

RF Test Report

Report Number: 208745-4 **Revision Level:** 1

Client: Trackonomy Systems, Inc.

214 Devcon Dr. San Jose, CA 95112

Equipment Under Test: Multi-Functional IoT Platform Sensor Gateway

Model: GBP-3001

FCC ID: 2AXA8-GBP-3001

Applicable Standards: FCC Part 15 Subpart C, § 15.247

ANSI C63.10:2013

Report issued on: June 25, 2024

Test Result: Compliant



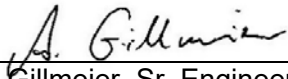
FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 1935.01

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1 Summary of Test Results

Test Description	Test Specification	Test Result
Conducted Output Power	15.247(b)(3)	Compliant
Radiated Spurious Emissions	15.247(d), 15.209(a), 15.205(a)	Compliant

Note: Device used a pre-certified module; but different antenna. Output power spot check verified and reported in this report. The Radiated Spurious Emissions also preformed to ensure product still in compliance.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Company Name: Trackonomy Systems, Inc.
Address: 214 Devcon Dr.
City, State, Zip, Country: San Jose, CA 95132

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 12310 World Trade Drive, Suite 106/107
City, State, Zip, Country: San Diego, CA 92128
Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 1935.01
Designation ID: US1346
CAB ID: US0236

2.3 General Information of EUT

Equipment Under Test: Multi-Functional IoT Platform Sensor Gateway
Model: GBP-3001
Serial Numbers: 20134 (Radiated and Conducted Sample x 1)

FCC ID: 2AXA8-GBP-3001
Frequency Range: 902-928 MHz
Antenna Manufacturer: BBT Antennas
Antenna Model: BBT-09PA08C065
Antenna Type: Panel, Low Profile
Antenna Gain*: 8 dBi (max.)
Rated Voltage: 12.0Vdc

Test Voltage: 12.0Vdc (via external power source for Radiated Measurements)

Sample Received Date: April 01, 2024
Dates of testing: April 15 to June 25, 2024

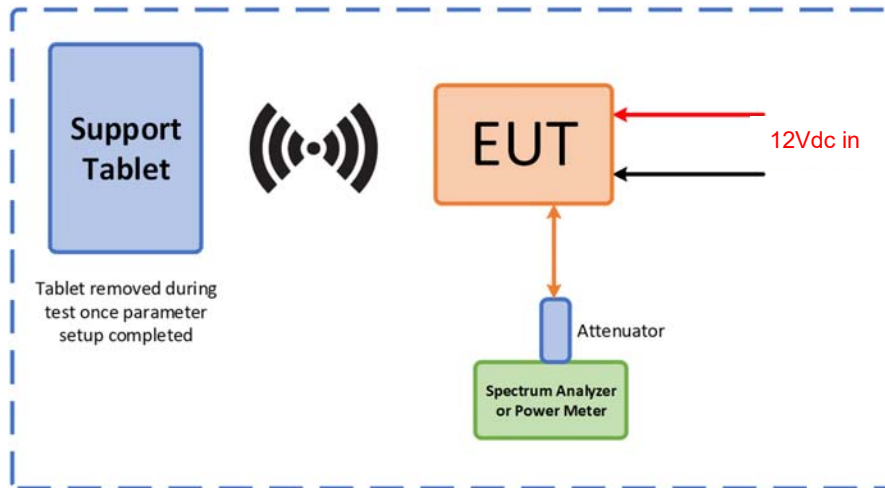
*Data was not measured by SGS laboratory and therefore SGS is not responsible for accuracy. Data obtained via customer, specification sheet, previous filing or other.

2.4 Operating Modes and Conditions

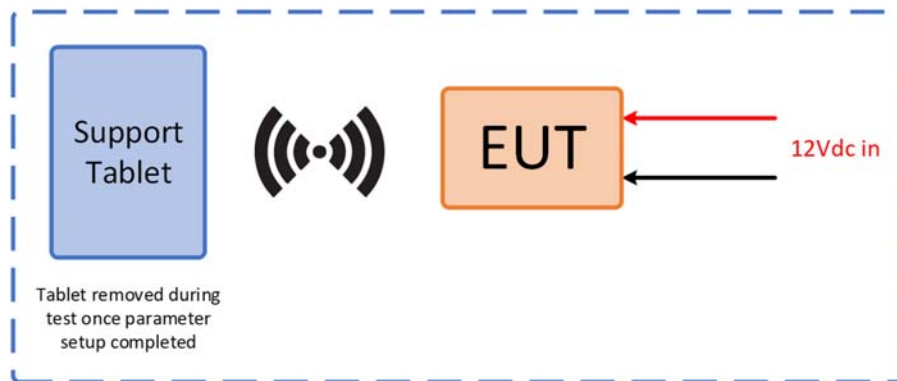
The EUT was running test mode via a support tablet which allowed the following:

- 1) Selecting low, middle and high LoRa channels;
- 2) Selecting the modulation scheme as used in normal operation, but with >98% duty cycle;
- 3) Setting the power level. The maximum power setting of 7 was used for all tests.

2.5 EUT Connection Block Diagram – Conducted Measurements



2.6 EUT Connection Block Diagram – Radiated Measurements

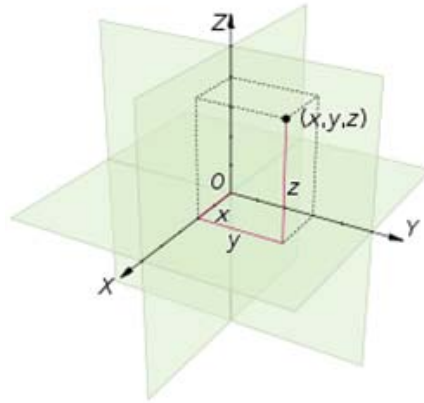


2.7 System Configurations

Manufacturer	Description	Model Number
Samsung	To set parameter on the EUT	SM-T387T

2.8 Worst-case Configuration

Based on the physical of the EUT usage and installation, EUT was evaluated X only orientation. For radiated measurements verification performed using "X" configuration.



3 Transmitter Conducted Output Power

3.1 Test Method

Fundamental maximum peak conducted output power measurements were performed using the method described in ANSI C63.10:2013 clause 7.8.5. This procedure is referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

3.2 Test Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm). Also, the e.i.r.p. shall not exceed 4 Watts (36 dBm)

Technology	Limit (dBm)
LoRa	28

3.3 Test date and test engineer(s)

June 18, 2024

3.4 Test Site

SGS EMC Laboratory, San Diego, CA

Environmental Conditions

Temperature: 17 °C

Relative Humidity: 64 %

Atmospheric Pressure: 101.7 kPa

3.5 Test Setup

Refer to Section 2.5 in this test report

3.6 Additional Observation

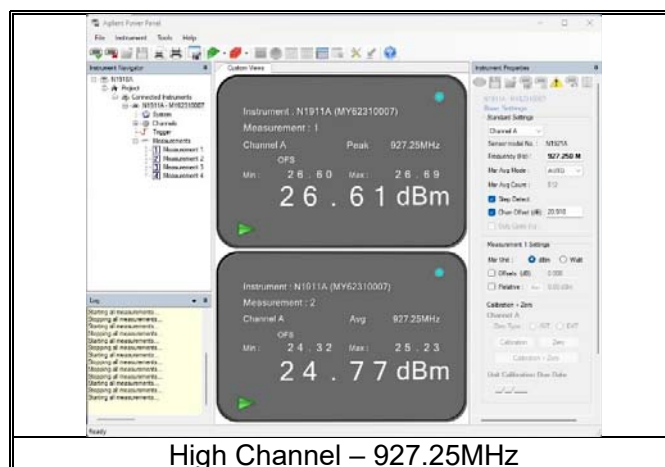
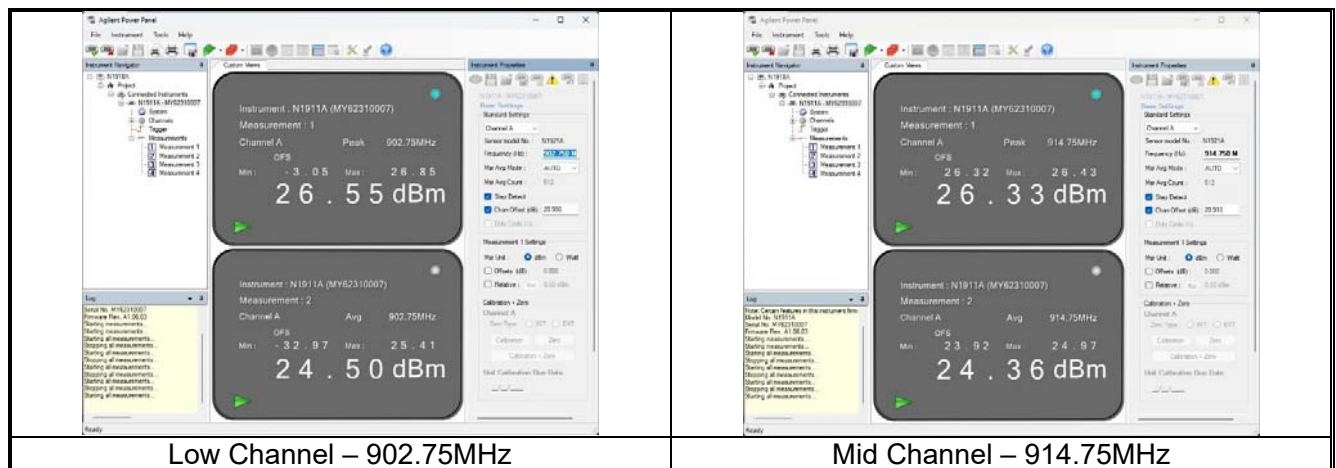
Per customer's declaration the power had been reduced as the power setting "7". The Conducted Output Power was performed and documented in this test report.

3.7 Test Equipment

Asset	Manufacturer	Equipment	Model	Serial No.	Cal Date	Cal Due Date
2013	Keysight	Single Channel PK Power Meter	N1911A	MY62310007	01/29/2024	01/29/2025
2015	Keysight	Wideband Power Sensor	N1921A	MY62220017	01/29/2024	01/29/2025
2018	Shenzhen Sky Toppower Tech.	DC Power Supply	STP3020	N/A	N.C.R.	
-	Weinschel	20dB attenuator	3M-20	116459	Verified	
-	ENS Microwave, LLC	RF cable	S190-320-MNS-MNS	-	Verified	

3.8 Test results

Technology	BW	Modulation	Channel Freq. Band (MHz)	Max Peak Power (dBm)	Antenna (dBi)	Limit (dBm)
LoRa	500kHz	ASK	902.75	26.85	8	28
			914.75	26.43	8	
			927.25	26.69	8	



4 Radiated Spurious Emissions

4.1 Test Result

Test Description	Test Specification	Test Result
Radiated Spurious Emissions	15.247(d), 15.209(a), 15.205(a)	Compliant

4.2 Test Method

Radiated emissions in restricted frequency bands were measured using methods defined in ANSI C63.10 clause 7.8.6 and 7.8.8. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limits within bands of operation:

Frequency	Limits ⁽¹⁾		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽²⁾	--
88 - 216 MHz	150	43.5 ⁽²⁾	--
216 - 960 MHz	200	46 ⁽²⁾	--
960 - 1000 MHz	500	54 ⁽²⁾	--
1 - 40 GHz	500	54 ⁽³⁾	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

4.3 Test Date and Test Engineer(s)

April 15 to June 25, 2024 / AC

4.4 Test Site

SGS EMC Laboratory, San Diego, CA

Environmental Conditions

Temperature: 17 °C

Relative Humidity: 64 %

Atmospheric Pressure: 101.7 kPa

4.5 Additional Observation

- Test was performed from 9kHz to 40GHz with EUT to measurement antenna distance was 3 meters.
- The low frequency band started from 9kHz to 30MHz was pre-scanned and the results was 20dB lower than the limit per 15.31(o); therefore, no data was presented in this test report.
- The high frequency band beyond 18GHz was pre-scanned and the results was 20dB lower than the limit; therefore, no data was presented in this test report.

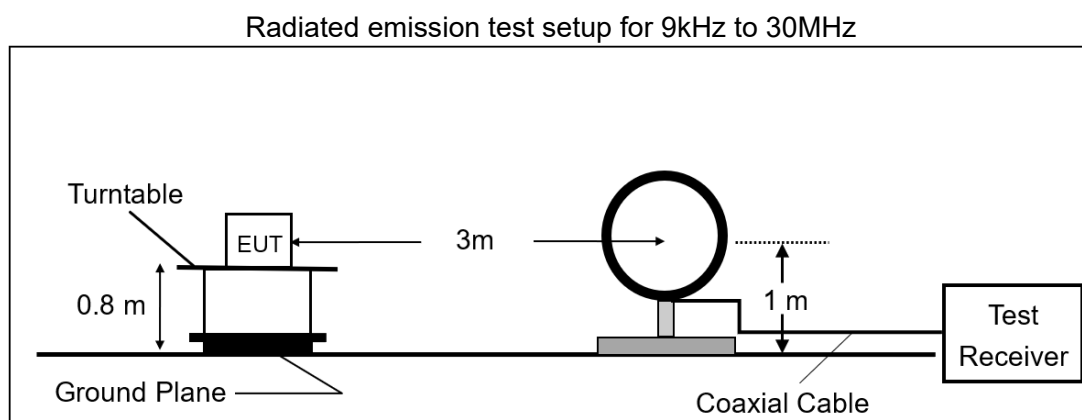
4.6 Test Equipment

Asset	Manufacturer	Equipment	Model	Serial No.	Cal Date	Cal Due Date
2034	ETS Lindgren	Biconilog Antenna 26M-6000MHz	3142E	00243882	06/29/2023	06/29/2025
2029	ETS Lindgren	Loop Antenna, H-Field	6512	00249642	08/31/2022	08/31/2024
2032	ETS Lindgren	DRG Horn Antenna 10G-40GHz	3116C	00251668	06/16/2022	07/16/2024*
-	Micro-Tronics	1GHz High pass filter	HPM16182	G015	Verified	
-	ENS Microwave, LLC	RF cable	S190-320-MNS-MNS	-	Verified	
2017	Keysight	EMI Receiver	N9038B	MY59050132	10/24/2023	10/24/2024
2026	RF-Lambda	RF Microwave Systems Amplifier	RAMP00M45GA	00089204010	06/01/2023	07/01/2024*
2033	ETS Lindgren	DRG Horn Antenna 1G-18GHz	3117	00251986	07/27/2022	07/27/2024
2018	Shenzhen Sky Toppower Tech.	DC Power Supply	STP3020	N/A	N.C.R.	
-	ETS Lindgren	Test Software	TILE!	V.7.8.1.7	N/A	

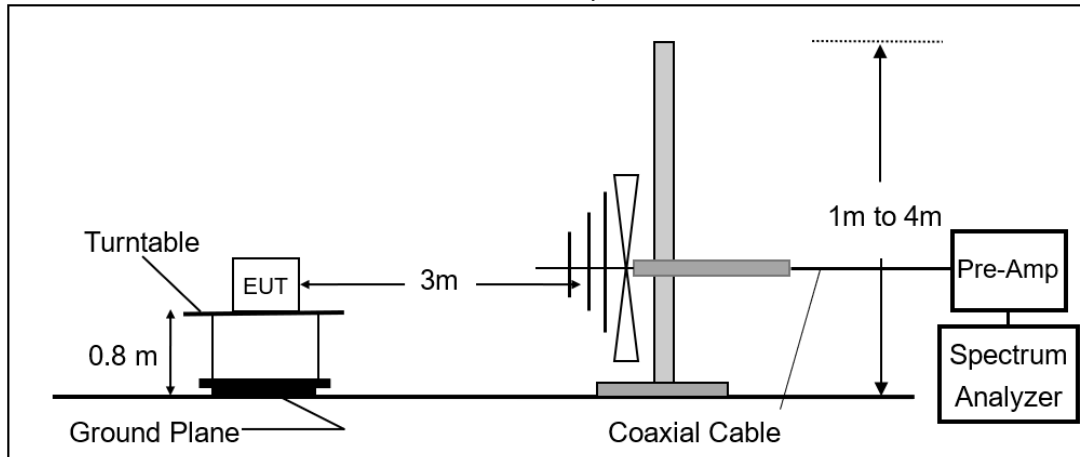
* Note: calibration extended 1 month and equipment verified prior to performed test.

4.7 Test Setup

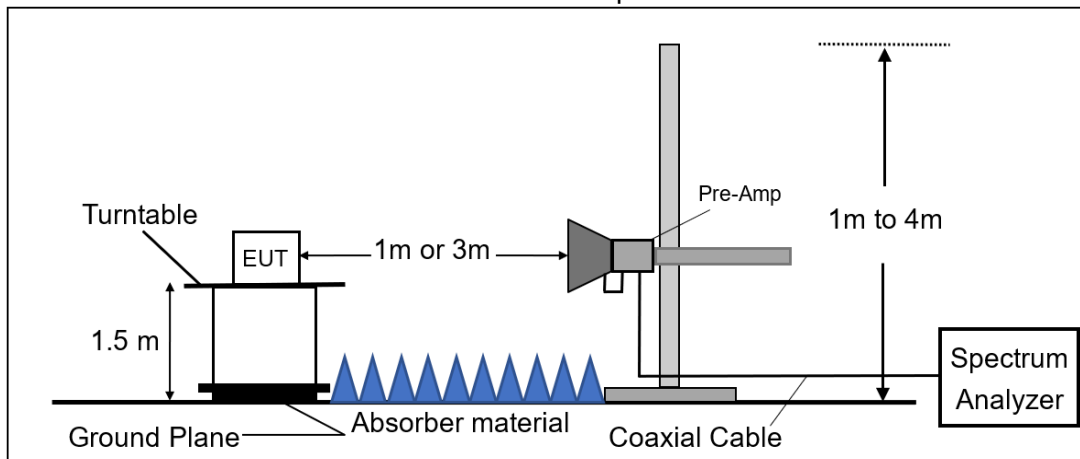
Refer to Section 2.6 in this test report of EUT setup.



Radiated emission test setup for 30MHz to 1GHz



Radiated emission test setup for above 1GHz



4.8 Field Strength Calculation

The total correction factor is calculated by adding the Antenna Factor, Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any).

The basic equation with a sample calculation as follows:

$$TC = AF + CL - AG$$

Where TC = Total Correction CL = Cable Loss
 AG = Amplifier Gain
 AF = Antenna Factor

The Final reading had been calculated internally by the test software by adding the Measurement Reading from the receiver and Total Correction factor.

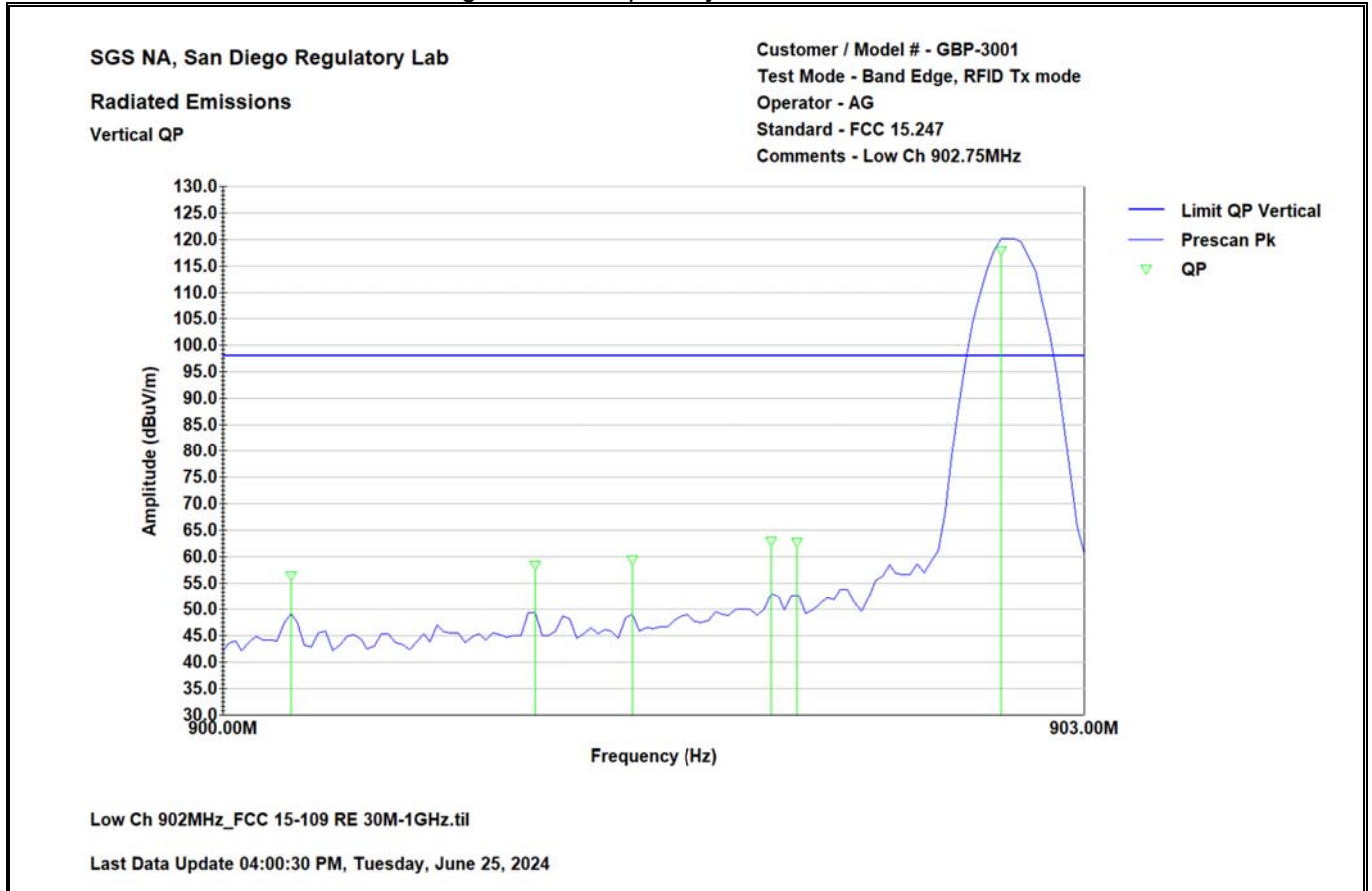
The basic equation with a sample calculation as follows:

$$Final = MR + TC$$

Where TC = Total Correction MR = Measurement Reading

4.9 Test Data – Radiated Band Edge

Low Channel 902.75MHz Band Edge – Vertical polarity

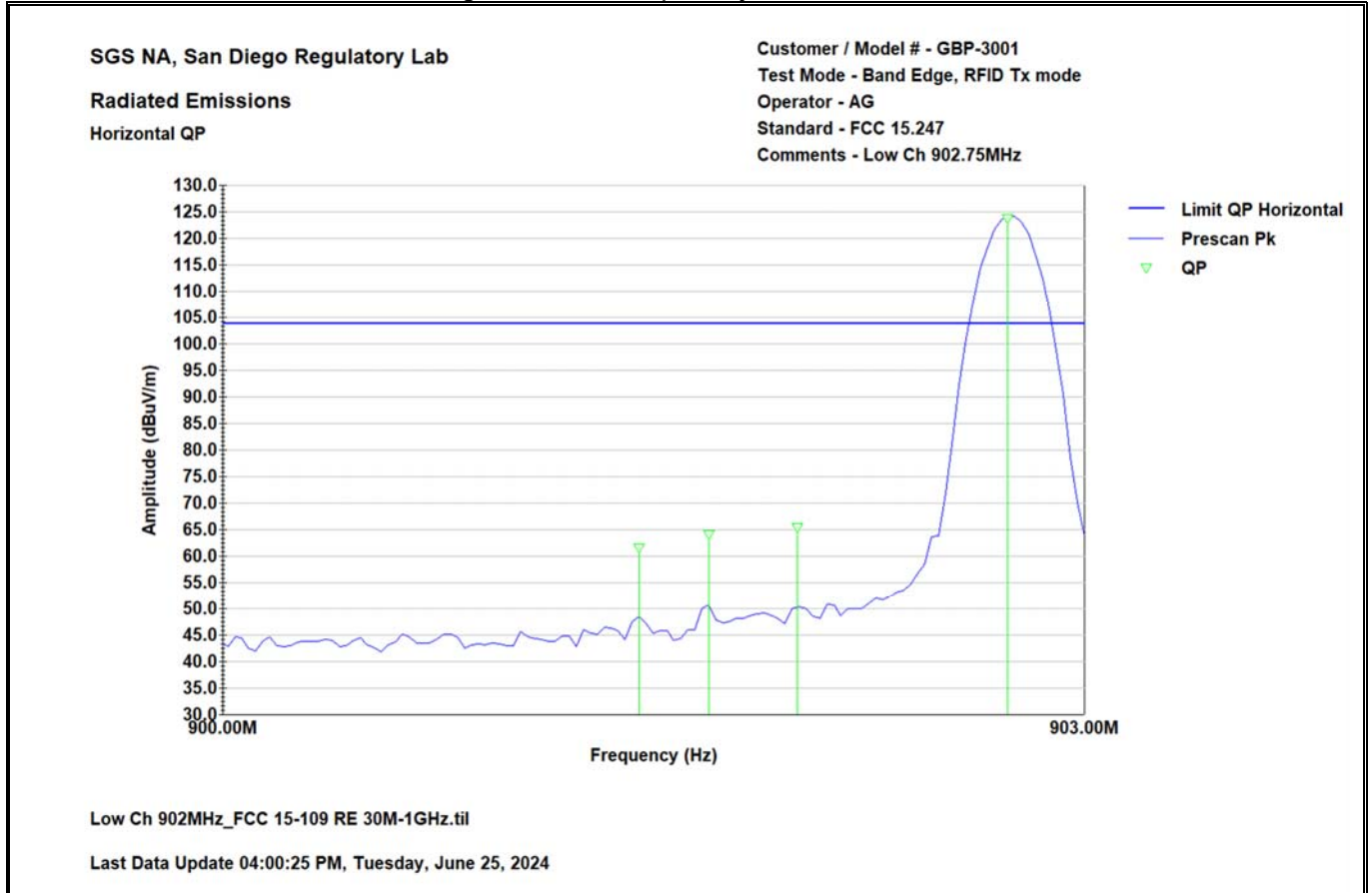


Quasi-Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
900.2355	56.54	-10.29	-41.37	97.91	100	269
901.0842	58.5	-10.25	-39.41	97.91	100	277
901.4237	59.45	-10.24	-38.46	97.91	101	277
901.9087	62.91	-10.21	-35	97.91	101	273
902	62.85	-10.21	-35.06	97.91	102	279
902.709	117.91	Note				

Note: Fundamental frequency not subject to the spurious emission limit. Result data provided for information purpose only.

Low Channel 902.75MHz Band Edge – Horizontal polarity

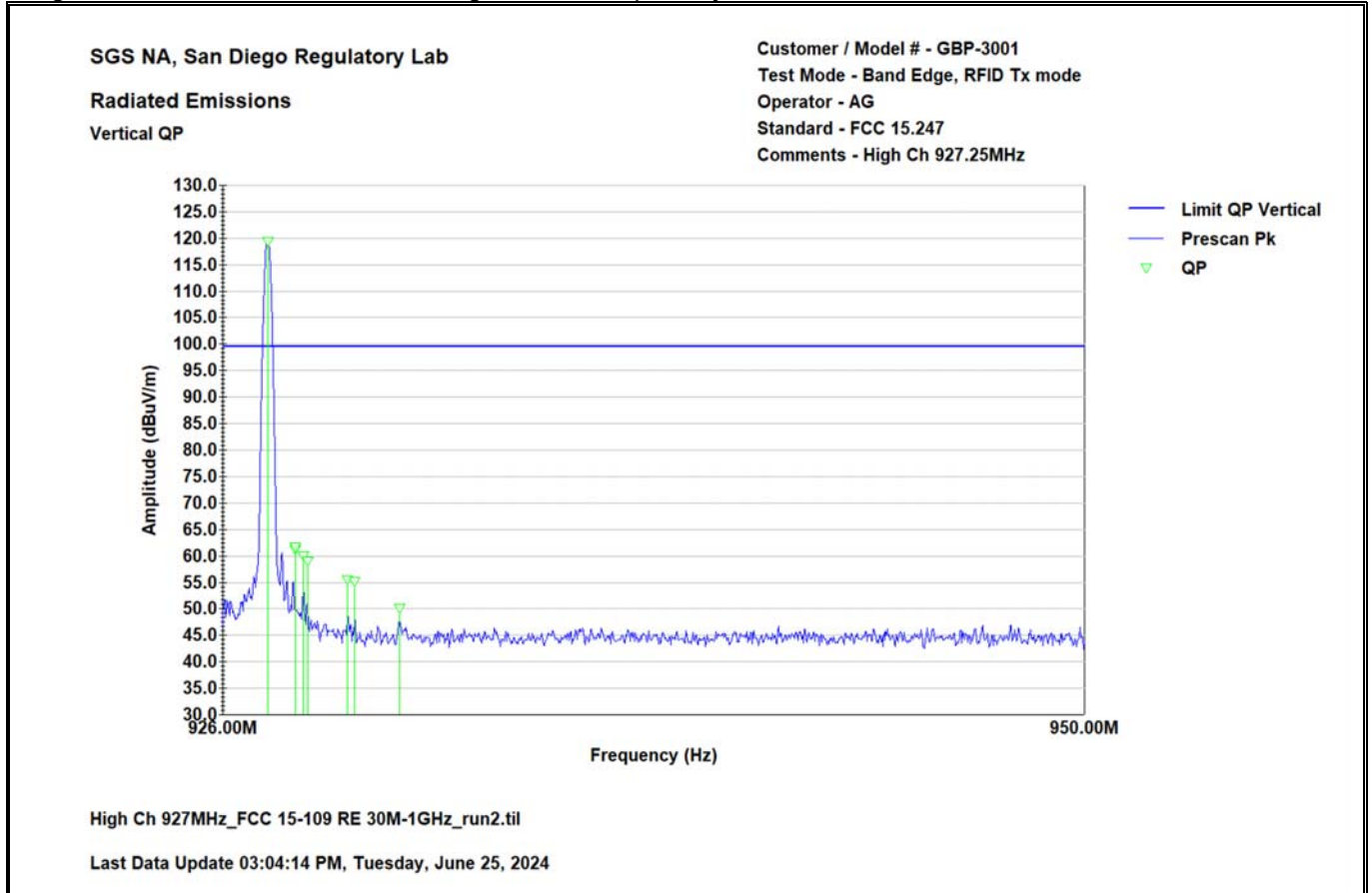


Quasi-Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
901.448	61.68	-10.23	-42.18	103.86	102	64
901.6905	64.11	-10.22	-39.75	103.86	102	55
902	65.55	-10.21	-38.31	103.86	108	51
902.7332	123.86	Note				

Note: Fundamental frequency not subject to the spurious emission limit. Result data provided for information purpose only.

High Channel 927.25MHz Band Edge – Vertical polarity

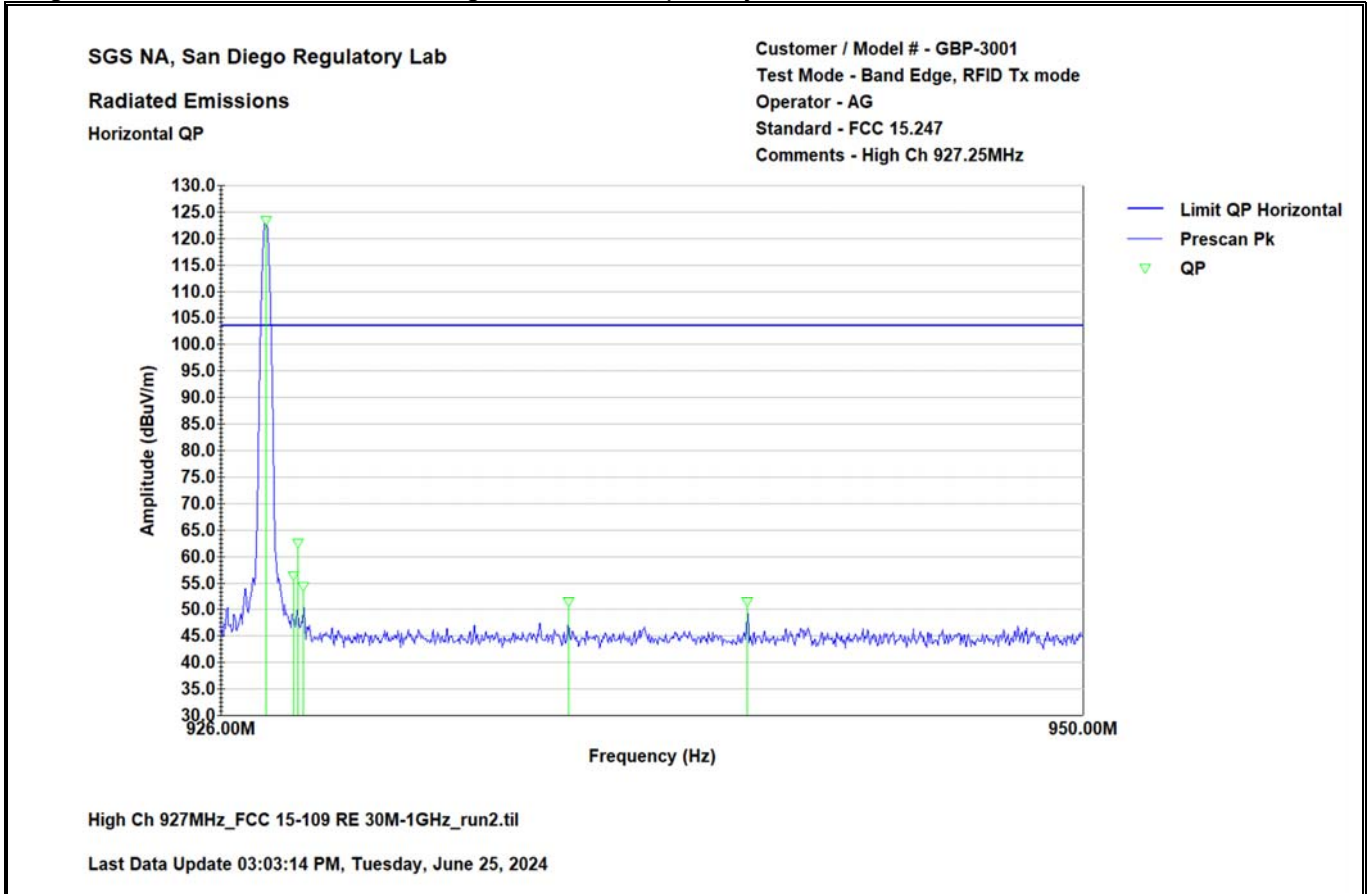


Quasi-Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
927.25	119.52	Note				
928	61.4	-8.59	-38.12	99.52	101	238
928	61.89	-8.59	-37.63	99.52	101	254
928.22	60.1	-8.58	-39.42	99.52	101	242
928.3412	59.09	-8.58	-40.43	99.52	131	380
929.4325	55.74	-8.53	-43.78	99.52	100	257
929.6265	55.39	-8.52	-44.13	99.52	100	257
930.8632	50.24	-8.48	-49.28	99.52	100	253

Note: Fundamental frequency not subject to the spurious emission limit. Result data provided for information purpose only.

High Channel 927.25MHz Band Edge – Horizontal polarity



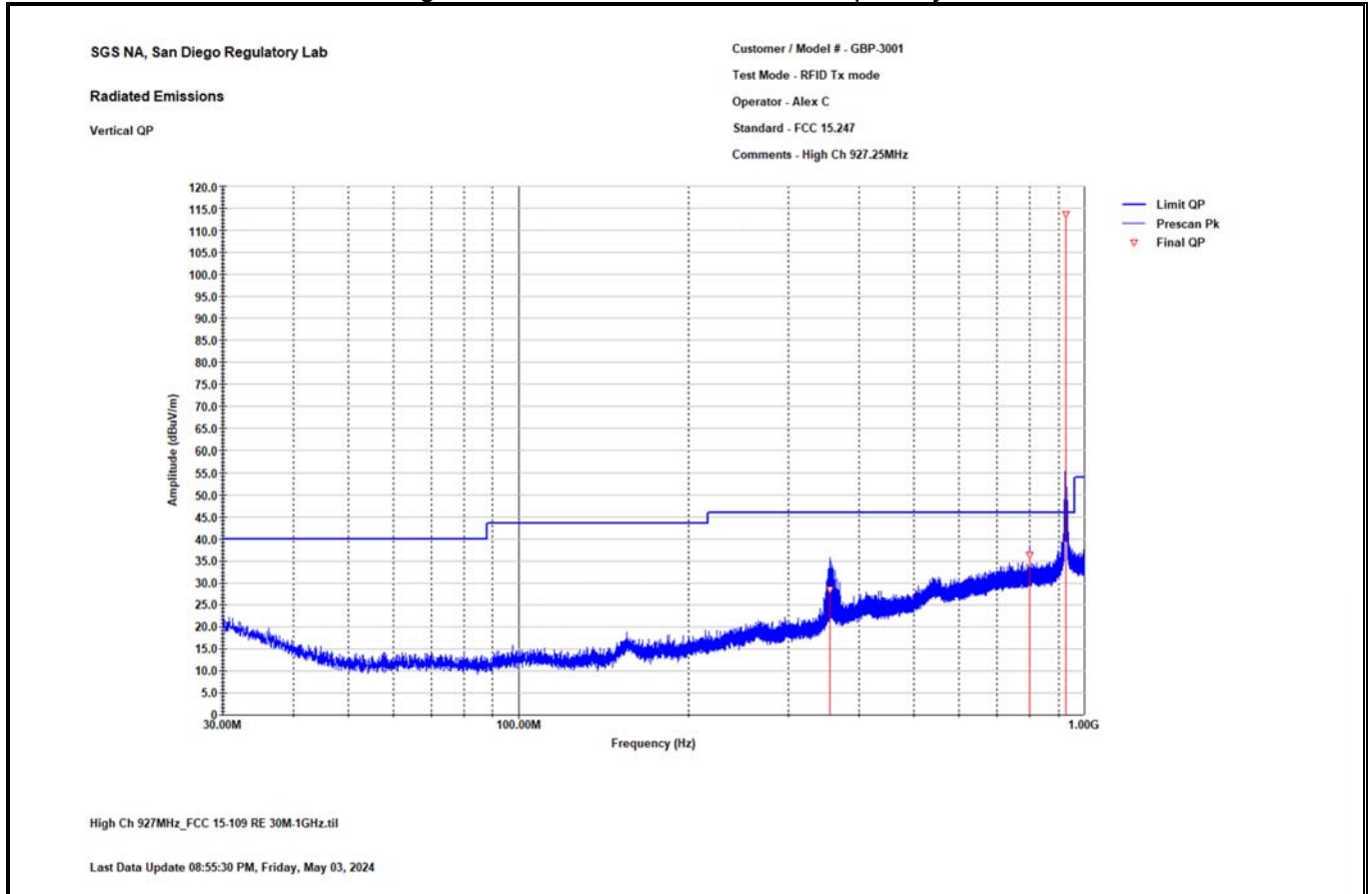
Quasi-Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
927.25	123.55	Note				
928	56.45	-8.59	-47.1	103.55	117	-20
928.123	62.67	-8.59	-40.88	103.55	100	44
928.2685	54.49	-8.58	-49.06	103.55	101	-20
935.592	51.46	-8.35	-52.09	103.55	177	173
940.5633	51.41	-8.3	-52.14	103.55	100	365

Note: Fundamental frequency not subject to the spurious emission limit. Result data provided for information purpose only.

4.10 Test Data – Radiated Spurious Emission

30MHz to 1GHz Worst-Case High Channel 927.25MHz – Vertical polarity

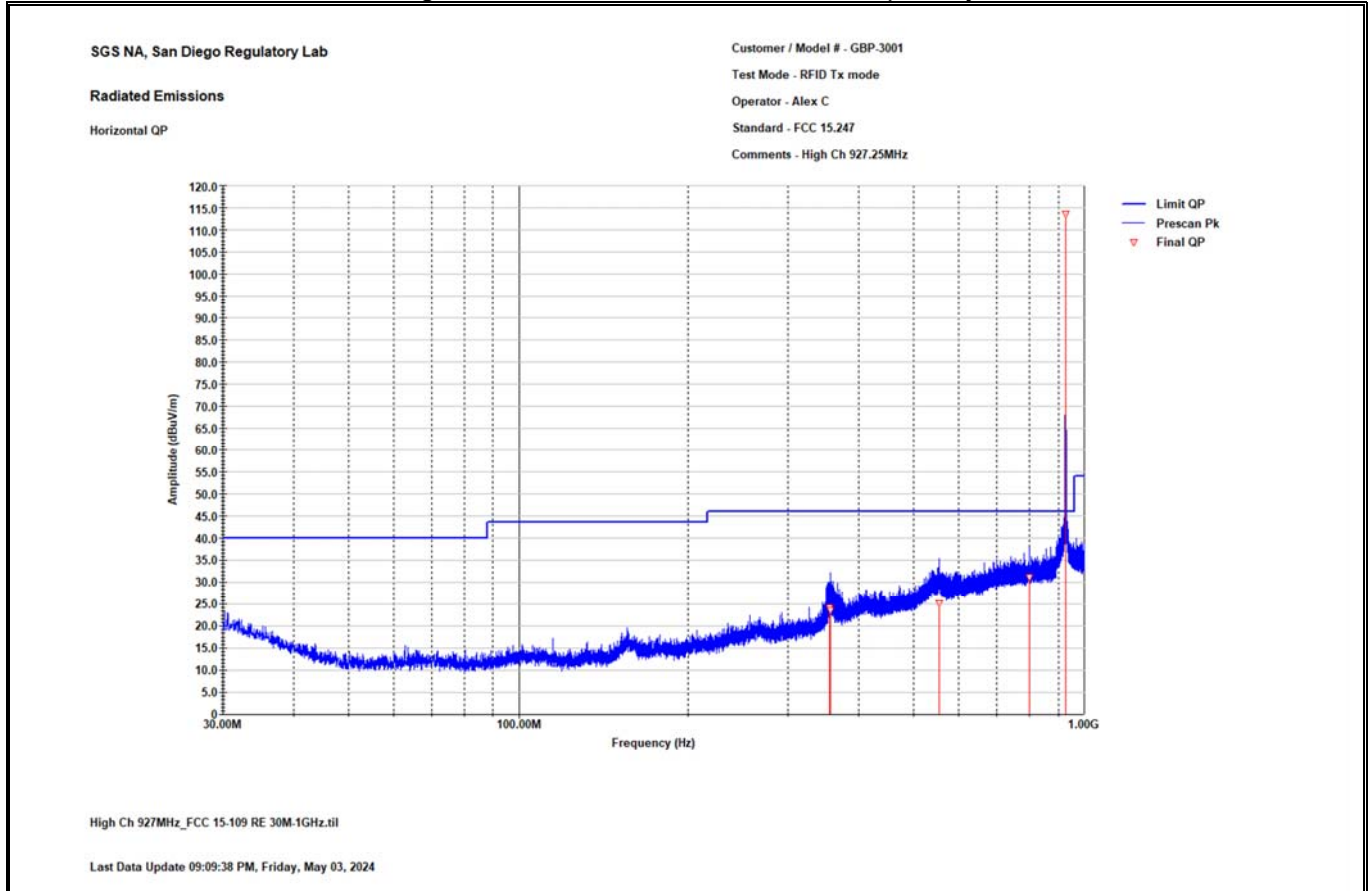


Quasi-Peak Data

Freq. (MHz)	Final QP (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
355.412	28.57	-20.7	-17.45	46.02	106	77
800	36.4	-11.35	-9.62	46.02	114	137
927.24	113.59	Note				

Note: Fundamental frequency not subject to radiated spurious emissions requirement. Result data provided for information purpose only.

30MHz to 1GHz Worst-Case High Channel 927.25MHz – Horizontal polarity

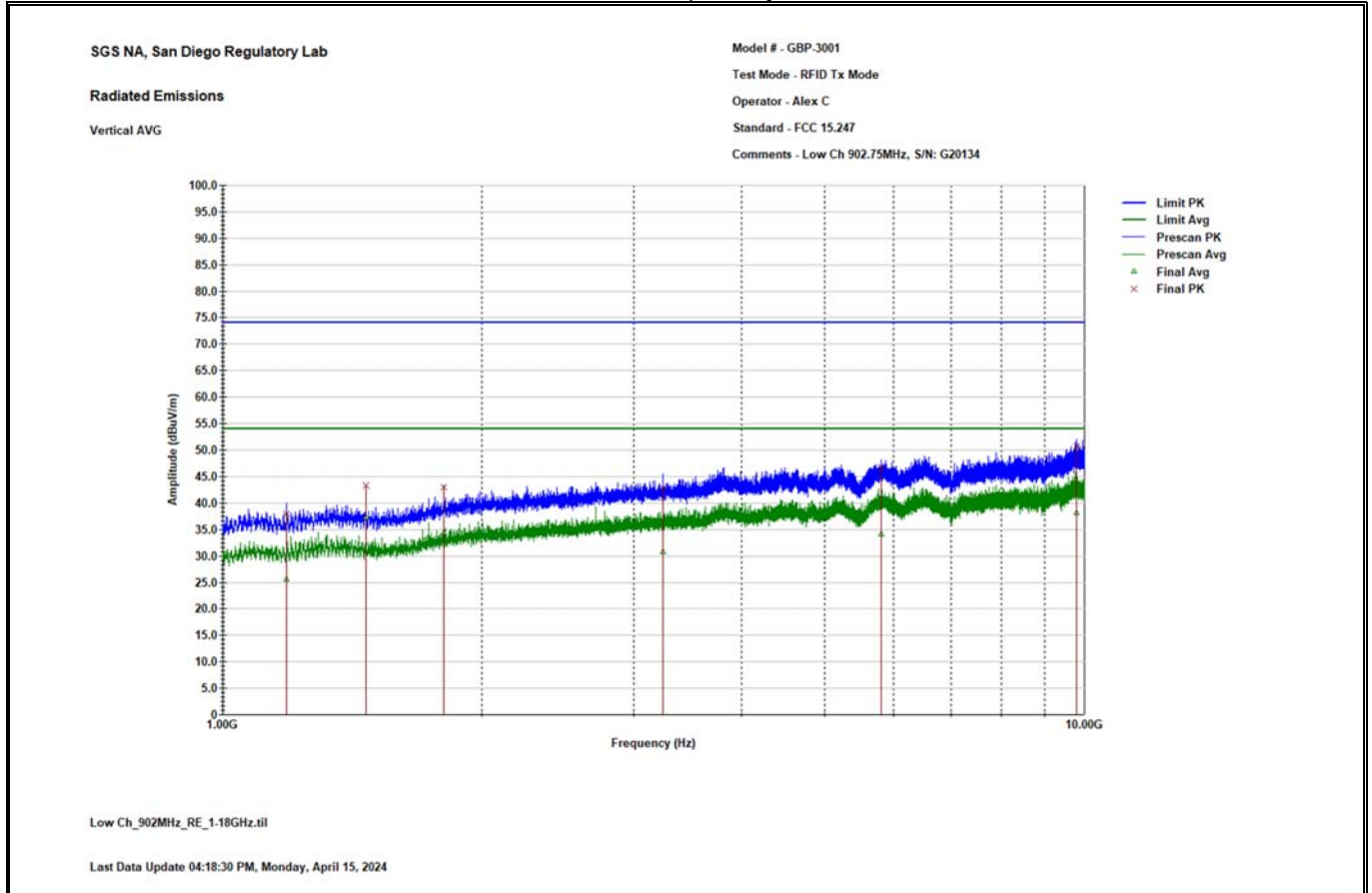


Quasi-Peak Data

Freq. (MHz)	Final QP (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
355.297	24.24	-20.7	-21.78	46.02	100	8
355.957	23.56	-20.68	-22.46	46.02	100	6
553.923	25.2	-13.62	-20.82	46.02	273	-17
799.964	31.23	-11.35	-14.79	46.02	153	132
927.24	113.6	Note				

Note: Fundamental frequency not subject to radiated spurious emissions requirement. Result data provided for information purpose only.

1GHz to 18GHz Low Channel 902.75MHz – Vertical polarity



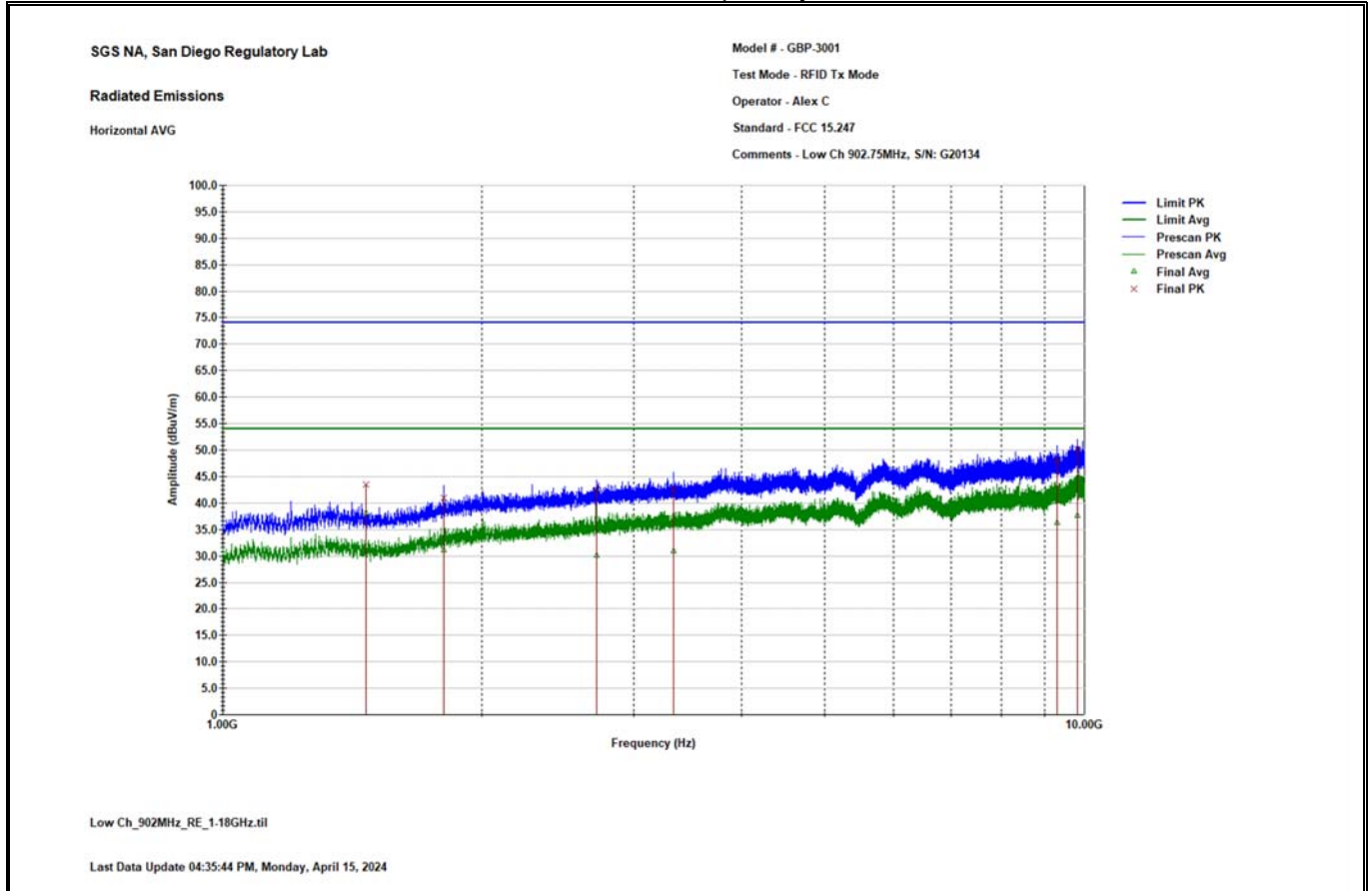
Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1186.575	37.98	-6.95	-36.02	74	390	60
1466.65	43.27	-6.41	-30.73	74	285	190
1805.8	43.06	-3.38	-30.94	74	212	160
3241.025	42.79	2.35	-31.21	74	172	30
5808.025	46.58	9.3	-27.42	74	400	2
9789	50.7	19.18	-23.3	74	179	208

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1186.575	25.61	-6.95	-28.39	54	390	60
1466.65	37.27	-6.41	-16.73	54	285	190
1805.8	34.54	-3.38	-19.46	54	212	160
3241.025	30.85	2.35	-23.15	54	172	30
5808.025	34.08	9.3	-19.92	54	400	2
9789	38.11	19.18	-15.89	54	179	208

1GHz to 18GHz Low Channel 902.75MHz – Horizontal polarity



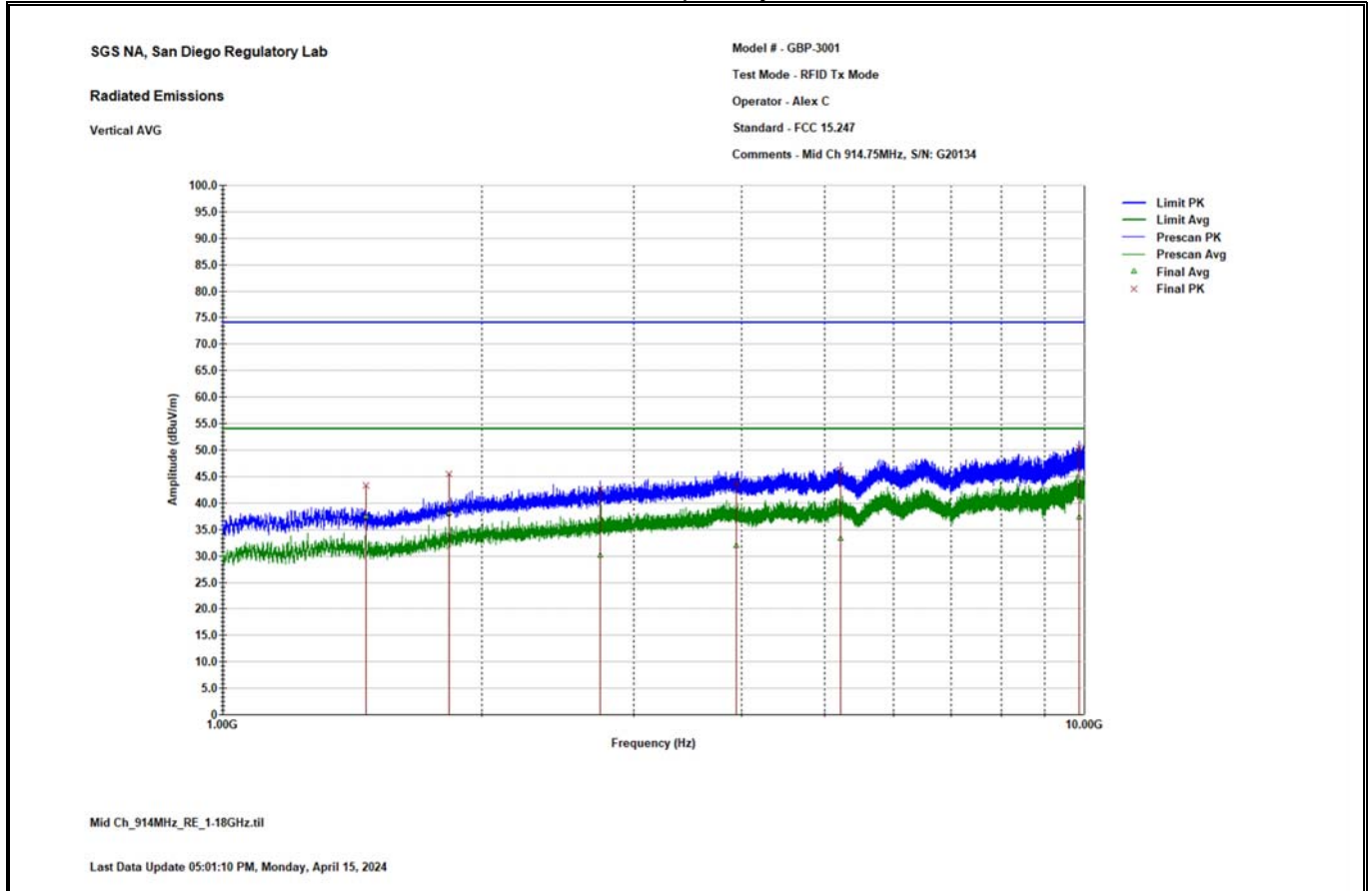
Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	43.47	-6.41	-30.53	74	260	170
1805.375	41.02	-3.38	-32.98	74	374	54
2715.725	42.45	1.2	-31.55	74	390	235
3332.825	42.74	2.48	-31.26	74	374	299
9302.8	48.11	18.05	-25.89	74	194	318
9813.225	50.19	19.14	-23.81	74	247	239

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	38.1	-6.41	-15.9	54	260	170
1805.375	31.19	-3.38	-22.81	54	374	54
2715.725	30.23	1.2	-23.77	54	390	235
3332.825	30.91	2.48	-23.09	54	374	299
9302.8	36.4	18.05	-17.6	54	194	318
9813.225	37.68	19.14	-16.32	54	247	239

1GHz to 18GHz Mid Channel 914.75MHz – Vertical polarity



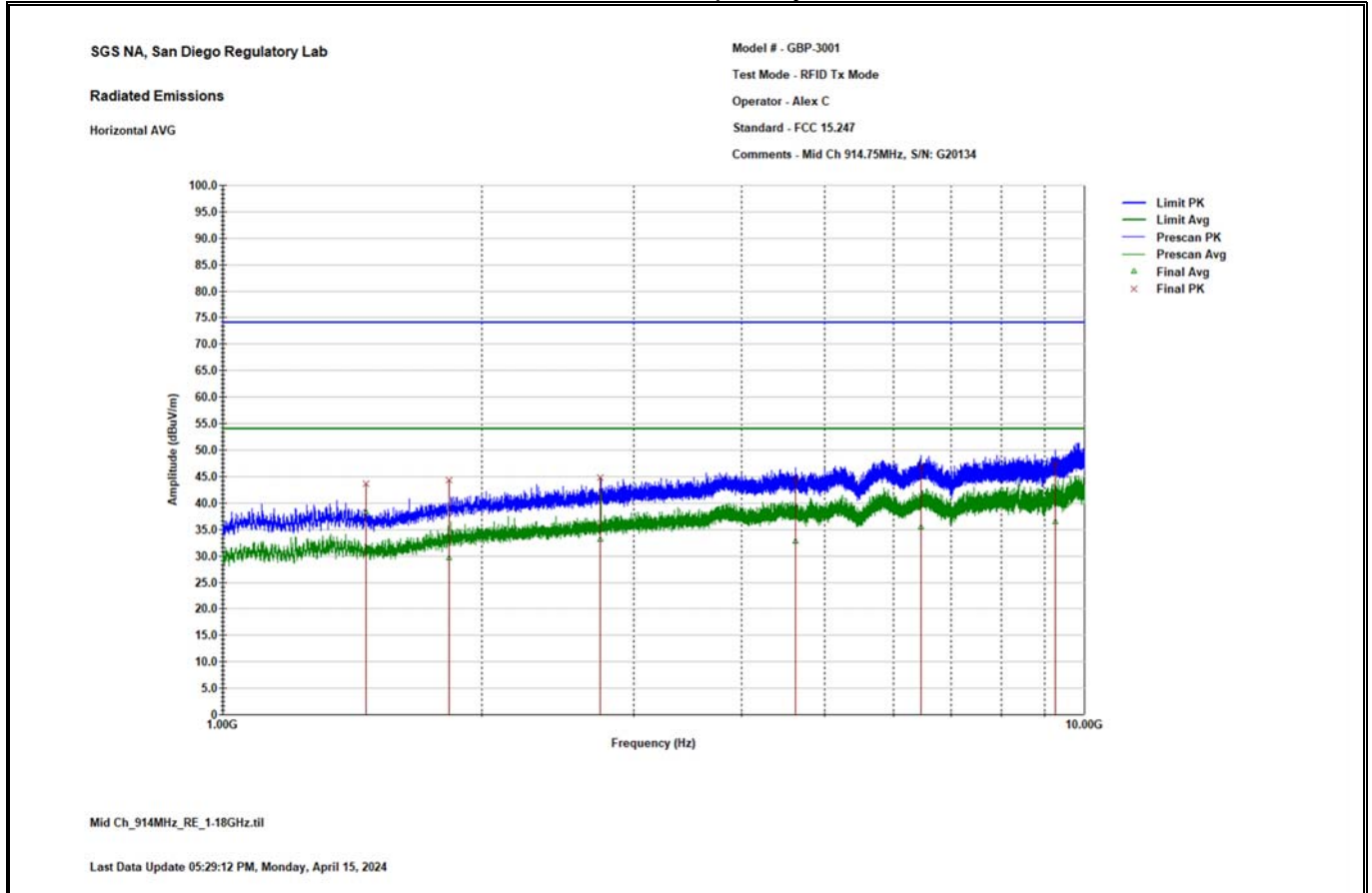
Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	43.26	-6.41	-30.74	74	261	193
1829.175	45.55	-3.09	-28.45	74	156	164
2739.95	42.63	1.34	-31.37	74	365	178
3946.525	43.8	4.09	-30.2	74	342	253
5209.2	46.3	7.38	-27.7	74	302	160
9871.875	50.53	19.06	-23.47	74	236	231

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	37.49	-6.41	-16.51	54	261	193
1829.175	38.11	-3.09	-15.89	54	156	164
2739.95	30.13	1.34	-23.87	54	365	178
3946.525	31.95	4.09	-22.05	54	342	253
5209.2	33.26	7.38	-20.74	54	302	160
9871.875	37.39	19.06	-16.61	54	236	231

1GHz to 18GHz Mid Channel 914.75MHz – Horizontal polarity



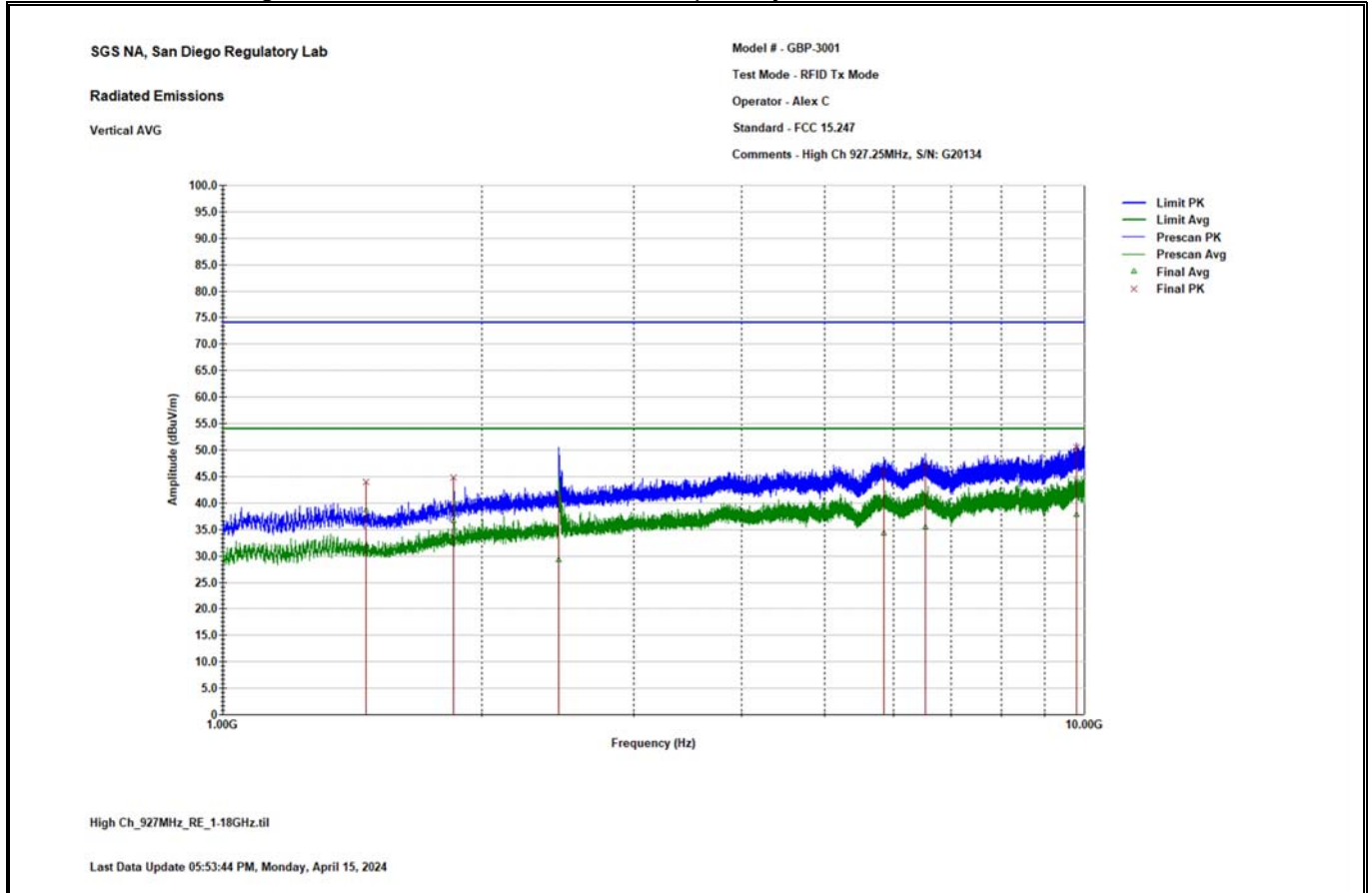
Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	43.69	-6.41	-30.31	74	332	167
1829.6	44.37	-3.09	-29.63	74	363	157
2744.2	44.83	1.35	-29.17	74	164	-20
4620.575	44.4	6.16	-29.6	74	331	64
6462.95	46.98	10.82	-27.02	74	386	-17
9252.64	47.54	17.79	-26.46	74	378	149

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	38.36	-6.41	-15.64	54	332	167
1829.6	29.66	-3.09	-24.34	54	363	157
2744.2	33.16	1.35	-20.84	54	164	-20
4620.575	32.76	6.16	-21.24	54	331	64
6462.95	35.44	10.82	-18.56	54	386	-17
9252.64	36.47	17.79	-17.53	54	378	149

1GHz to 18GHz High Channel 927.25MHz – Vertical polarity



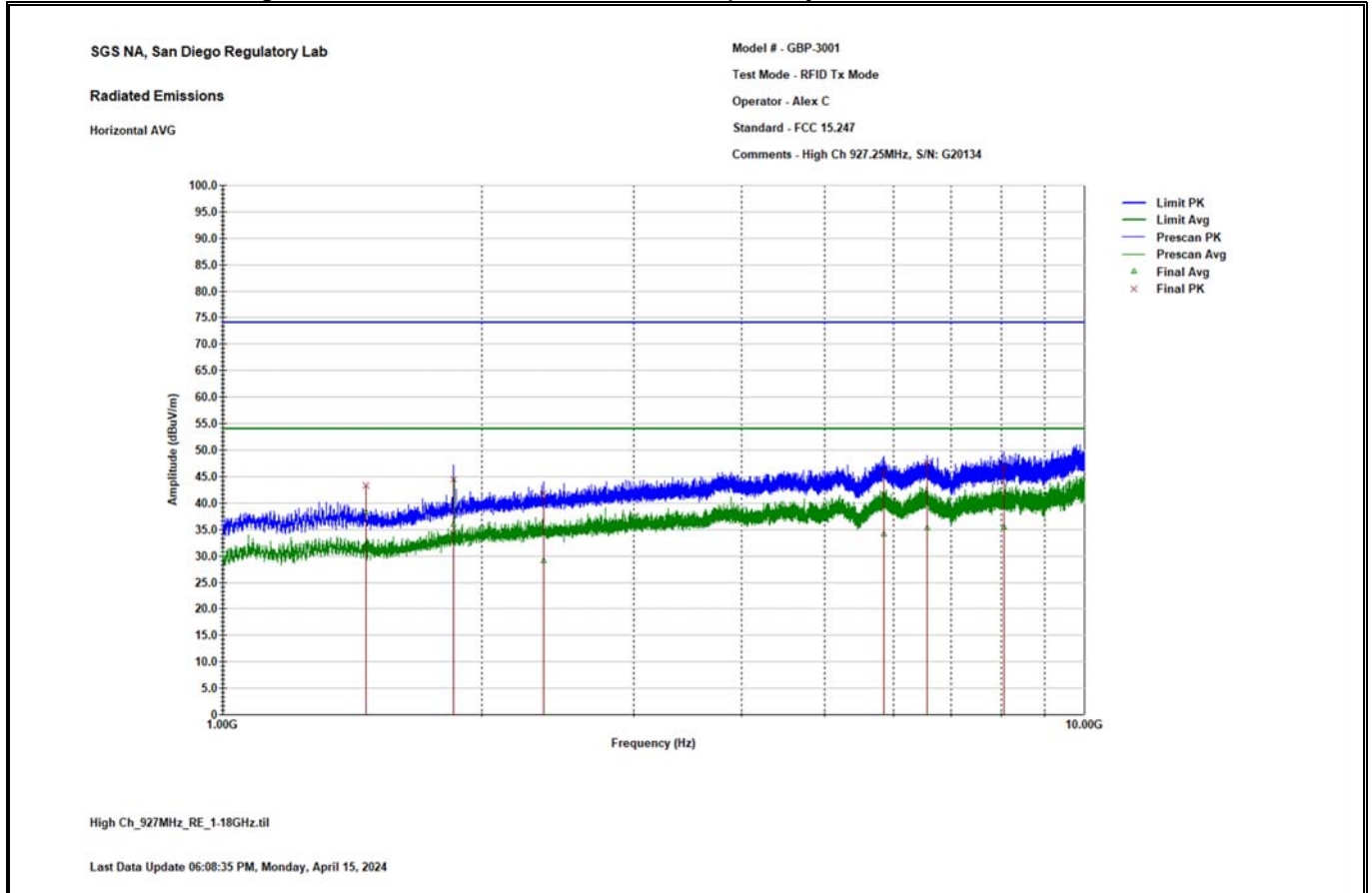
Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	43.91	-6.41	-30.09	74	253	211
1854.675	44.81	-2.86	-29.19	74	400	291
2454.34	41.08	-0.28	-32.92	74	375	232
5849.675	46.22	9.56	-27.78	74	400	370
6544.125	47.24	11.08	-26.76	74	256	137
9800.9	50.56	19.16	-23.44	74	256	197

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	38.68	-6.41	-15.32	54	253	211
1854.675	36.71	-2.86	-17.29	54	400	291
2454.34	29.27	-0.28	-24.73	54	375	232
5849.675	34.28	9.56	-19.72	54	400	370
6544.125	35.48	11.08	-18.52	54	256	137
9800.9	37.77	19.16	-16.23	54	256	197

1GHz to 18GHz High Channel 927.25MHz – Horizontal polarity



Peak Data

Freq. (MHz)	Final Pk (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	43.34	-6.41	-30.66	74	332	172
1854.25	44.46	-2.87	-29.54	74	150	60
2356.5	41.88	-0.72	-32.12	74	364	373
5854.775	45.91	9.59	-28.09	74	194	281
6562.4	47.72	11.15	-26.28	74	163	273
8059.25	46.79	15.23	-27.21	74	355	355

Average Data

Freq. (MHz)	Final Avg (dBμV/m)	Total Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Ant. Height (cm)	Azimuth (deg.)
1466.65	38.39	-6.41	-15.61	54	332	172
1854.25	35.91	-2.87	-18.09	54	150	60
2356.5	29.09	-0.72	-24.91	54	364	373
5854.775	34.23	9.59	-19.77	54	194	281
6562.4	35.38	11.15	-18.62	54	163	273
8059.25	35.44	15.23	-18.56	54	355	355

5 Measurement Uncertainty

The measurement uncertainty figures are calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) $k = 2$ (which provides confidence levels of 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Measurement uncertainty is not used to adjust the measurements to determine compliance.

Parameter	Expanded Uncertainty for Normal k factor equal to 2	
	Required	Laboratory Actual
all emissions, radiated	± 6 dB	± 4.8 dB
temperature	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	± 5 %	$\pm 3.5\%$

6 Revision History

Revision Level	Description of changes	Revision Date
1	Initial release	June 25, 2024