CERTIFICATION TEST REPORT

Report Number. : R12831687-E1

Applicant	:	Ei Electronics Campus Shannon Industrial Estate, Shannon, V14 H020 Co.Clare, Ireland
Model	:	EiA200MRF
FCC ID	:	A5FEIA200MRF
IC	:	22380-EIA200MRF
EUT Description	:	RF Module used in host CO Alarms
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-210 ISSUE 9 ISED RSS-GEN ISSUE 5

Date Of Issue:
2020-05-29

Prepared by:
UL LLC
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Research Triangle Park, NC 27709 U.S.A.
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NVLAP TESTING

NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
1	2019-11-01	Initial Issue	Niklas Haydon
2	2020-05-29	Revised model description and model number. Added host description	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ei Electronics Campus
Shannon Industrial Estate,
Shannon, V14 H020
Co.Clare, Ireland

EUT DESCRIPTION: RF Module used in host CO Alarms

MODEL: EiA200MRF

SERIAL NUMBER: 2321293

DATE TESTED: 2019-09-03 to 2019-10-10

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Compliant
ISED RSS-210 Issue 9, Annex B.10	Compliant
ISED RSS-GEN Issue 5	Compliant

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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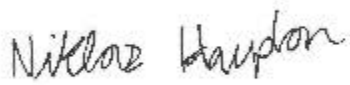
Approved & Released For
UL LLC By:

Jeffrey Moser
Operations Leader
Consumer Technology Division
UL LLC

Prepared By:



Niklas Haydon
Engineer
Consumer Technology Division
UL LLC

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 5, and RSS-210 Issue 9 Annex B.10.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, North Carolina, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, North Carolina, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

12 Laboratory Dr.	2800 Perimeter Park Dr., Suite B
ISED Site Code: 2180C	
☐ Chamber A RTP	☒ North Chamber
☐ Chamber C RTP	☐ South Chamber

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	2.50 dB
All emissions, radiated	4.88 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an RF module used in host CO Alarms that operates on a single channel. EiA200MRF was tested in Ei207W CO detector and alarm as host.

5.2. MAXIMUM E-FIELD STRENGTH

The transmitter has a E-Field strength as follows:

Frequency Range (MHz)	Mode	Output Peak E-field Strength (dBuV/m)	Output Quasi-Peak E-field Strength (dBuV/m)
926.365	Z-Wave	93.14	93.16

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a ¼ wave whip antenna, with a maximum gain of 0 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was v0

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emissions between 1GHz and 10GHz were performed with the EUT set to transmit at the highest power.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Power line conducted emissions is not applicable as the EUT is battery powered only.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
None				

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None						

TEST SETUP

The EUT is flashed with firmware to transmit continuously when buttons on the EUT are pressed.

SETUP DIAGRAMS

Please refer to 12831687-EP1 for setup diagrams

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6. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Section 11.6

20 dB BW: ANSI C63.10 Subclause 6.9.2

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

General Radiated Emissions: ANSI C63.10:2013 Sections 6.3 – 6.6

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-08-08	2020-08-08
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2019-008-08	2020-08-08
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-03-22	2020-03-22
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-15	2020-03-15
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2019-03-19	2020-03-19
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27
HPF009	1GHz high-pass filter, 2W, F_{high} =10GHz	Micro-Tronics	HPM17672	2019-03-08	2020-03-08

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

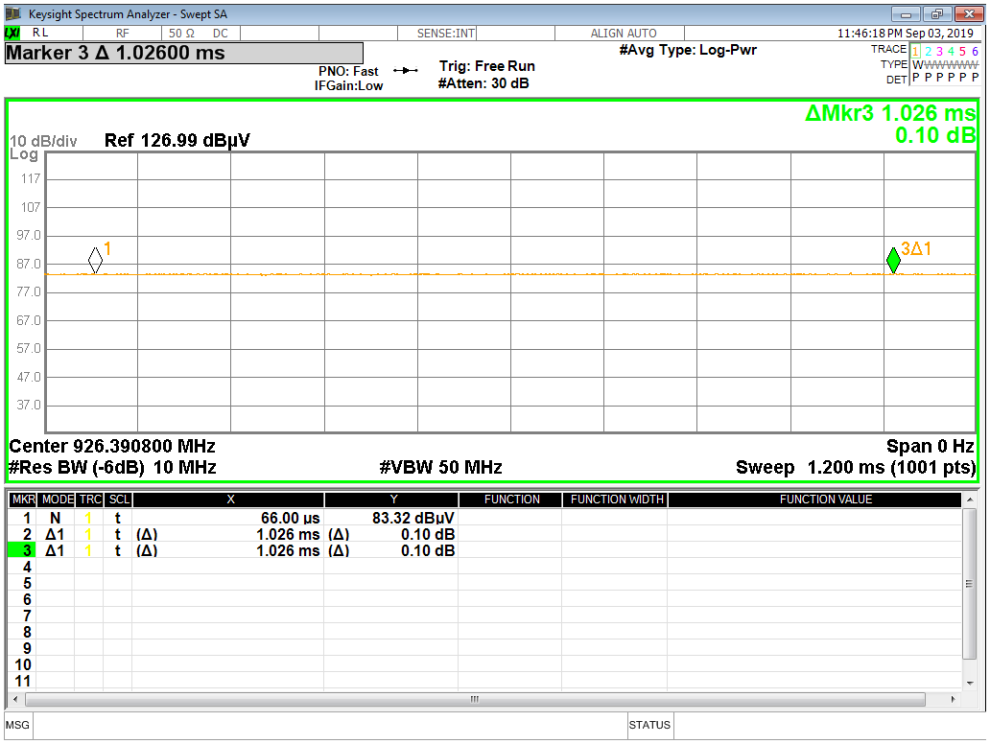
None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
Z-Wave	1.026	1.026	1.000	100.00%	0.00	0.010



DUTY CYCLE Z-Wave

Tested by: 11993
Date: 2019-09-03

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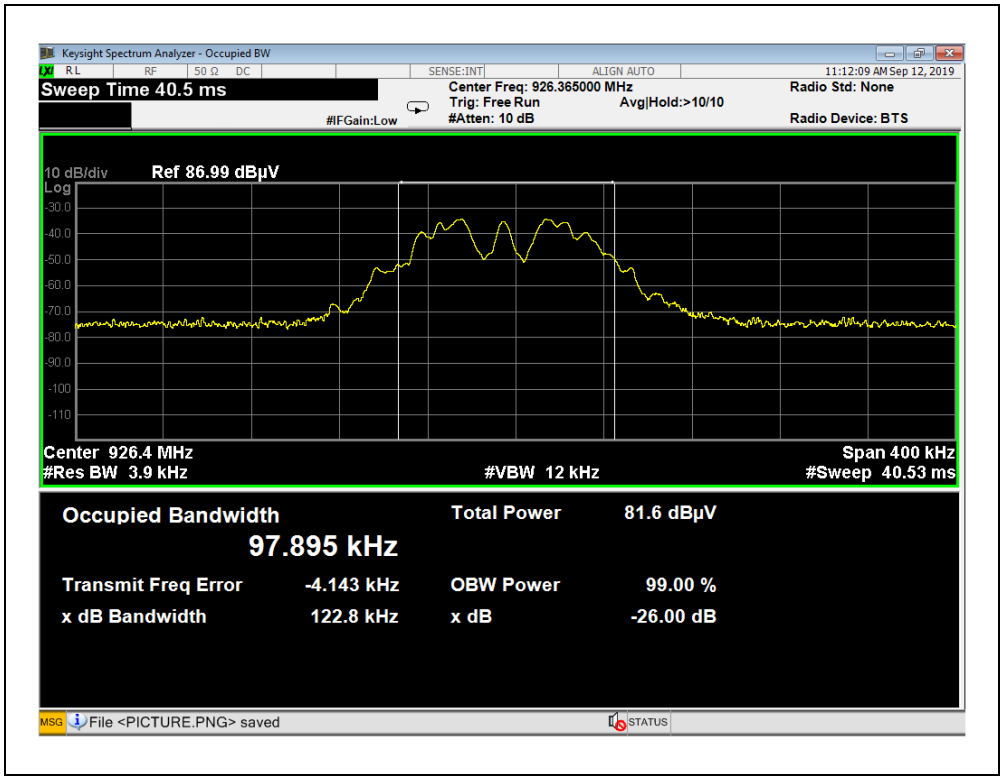
8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Frequency (MHz)	99% Bandwidth (MHz)
926.365	0.0979



Tested by: 11993
Date: 2019-09-12

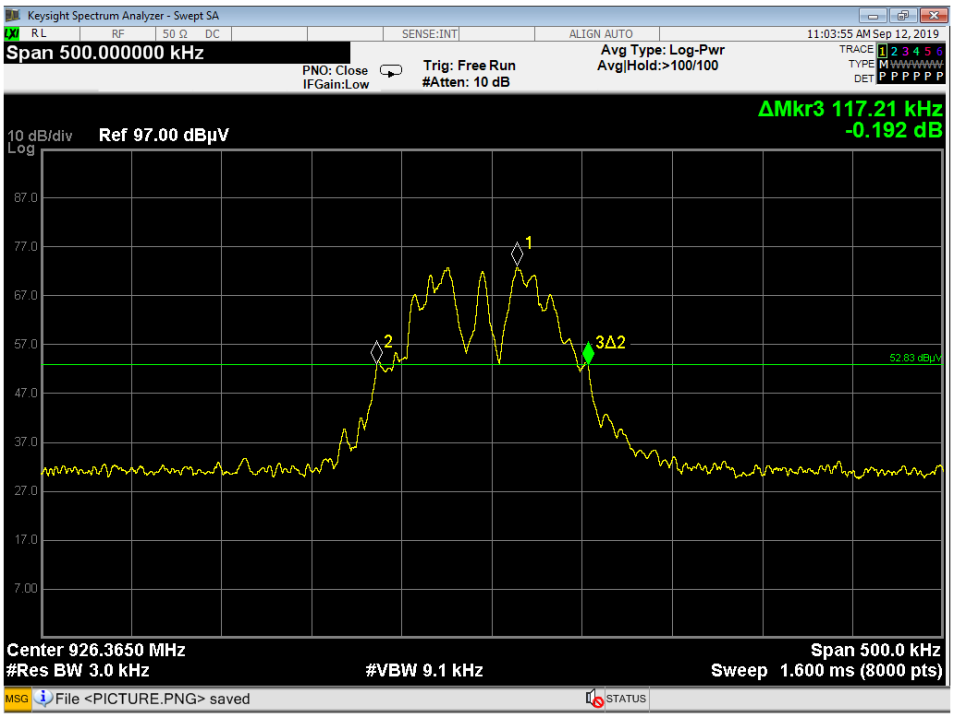
8.3. 20 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Frequency (MHz)	6 dB Bandwidth (MHz)
926.365	0.1172



LOW CHANNEL

Tested by: 11993
Date: 2019-09-12

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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

IC RSS-210, B.10
FCC 15.249

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.
(a) Except as provided in paragraph (b) of this section, 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

(d) 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.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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.

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FCC §15.205 and §15.209
RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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9.2. FUNDAMENTAL FIELD STRENGTH

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
926.3558	82.88	Pk	28.6	-26	85.48	-	-	269	172	V
926.3558	82.88	Qp	28.6	-26	85.48	94	-8.52	269	172	V
926.3572	90.56	Qp	28.6	-26	93.16	-	-	329	158	H
926.3592	90.54	Pk	28.6	-26	93.14	94	-0.86	329	158	H

Pk - Peak detector
Qp - Quasi-Peak detector

Test Information
Test Date: 2019-10-10
Tested By: 11993

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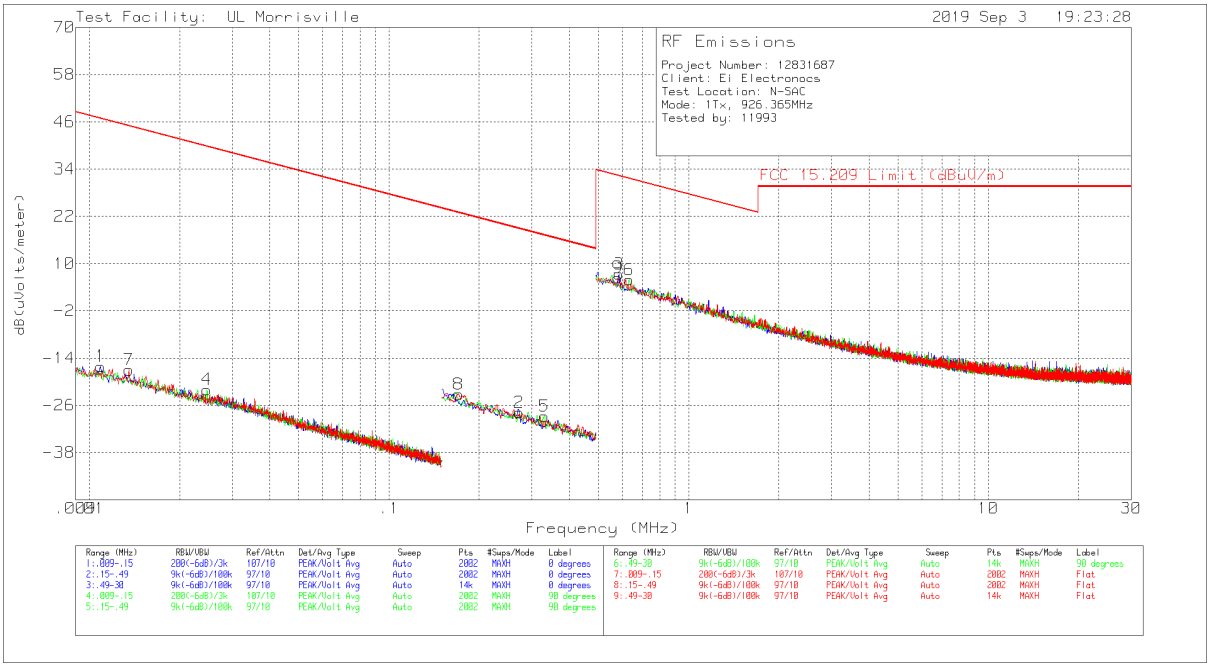
9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uV/m)	FCC 15.209 QP/AV Limit (dBuV/m)	FCC 15.209 PK Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)	Antenna Face
1	.01089	46	Pk	17.8	.1	-80	-16.1	46.86	66.86	-62.96	0-360	On
7	.01355	46.19	Pk	16.7	.1	-80	-17.01	44.97	64.97	-61.98	0-360	Flat
4	.02468	44.3	Pk	13.6	.1	-80	-22	39.76	59.76	-61.76	0-360	Off
8	.17057	45.68	Pk	11	.1	-80	-23.22	22.97	42.97	-46.19	0-360	Flat
2	.27206	41.12	Pk	11	.1	-80	-27.78	18.91	38.91	-46.69	0-360	On
5	.32918	40.14	Pk	11	.1	-80	-28.76	17.26	37.26	-46.02	0-360	Off
9	.58064	35.31	Pk	11	.1	-40	6.41	32.33	-	-25.92	0-360	Flat
3	.58486	36.25	Pk	11	.1	-40	7.35	32.26	-	-24.91	0-360	On
6	.63334	34.81	Pk	11	.1	-40	5.91	31.57	-	-25.66	0-360	Off

Pk - Peak detector

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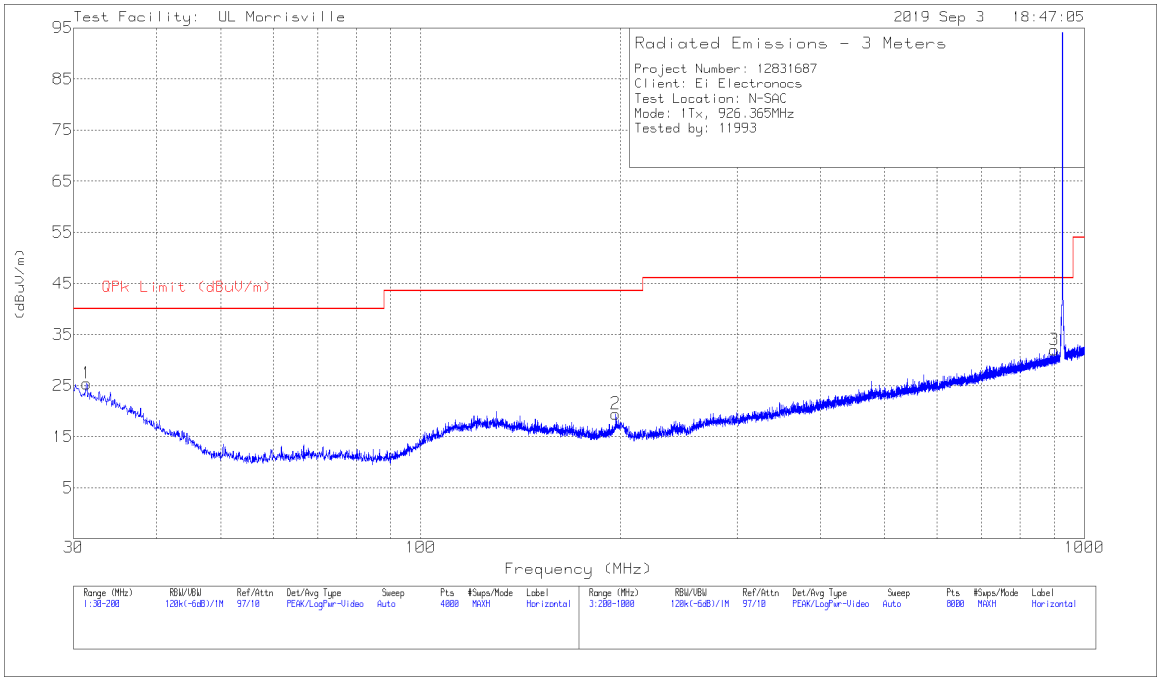
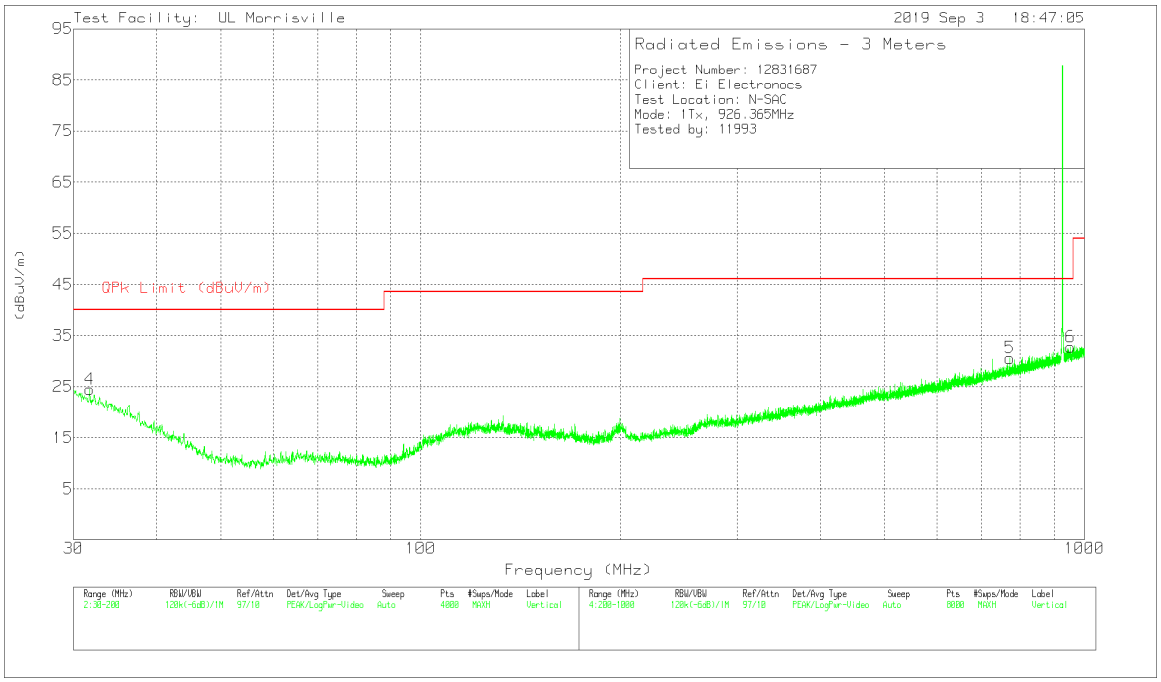
9.4. WORST CASE BELOW 1 GHZ

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.4029	30.31	Pk	26.8	-31.7	25.41	40	-14.59	0-360	398	H
4	31.7004	29.55	Pk	26.6	-31.7	24.45	40	-15.55	0-360	102	V
2	196.8132	30.47	Pk	19.1	-30.1	19.47	43.52	-24.05	0-360	102	H
5	772.2744	30.36	Pk	27.7	-27.5	30.56	46.02	-15.46	0-360	102	V
3	900.7911	29.47	Pk	28.8	-26.3	31.97	46.02	-14.05	0-360	399	H
6	953.4979	29.02	Pk	29.4	-25.7	32.72	46.02	-13.3	0-360	102	V

Pk – Peak Detector

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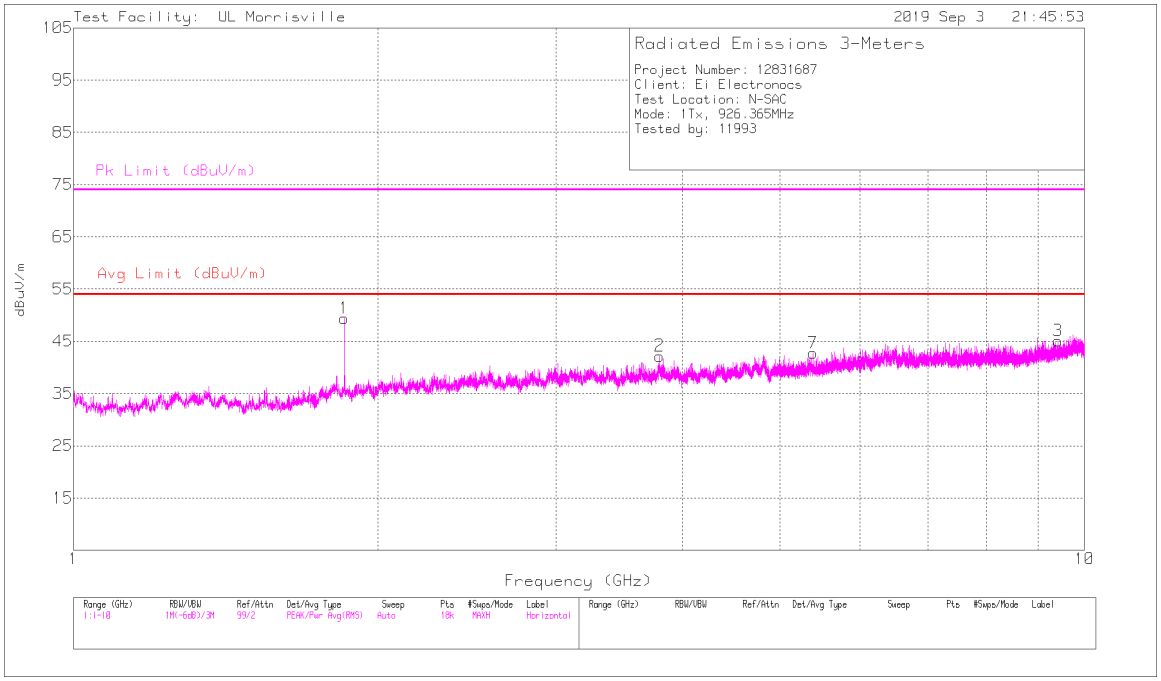
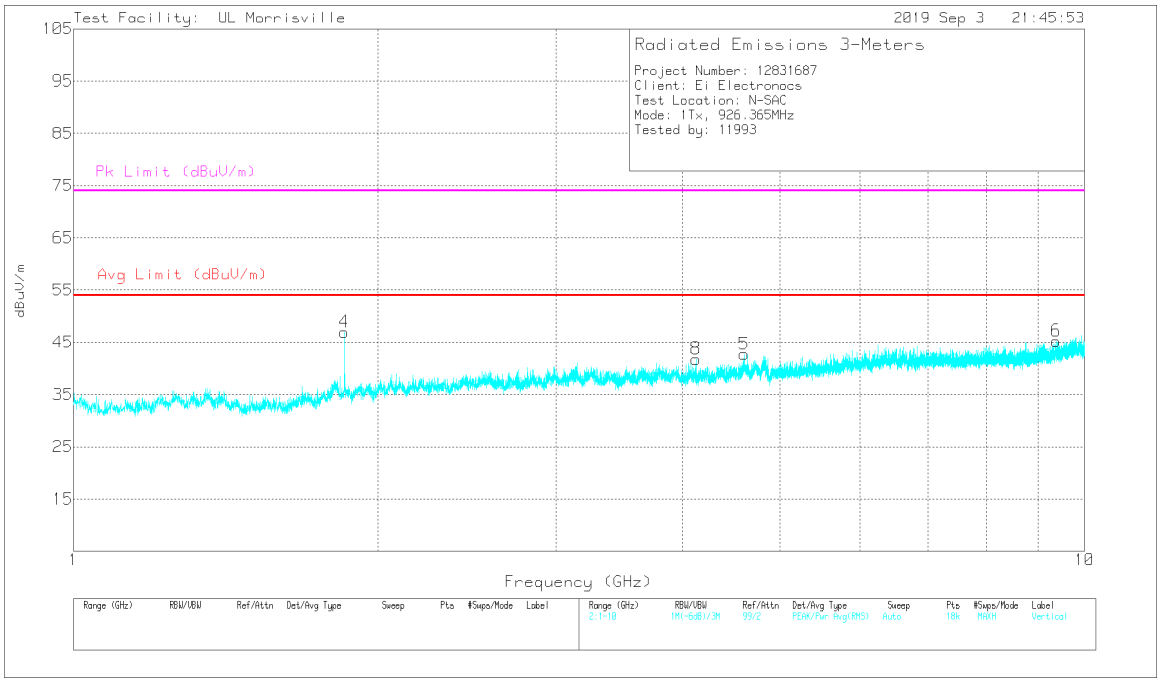
9.5. TRANSMITTER ABOVE 1 GHz



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/ Fltr/Pad (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.85257	50.07	PK2	30.8	-35.7	.4	45.57	-		74	-28.43	161	126	H
	** 1.85269	42.44	MAv1	30.8	-35.7	.4	37.94	54	-16.06	-	-	161	126	H
2	* ** 3.79955	41.54	PK2	33.5	-33	.4	42.44	-	-	74	-31.56	186	151	H
	* ** 3.79975	29.29	MAv1	33.5	-33	.4	30.19	54	-23.81	-	-	186	151	H
3	* ** 9.41492	37.47	PK2	36.4	-28.9	.9	45.87	-	-	74	-28.13	87	100	H
	* ** 9.41427	25.53	MAv1	36.4	-28.9	.9	33.93	54	-20.07	-	-	87	100	H
7	* ** 5.38915	40.79	PK2	34.4	-32.2	.4	43.39	-	-	74	-30.61	24	104	H
	* ** 5.38953	28.23	MAv1	34.4	-32.2	.4	30.83	54	-23.17	-	-	24	104	H
4	** 1.8554	42.9	PK2	30.8	-35.7	.4	38.4	-	-	74	-35.6	331	102	V
	** 1.85247	31.11	MAv1	30.8	-35.7	.4	26.61	54	-27.39	-	-	331	102	V
5	* ** 4.60664	42.41	PK2	34.1	-32.8	.3	44.01	-	-	74	-29.99	340	232	V
	* ** 4.60663	29.46	MAv1	34.1	-32.8	.3	31.06	54	-22.94	-	-	340	232	V
6	* ** 9.37605	37.31	PK2	36.4	-28.7	.9	45.91	-	-	74	-28.09	187	167	V
	* ** 9.37603	25.66	MAv1	36.4	-28.7	.9	34.26	54	-19.74	-	-	187	167	V
8	* ** 4.12528	40.45	PK2	33.5	-33.1	.4	41.25	-	-	74	-32.75	246	207	V
	* ** 4.12534	28.54	MAv1	33.5	-33.1	.4	29.34	54	-24.66	-	-	246	207	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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10. SETUP PHOTOS

Please refer to 12831687-EP1 for setup photos

END OF TEST REPORT

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