL

TEMP/HUM : 24.5°C/50%

2021-04-19



Item	Freq.	Reading	Factor	Level	Limit	Margin	Remark
Mark	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1816.000	68.98	-19.50	49.48	74.00	-24.52	Peak
2	1816.000	66.20	-19.50	46.70	54.00	-7.30	Average
3	2884.000	60.24	-14.48	45.76	74.00	-28.24	Peak
4	2884.000	50.20	-14.48	35.72	54.00	-18.28	Average
5	4040.000	59.56	-11.41	48.15	74.00	-25.85	Peak
6	4040.000	48.60	-11.41	37.19	54.00	-16.81	Average

Remark: Corrected Level = Reading + Correction Factor - Preamp

Correction Factor = Antenna Factor + Cable Loss

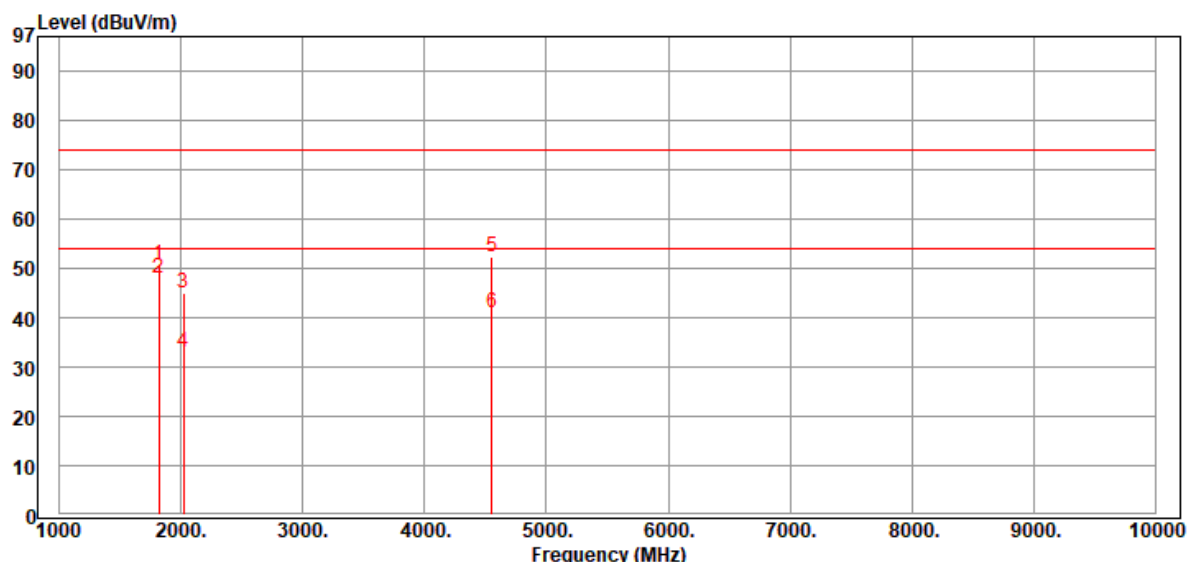
Margin = Corrected Level – Limits

“ * ” Mark indicated Background Noise Level

Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.

CLIENT: Nutek Corporation
EUT: Transmitter
MODEL: CARF-LR4
RATING: DC 3V
COMMENT: 909.6 MHz
Data:46

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : VERTICAL
TEMP/HUM : 24.5°C/50%
2021-04-19



Item	Freq.	Reading	Factor	Level	Limit	Margin	Remark
Mark	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1816.000	70.03	-19.50	50.53	74.00	-23.47	Peak
2	1816.000	67.61	-19.50	48.11	54.00	-5.89	Average
3	2020.000	63.20	-18.19	45.01	74.00	-28.99	Peak
4	2020.000	51.30	-18.19	33.11	54.00	-20.89	Average
5	4552.000	61.98	-9.57	52.41	74.00	-21.59	Peak
6	4552.000	50.69	-9.57	41.12	54.00	-12.88	Average

Remark: Corrected Level = Reading + Correction Factor - Preamp

Correction Factor = Antenna Factor + Cable Loss

Margin = Corrected Level – Limits

“ * ” Mark indicated Background Noise Level

Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.

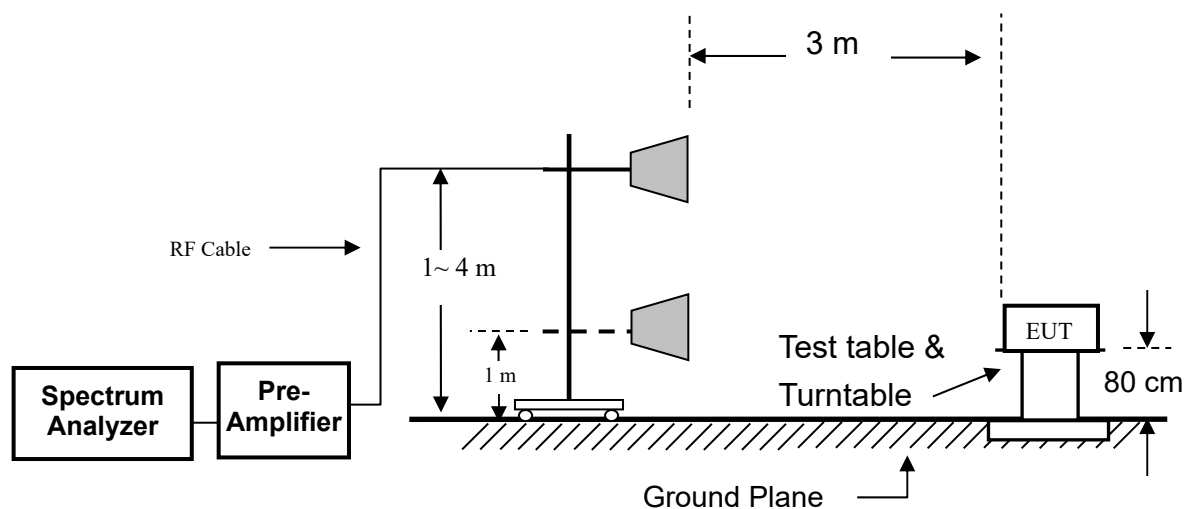
5 Emission on the Band Edge test

5.1 Limit

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.

5.2 Configuration of Measurement

Measurement Frequency above 1 GHz



5.3 Test Procedure

The EUT was setup to ANSI C63.10-2013.

The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meter and down to 1 meter.

5.4 Test Result

PASS.

The final test data is shown on as following pages.

Band edge

CLIENT: Nutek Corporation

EUT: Transmitter

MODEL: CARF-LR4

RATING: DC 3V

COMMENT: 909.6 MHz

OPERATOR : Scott

TEST SITE : Chamber 3

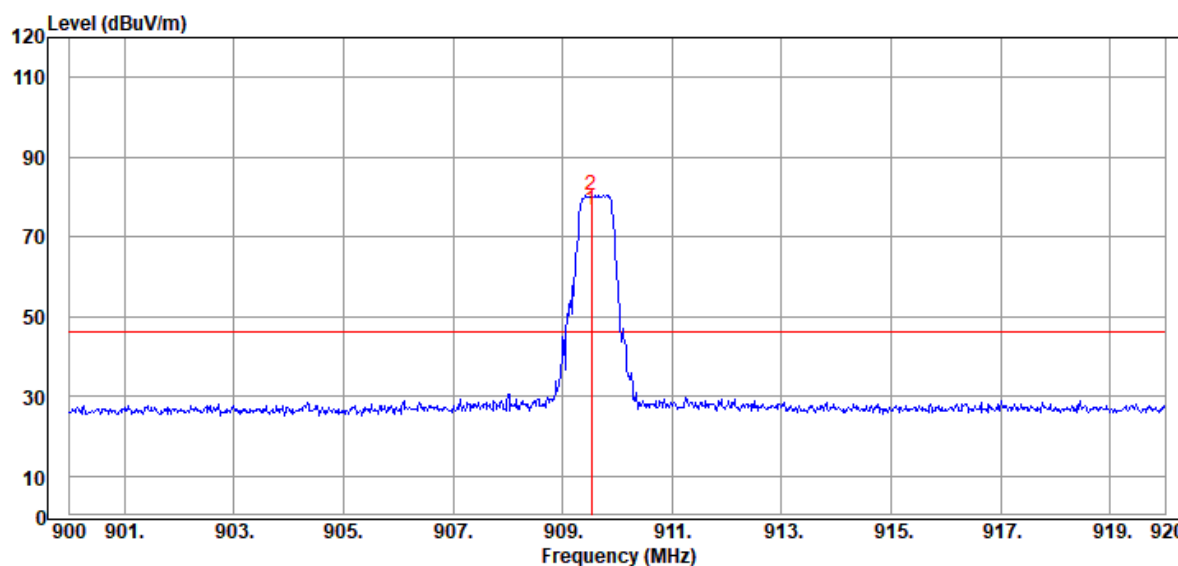
TEST DISTANCE : 3 m

POLARIZATION : HORIZONTAL

TEMP/HUM : 24.4°C/45%

Data:116

2021-04-22



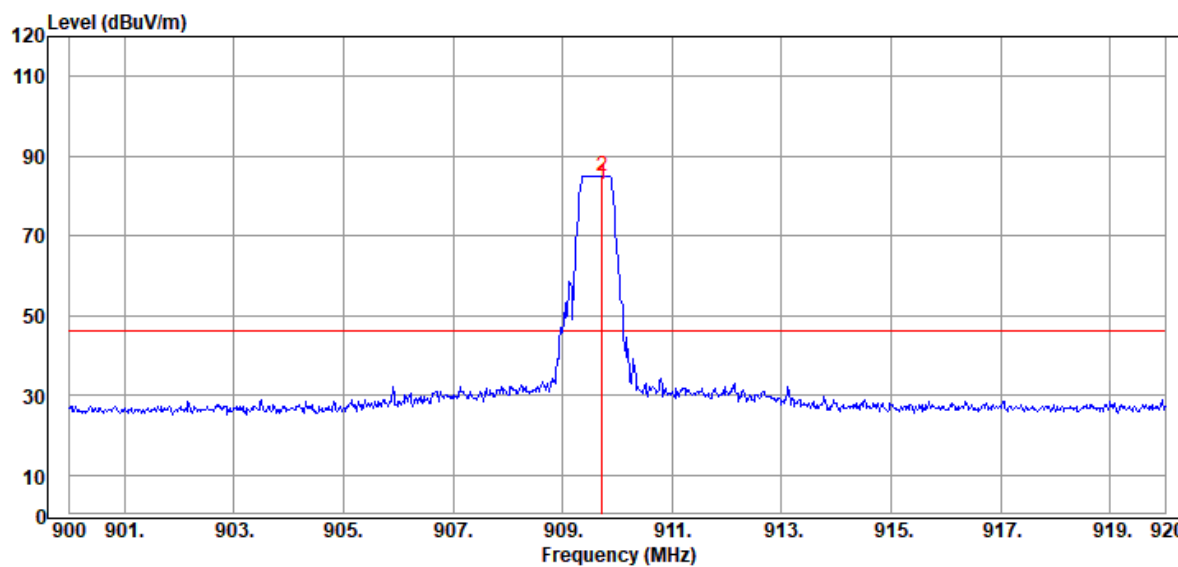
Item	Freq.	Reading	Factor	Level	Limit	Margin	Remark
Mark	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	909.520	97.20	-20.46	76.74	94.00	-17.26	QP
* 2	909.520	100.70	-20.46	80.24	114.00	-33.76	Peak

CLIENT: Nutek Corporation
EUT: Transmitter
MODEL: CARF-LR4
RATING: DC 3V
COMMENT: 909.6 MHz

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : VERTICAL
TEMP/HUM : 24.4°C/45%

Data:117

2021-04-22



Item	Freq.	Reading	Factor	Level	Limit	Margin	Remark
Mark	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	909.720	103.35	-20.45	82.90	94.00	-11.1	QP
2	909.720	105.55	-20.45	85.10	114.00	-28.9	Peak