

ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Antenna Gain Test Report

Model / HVIN: FBRFS23

FireBoard Labs LLC

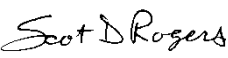
501 Charlotte
Kansas City, MO 64106

FCC Designation: US5305

ISED Registration: 3041A

Test Report Number: 230818

Test Date: November 7, 2023

Authorized Signatory: 
Scot D. Rogers

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Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

FireBoard Labs LLC
HVIN: FBRFS23
Test: 230818
File: Fireboard FBRFS23 Antenna TstRpt 230818

FCC ID: 2A29A-FBRFS23
IC: 27842-FBRFS23
SN's: S432RZ64G, S6F32Z64G
Date: November 14, 2023
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Revisions

Revision 1 Issued November 14, 2023

Foreword

The following information is submitted as details of antenna gain.

Name of Applicant: FireBoard Labs LLC
501 Charlotte
Kansas City, MO 64106

HVIN: FBRFS23

Reported Data

Frequency Band (MHz)	Gain (dBi)
910-920	-1.4

Environmental Conditions

Ambient Temperature 23.6° C
Relative Humidity 42%
Atmospheric Pressure 1006.8 mb

Equipment Tested

Model: FBRFS23

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT	FBRFS23	S432RZ64G

Test results in this report relate only to the items tested.

Equipment Function and Configuration

An Open-Air Test (OAT) setup was used to measure the antenna gain of the EUT. A Biconical, Biconilog, double ridge horn or appropriate antenna connected to a receiver system (including coaxial cables, preamplifier, and spectrum analyzer), a spectrum analyzer was used to receive and measure the strength of the radiated signal. Measurements were taken with the antenna placed at a distance of 3 meters from the EUT. Additionally, measurements were taken with the antenna in both a horizontal and vertical orientation. The EUT was oriented in three axes for antenna pattern characterization. While monitoring the radiated signal the EUT position was adjusted to find the orientation with the highest measured radiated signal strength. A comparison between the EUT antenna and the reference antenna signal strength were used to calculate the final EUT antenna gain.

Equipment Configuration

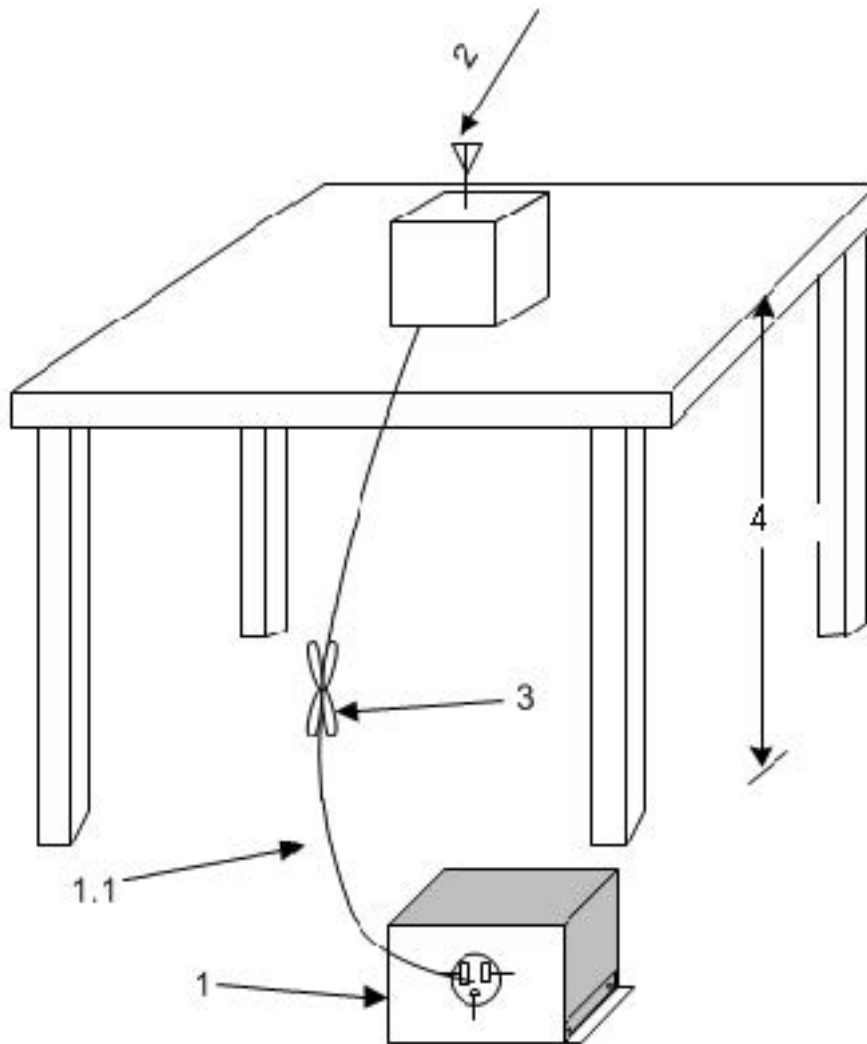


Unit under Test

Test Procedure

Radiated emissions testing was performed on an NSA compliant Open Area Test Site. The test contains both the Equipment Under Test (EUT) and the measurement antenna. The EUT is positioned on a turn table and evaluated over three axes which orient the EUT over all orientations relative to the measurement antenna. The measurement antenna was positioned in both polarizations measuring horizontal and vertical polarization. The radiated energy was maximized by equipment placement permitting orientation in three orthogonal axes and rotating the turntable. Refer to diagrams 1 and 2 showing typical test setup. Refer to photographs in the test setup.

Diagram 1 Test arrangement for radiated emissions of tabletop equipment.



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).

1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.

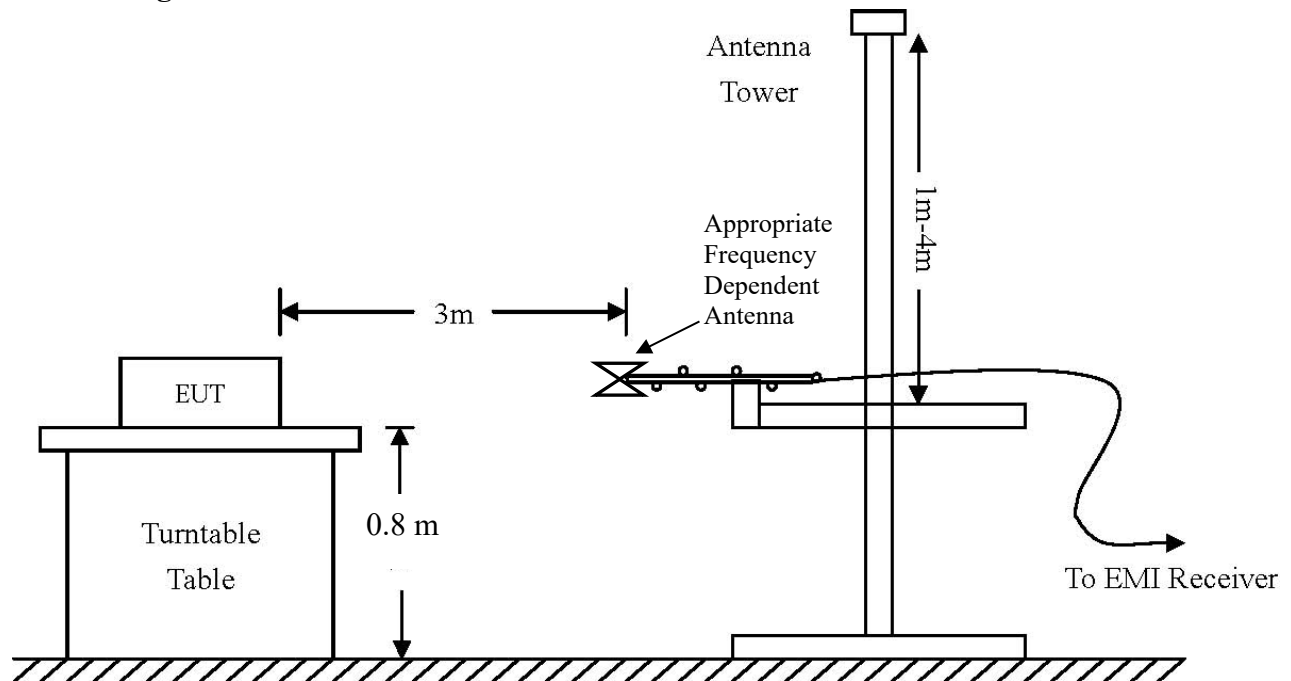
2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).

3—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).

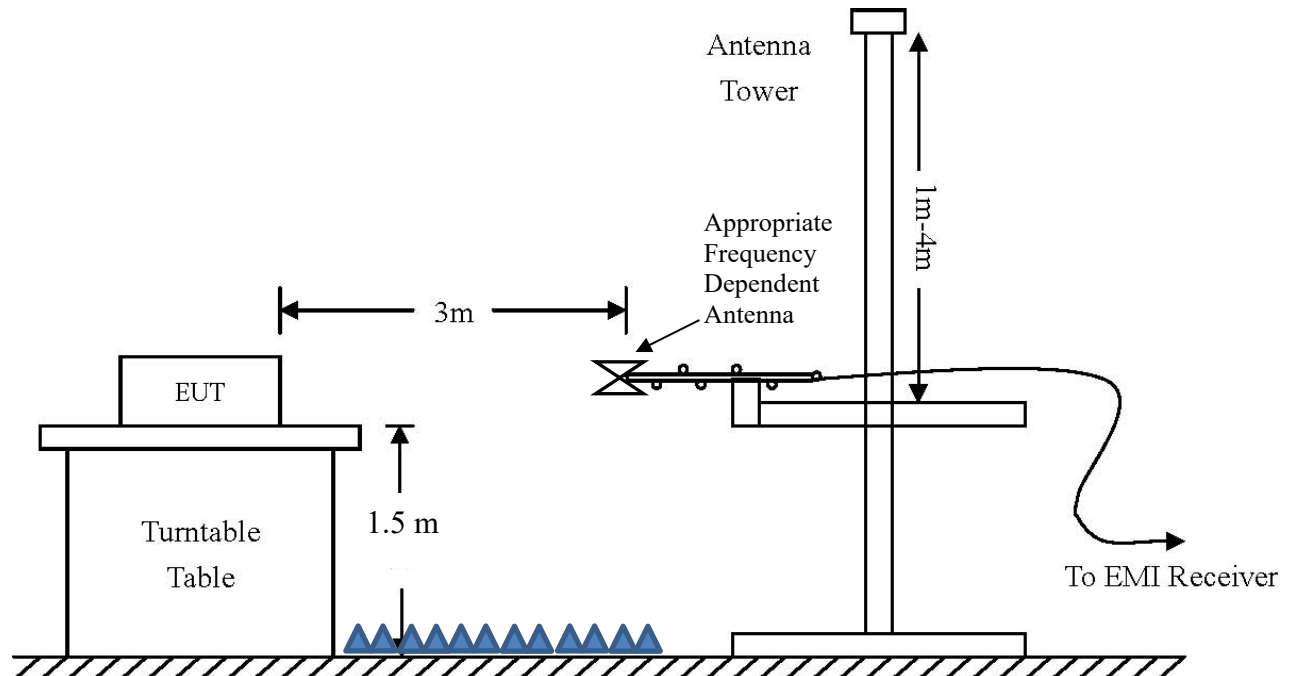
4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

Diagram 2 Test arrangement for radiated emissions tested on Open Area Test Site

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz



Test Site Locations

Conducted EMI	AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259 th Terrace, Louisburg, KS
Antenna port	Antenna port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259 th Terrace, Louisburg, KS
Radiated EMI	The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259 th Terrace, Louisburg, KS
Registered Site information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096	
NVLAP Accreditation	Lab code 200087-0

Units of Measurements

Conducted EMI	Data presented in dB μ V; dB referenced to one microvolt.
Antenna port Conducted	Data is in dBm; dB referenced to one milliwatt.
Radiated EMI	Data presented in dB μ V/m; dB referenced to one microvolt per meter.
Note: Radiated limit may be expressed for measurement in dB μ V/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for Open Area Test Site using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.	

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains

$RFS (dB\mu V/m @ 3m) = FSM (dB\mu V) + A.F. (dB/m) + Losses (dB) - Gain (dB)$

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. The results of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those evaluated may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.14
3 Meter Measurements 18-40 GHz	5.16

Annex B Test Equipment List

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model (SN)</u>	<u>Band</u>	<u>Cal Date(m/d/y)</u>	<u>Due</u>
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/26/2023	9/26/2024
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/26/2023	9/26/2024
<input type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	9/26/2023	9/26/2024
<input type="checkbox"/> Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/26/2023	9/26/2024
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	9/26/2023	9/26/2024
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/26/2023	9/26/2024
<input type="checkbox"/> Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/26/2023	10/11/2024
<input type="checkbox"/> Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/28/2022	3/29/2024
<input type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/11/2022	10/11/2024
<input type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	3/27/2023	3/27/2025
<input type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	6/26/2023	6/26/2024
<input type="checkbox"/> Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/25/2023	1/25/2024
<input type="checkbox"/> Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
<input type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/26/2023	9/26/2024
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/26/2023	9/26/2024
<input type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/26/2023	9/26/2024
<input type="checkbox"/> Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/26/2023	9/26/2024
<input type="checkbox"/> Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
<input type="checkbox"/> Power meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/28/2023	3/28/2025
<input type="checkbox"/> Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/28/2023	3/28/2024
<input checked="" type="checkbox"/> Weather station	Davis	6152 (A70927D44N)		7/13/2022	7/14/2024