

Advanced
Compliance

210 Cougar Court
Hillsborough, NJ 08844
Tel: (908) 927 9288
Fax: (908) 927 0728

Electromagnetic Emission Test Report



EUT Name: GROUNDSENSE

EUT Model: 166-53-05NC-E

Report Date: March 11, 2024

Client Name: GPR

Tested By: Advanced Compliance Laboratory, Inc.

Test Spec: FCC Part 15, Subpart C 15.209
ISED RSS-210 & RSS-Gen & RSS-102

Test Staff(s): David Tu

Manager: Wei Li

Report Number: 0048-231023-02-FCC-IC



**The test result in this report IS supported and covered
by ANAB accreditation (Certificate No. AT-3288).**

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1. GENERAL INFORMATION

1.1 Verification of Compliance

EUT: GROUNDSENSE

Model: 166-53-05NC-E

Applicant: GPR
444 Somerville Ave.
Somerville, MA 02143

Test Type: FCC Part 15, Subpart C 15.209
ISED RSS-210 (issue 10) & RSS-Gen (issue 5)
RSS-102 (issue 6)

Result: PASS

Tested by: ADVANCED COMPLIANCE LABORATORY

Test Date: 10/23/2023~3/11/2024

Report Number: **0048-231023-02-FCC-IC**

The above equipment was tested by Advanced Compliance Laboratory for compliance with the requirement set forth in FCC Part 15, Subpart C. This said equipment in the configuration described in the report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

The estimated uncertainty of the test result is given as following. The method of uncertainty calculation is provided in Advanced Compliance Lab. Doc. No. 0048-01-01.

	Prob. Dist.	Uncertainty(dB)	Uncertainty(dB)	Uncertainty(dB)
		30-1000MHz	1-6.5GHz	Conducted
Combined Std. Uncertainty u_c	norm.	±2.36	±2.99	±1.83



Wei Li
Lab Manager
Advanced Compliance Lab

Date: 3/11/2024

1.2 Equipment Modifications

N/A

1.3 Product Information

Part	QTY		Mfr. P/N
EUT	1	GROUNDSENSE/ 166-53-05NC-E	
Cable	1	Ethernet /DC Power cable	

System Accessories:

ITEM	DESCRIPTION	FCC ID /DOC or CE	CABLE
Battery	12VDC		

*Detailed information shall be provided by applicant :

- Manufacturer
- Description of equipment
- Model Number
- Serial Number
- Software used for testing

1.4 Test Methodology

Radiated tests were performed according to the procedures in ANSI C63.4-2014/C63.10-2013 at an antenna to EUT distance of 3 or 10 meters.

1.5 Test Facility

The open area test site and conducted measurement facility used to collect the radiated and conducted data are located at Hillsborough, New Jersey. This site is accepted by FCC to perform measurements under Part 15 or 18 (Registration # 185968, MRA designation No. US3288) and also designated by IC as “ site IC 3130A”. The ANAB Certificate Number for ISO/IEC 17025 accreditation is AT-3288 (expiry date: 2/27/2026).

1.6 Test Equipment

Manufacture	Model	Serial No.	Description	Cal Due dd/mm/yy
Hewlett-Packard	HP8546A	3448A00290	EMI Receiver	25/09/24
Agilent	E4440A	US40420700	3Hz-26.5GHz Spectrum Analyzer	17/06/24
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	15/01/25
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	15/01/25
EMCO	3115	4945	Double Ridge Guide Horn Antenna	22/01/25

All Test Equipment Used are Calibrated Traceable to NIST Standards.

1.7 Statement for the Document Use

This report shall not be reproduced except in full, without the written approval of the laboratory. And this report must not be used by the client to claim product endorsement by ANAB or any agency of the U.S. /Canada Government.

2. PRODUCT LABELING

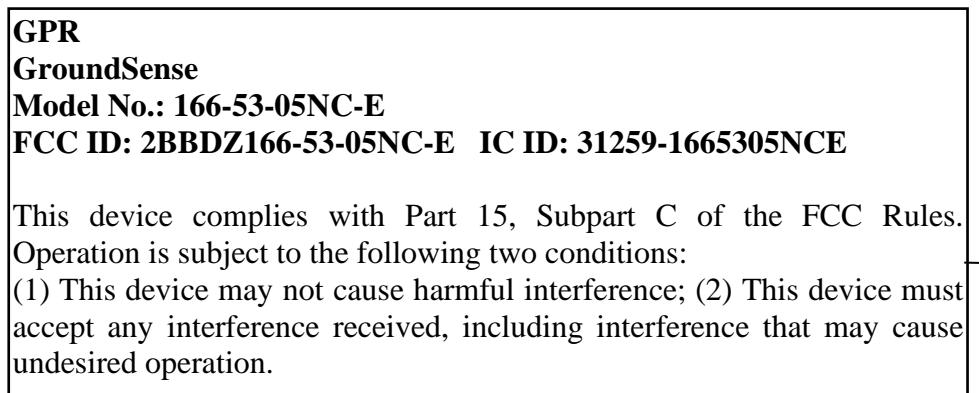


Figure 2.1 ID Label

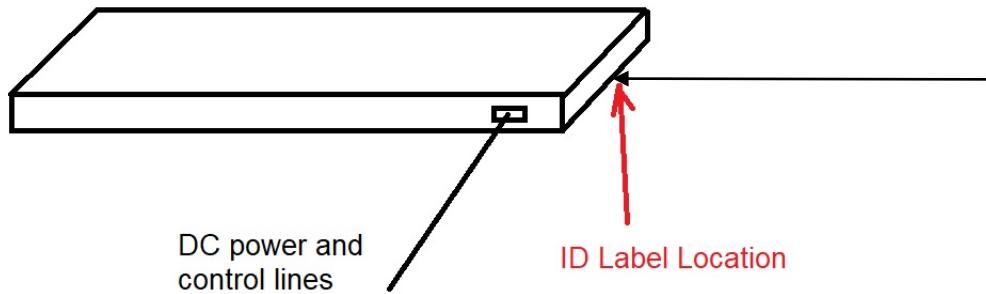


Figure 2.1 ID Label Location
(drawing for reference only)

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The EUT was configured and operated per GPR Document.

The following operation mode was investigated:

EUT continuously transmitted RF signal with Digital Emission Mask:

Part 15C Notch Filter BW Setting: 108-121.94; 123-138; 149.9-150.05; 156.52475-156.525; 156.7-156.9; 162.0125-167.17; 167.72-173.2; 174-216; 240-285; 322-335.4; 399.9-410 (MHz).

This will meet FCC restricted bands requirements per FCC 15.205 and additional provisions stated in FCC 15.236, 15.241, 15.242.

Therefore the simplified passband settings are given as following:

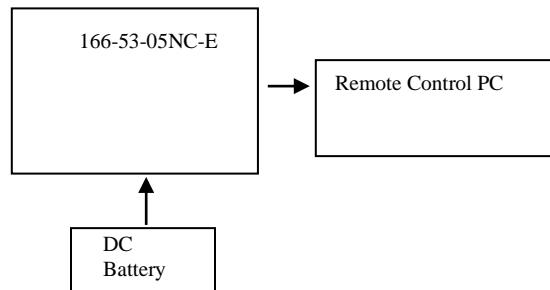
103.0-108.0MHz, 138.0-149.9MHz, 150.05-156.5MHz, 156.9-162.0MHz, 216.0-240.0MHz; 285.0-322.0MHz; 335.4-399.9MHz.

EUT was powered by external 12V battery during the test.

3.2 Special Accessories

N/A

3.3 Configuration of Tested System



Provided in separate exhibit

Fig. 3.1 Radiated Emission Test Setup

4. SYSTEM BLOCK DIAGRAM

Provided by GPR upon request

Figure 4.1 System Schematics /Block Diagram

5. RADIO FREQUENCY EXPOSURE

LIMITS for FCC RF Exposure Evaluation

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

LIMITS for FCC SAR Evaluation

KDB 447498 D04 Interim General RF Exposure Guidance v01, section 2.1.3 SAR- Based Exemption:

“A more comprehensive exemption, considering a variable power threshold that depends on both the separation distance and power, is provided in § 1.1307(b)(3)(i)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with test separation distances between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions.”

LIMITS for ISED RF Exposure Evaluation

Per RSS-102, Section 2.5.2 Exemption Limits for Routine Evaluation

LIMITS for ISED SAR Evaluation

Per RSS-102, Section 2.5.1 Exemption Limits for Routine Evaluation & Table 1

CALCULATIONS for applicable limits:

RF Exposure for separation $\geq 20\text{cm}$

FCC: From §1.1310 Table 1 (B), for Public $S = 1.0 \text{ mW/cm}^2$; for Professional, $S = 5.0 \text{ mW/cm}^2$.

$S = 0.0795 * 10^{(P+G)/10} / d^2$

ISED: EIRP limit by using formula of $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ for 300MHz to 6GHz range; 0.6W for 48-300MHz. (examples are 1.37W at 902MHz, 2.67W at 2400MHz)

SAR Exclusion Thresholds for separation $\leq 5\text{-}40\text{cm}$:

FCC : Use Formular in FCC § 1.1307(b)(3)(i)(B) & KDB 447498 D04

IC: Use RSS-102 Table 1. Apply duty cycle factor & 2.5 factor for extremity or limb-worn devices.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of ≥25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	299 mW
5800	56 mW	71 mW	83 mW	97 mW	106 mW

1-mW Test Exemption:

Per § 1.1307(b)(3)(i)(A), a single RF source is exempt RF device (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance.

This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions.

RESULTS

For this EUT, operating between 103-400MHz & d>20cm, max emission level is under the 0dBm (1mW) set by the limit in Part 15.209. No RF hazard need to be concerned.

The max. emission level is 44.6dBuV/m @ 3m, the eirp= 44.6-95.3=-50.7dBm. So the max. power density can be obtain by using the max. P+G= -50.70dBm and d=20cm, and plug all three items into equation, yielding,

Power Density Limit (mW/cm ²)	Max. Output Power+ Antenna Gain (dBm)	Calculated Power Density (mW/ cm ²)
1.0/5.0	-50.70	2E-9

6. RADIATED EMISSION DATA

6.1 Field Strength Calculation

The corrected field strength is automatically calculated by EMI Receiver using following:

$$FS = RA + AF + CF + AG$$

where FS: Corrected Field Strength in dB μ V/m

RA: Amplitude of EMI Receiver before correction in dB μ V

AF: Antenna Factor in dB/m

CF: Cable Attenuation Factor in dB

AG: Built-in Preamplifier Gain in dB (Stored in receiver as part of the calibration data)

6.2 Test Methods and Conditions

The EUT exercise program was loaded during the radiated emission test. The initial step in collecting radiated data is a EMI Receiver scan of the measurement range 30MHz - 6GHz using peak detector. IF bandwidth is 120kHz and video bandwidth is 300kHz for measuring 30MHz-1GHz. Both bandwidths are 1MHz for above 1GHz measurement.

FCC Part 15.209 & RSS-Gen Limit:

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

Radiated Emission Technical Requirements		
Frequency (MHz)	FCC Part 15.209 limit @ 3meter for 30-1000MHz Range Quasi-Peak (dB μ V/m)	FCC Part 15.209 limit @ 3meter for above 1000MHz Range Average (dB μ V/m)
30-88	40	
88-216	43.5	
216-960	46.0	
960-1000	54.0	
Above 1GHz		54

*Except as provided in 15.209 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.

**For band 9-90 kHz, 110-490 kHz and above 1000 MHz, radiated emission limits are based on measurements employing an average detector.

6.3 Test Data

The following data lists the significant emission frequencies, polarity and position, peak reading of the EMI Receiver, calculated average reading, the FCC limit, and the difference between the peak reading and the limit. Explanation of the correction and calculation are given in section 6.1.

The following radiated test data shows the worst case emissions are still below FCC Part 15C, Sec. 15.209/ RSS-Gen limit.

Test Personnel:

Tester Signature: David Tu

Date: 3/11/2024

Typed/Printed Name: David Tu

Operation Mode : RF ON with digital emission mask applied. The transmitting bands given as following:

**103.0-108.0MHz, 138.0-149.9MHz, 150.05-156.5MHz, 156.9-162.0MHz, 216.0-240.0MHz;
 285.0-322.0MHz; 335.4-399.9MHz.**

Freq.** (MHz)	H,V	SA QP* Reading (dBuV/m)	Heigh t (m)	Angle (degree)	Refer to Part 15.209 /RSS-Gen 3m Limit (dBuV/m)	Margin (dB)	Result
103.4	H	35.9	1.8	090	43.5	-7.6	Pass
107.5	H	36.8	1.8	090	43.5	-6.7	Pass
138.5	H	37.9	1.8	090	43.5	-5.6	Pass
144.1	H	38.6	1.8	090	43.5	-4.9	Pass
149.7	H	38.7	1.8	090	43.5	-4.8	Pass
150.5	H	40.8	1.8	090	43.5	-2.7	Pass
156.1	H	40.0	1.8	090	43.5	-3.5	Pass
157.4	H	39.6	1.8	090	43.5	-3.9	Pass
161.5	H	40.3	1.8	090	43.5	-3.2	Pass
216.5	H	42.4	1.0	090	46.0	-3.6	Pass
228.6	H	43.1	1.0	090	46.0	-2.9	Pass
239.5	H	44.6	1.0	270	46.0	-1.4	Pass
285.6	H	43.2	1.0	090	46.0	-2.8	Pass
303.2	H	43.8	1.0	090	46.0	-2.2	Pass
321.5	H	43.0	1.0	090	46.0	-3.0	Pass
335.9	H	44.4	1.0	090	46.0	-1.6	Pass
368.0	H	44.0	1.0	090	46.0	-2.0	Pass
399.4	H	43.4	1.0	090	46.0	-2.6	Pass
738.5	H	34.8	1.0	090	46.0	-11.2	Pass
103.5	V	36.0	1.1	000	43.5	-7.5	Pass
107.4	V	37.1	1.1	000	43.5	-6.4	Pass
138.4	V	37.9	1.0	000	43.5	-5.6	Pass
144.0	V	38.0	1.0	000	43.5	-5.5	Pass
149.5	V	38.9	1.0	000	43.5	-4.6	Pass
150.5	V	39.0	1.0	000	43.5	-4.5	Pass
156.0	V	40.6	1.0	000	43.5	-2.9	Pass
157.4	V	40.4	1.1	000	43.5	-3.1	Pass
161.5	V	39.9	1.1	000	43.5	-3.6	Pass
216.5	V	42.8	1.1	180	46.0	-3.2	Pass
228.5	V	44.6	1.1	180	46.0	-1.4	Pass
239.5	V	44.0	1.1	190	46.0	-2.0	Pass
285.5	V	44.2	1.1	000	46.0	-1.8	Pass

303.0	V	42.8	1.1	180	46.0	-3.2	Pass
321.5	V	44.1	1.1	180	46.0	-1.9	Pass
335.9	V	42.6	1.1	180	46.0	-3.4	Pass
368.0	V	41.4	1.1	180	46.0	-4.6	Pass
399.5	V	40.0	1.1	180	46.0	-6.0	Pass
810.3	V	36.4	1.1	180	46.0	-9.6	Pass

*Peak /Quasi-peak /Average reading. For emissions that have peak values close to (or over) the specification limit (if any) will be also measured in the quasi-peak or average mode to determine the compliance. No other significant emissions were found in the rest frequency bands.

** Frequency points for digital signals are excluded.

All the emission levels are well below 15.209 general limit and the specific requirement in each “restricted” band is also met with added “digital notch filter” (spectrum mask) in place.

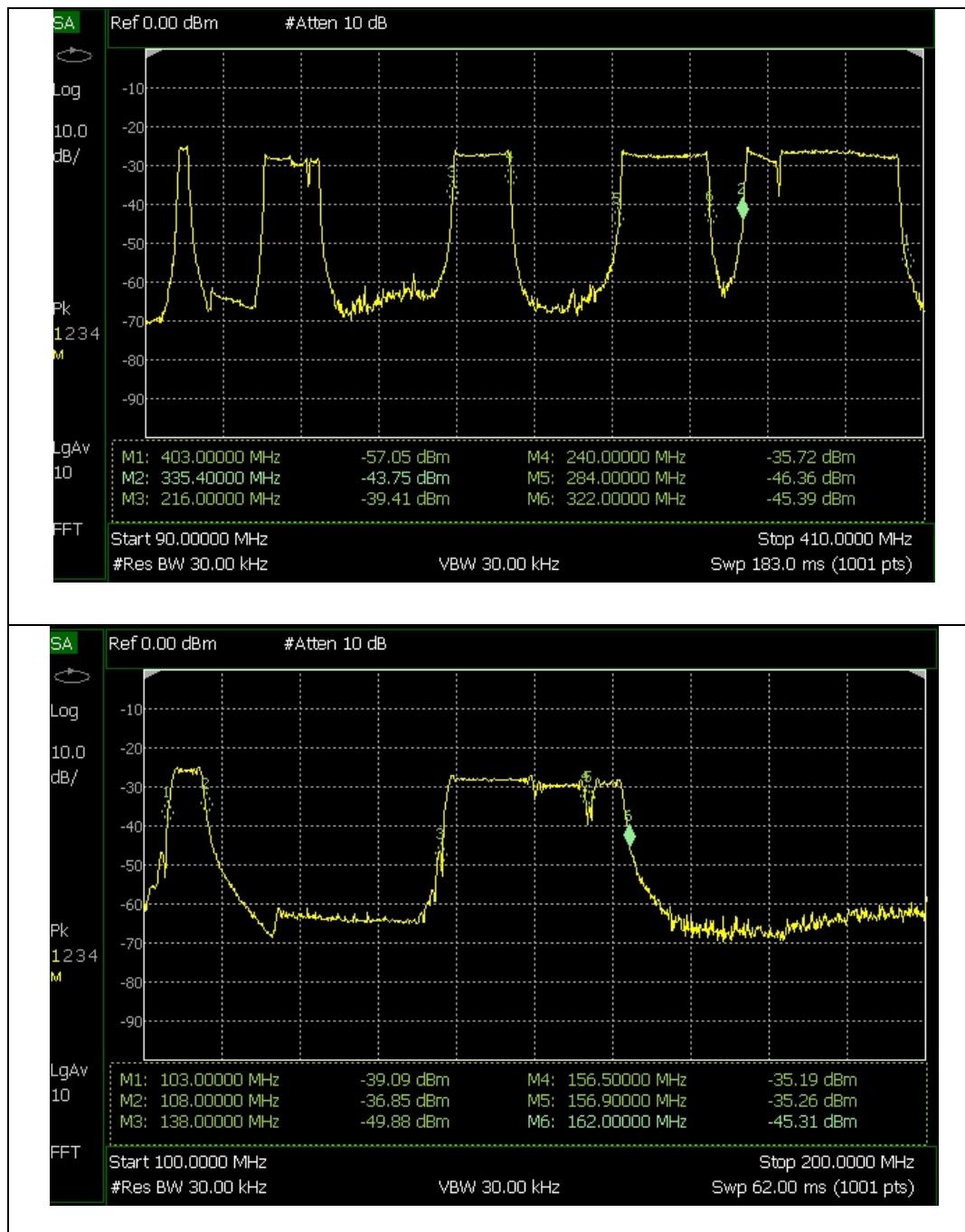


Figure 6.1 Spectrum with FCC Part 15C Notch Mask