FCC 15.245 Test Report

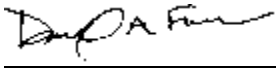
Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 (USA)	Sensys Gatso Sweden AB Tel: +46 36 34 29 80 Vasavagen 3C Box 2174 SE-554 54 Jonkoping Sweden

Model	17-012166 TD1	**Test Report Date**	June 27, 2023
FCC ID	2BA8R-TD1N66R1	**RTL Work Order #**	2022098
		RTL Quote	QRTL22-098B

American National Standard Institute	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC Classification	FDS: Field Disturbance Sensor
FCC Rule Part(s)/ Guidance	FCC 15.245: Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500-10550 MHz, and 24075–24175 GHz (10-01-21)

Frequency Range (MHz)	Output Power (W)	Frequency Tolerance (%)	Emission Designator
24075–24175	N/A	N/A	N/A

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviations from, additions to, or exclusions from, the applicable parts of ANSI 63.10, FCC Part 2 and Part 15.

Signature:  Date: June 27, 2023

Name: Desmond A. Fraser Position: President

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This replaces R1.0.

These test(s) are accredited under Rhein Tech Laboratories, Inc. ISO/IEC 17025 accreditation issued by ANAB. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This is an FCC test report prepared on behalf of Sensys Gatso Sweden AB.

Applicable standard:

FCC 15.245: Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500-10550 MHz, and 24075–24175 GHz (10-01-21)

1.2 Description of EUT

Equipment Under Test	Radar
Model	17-012166 TD1
Input Power Rating	12 VDC
Modulation Type	FMCW
Frequency Range	24075 – 24175 MHz

1.3 Test Facility

The open area test site (OATS) and conducted measurement facility used to collect the conducted and radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170 (USA).

1.4 Related Submittal(s)/ Grant(s)

None.

1.5 Modification(s) to EUT

None.

1.6 Deviation(s) from Standard(s)

None.

1.7 Acronyms Used in this Document

AVG - Average
EUT - Equipment Under Test
LISN - Line Impedance Stabilization Network
PK - Peak
QPK - Quasi-Peak
SCF - Site Correction Factor

2 Test Information

2.1 Exercising the EUT

The 17-012166 TD1 was configured for testing in a fashion simulating how an end-user would operate the device. All ports were loaded. The 17-012166 TD1 was connected to a laptop with an ethernet/power/IO pigtail cable.

The EUT was provided power through an external 12 VDC supply

For all tests, the EUT was operated in its most EMC-sensitive configuration.

2.2 Description of Test Mode(s)

In accordance with FCC Part 15.31(m), the following frequency was tested:

Table 2-1: Test Frequency

Channel (#)	Frequency (MHz)
N/A	24128.7

2.3 Test Result Summary

Table 2-2: Test Result Summary

Test	FCC Reference	Result
AC/DC Conducted Emissions	Part 15.207	Pass
Radiated Emissions	Part 15.209	Pass
Field Strength of Fundamental and Harmonics	Part 15.245(b)	Pass

2.4 Test System Details

The test sample was received on May 30, 2023. The FCC identifiers for all applicable equipment and cable descriptions used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

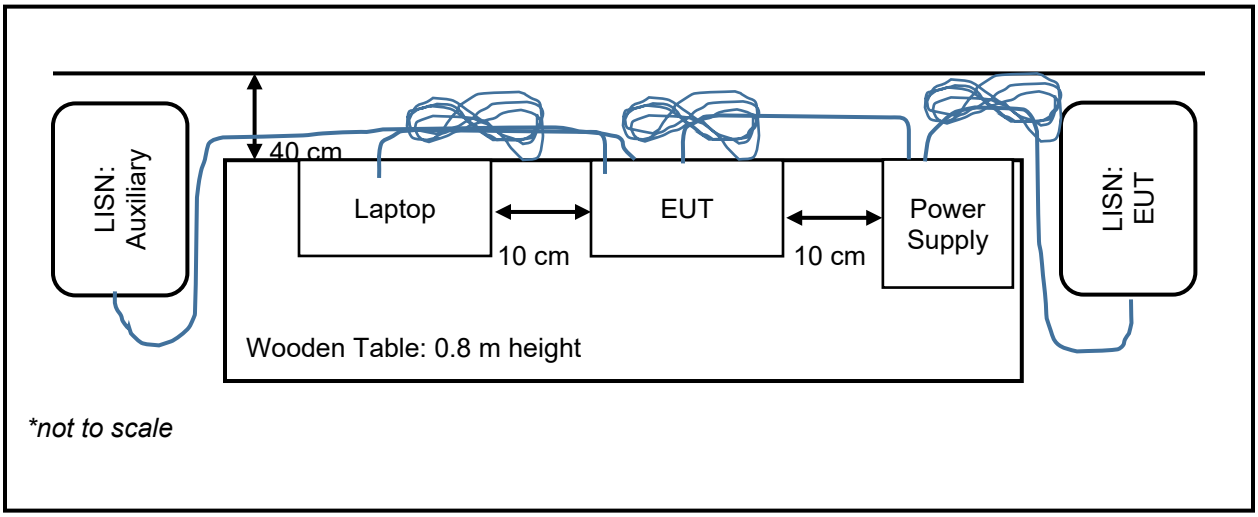
Part	Manufacturer	Model	Serial Number	Cable Description	RTL Bar Code
Radar	Sensys Gatso Sweden AB.	17-012166 TD1	E95E1C1D0000 (S2)	Unshielded Power	24291
Radar with mounting bracket	Sensys Gatso Sweden AB.	17-012166 TD1	BF961C1D0000 (S1)	Unshielded Power	24290

Table 2-4: Auxiliary Equipment

Part	Manufacturer	Model	Serial Number	Cable Description	RTL Bar Code
DC Power Supply	Instek	PSS-32-3	B200344	Unshielded ethernet/power	2679
AC Adapter	Green Cell Pro	AD07AP	AD07AP1211210GP00070	1.5 m Unshielded AC/DC	24293
Laptop	DELL	Latitude E5470	7YW1NC2	Unshielded	24294

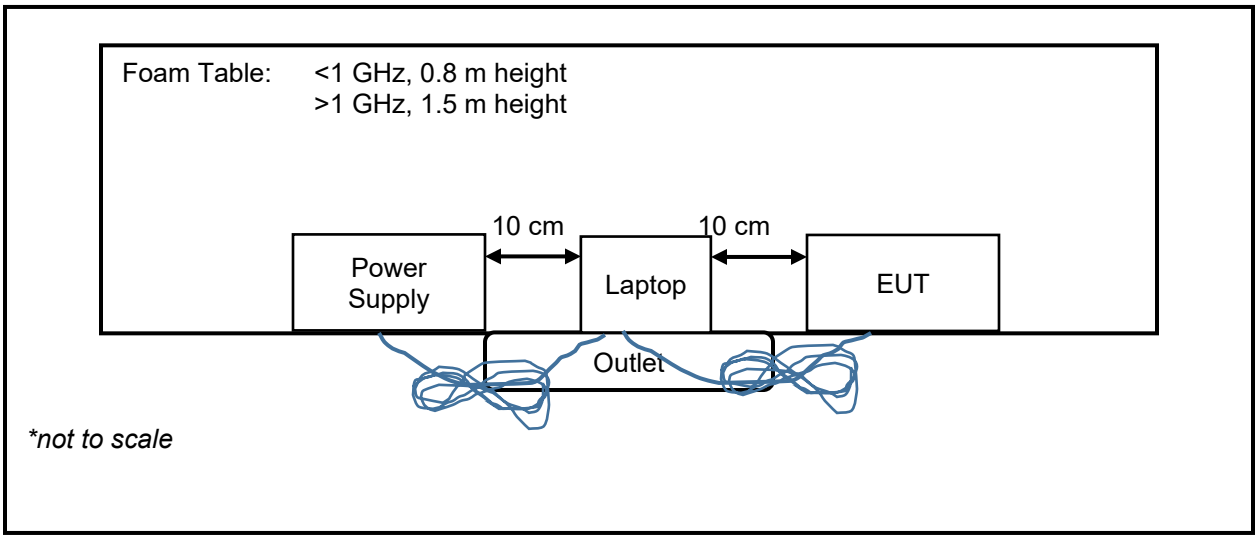
2.5 Test Configuration

Figure 2-1: Configuration of Tested System, Conducted Emissions



*not to scale

Figure 2-2: Configuration of Tested System, Radiated Emissions



*not to scale

3 Conducted Emissions – FCC Part 15.207

3.1 Conducted Emissions Test Procedure

The powerline conducted emissions measurement were performed in a Series 81 Type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 cm high. Power was fed to the EUT through a 50 Ω/ 50 µH Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an AC filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed AC power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers a DC power supply which powers the EUT.

The spectrum analyzer (SA) was connected to the AC line through an isolation transformer. The 50 Ω output of the LISN was connected to the SA input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the SA from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the SA operating in the CISPR quasi-peak (QPK) mode or peak (PK) mode if applicable.

The SA's 6 dB bandwidth was set to 9 kHz. Video bandwidth (VBW) filter less than 10 times the resolution bandwidth (RBW) is not used. Average (AVG) measurements are performed in linear mode using a 10 kHz RBW, 1 Hz VBW, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and recorded.

3.2 Conducted Emissions Limits

Table 3-1: Conducted Emissions Limits per FCC Part 15.207

Frequency (MHz)	QPK (dBµV)	AVG (dBµV)
0.15 – 0.50	66 – 56	56 – 46
0.5 – 5.0	56	46
5 – 30	60	50

3.3 Measurement Uncertainty

Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2.

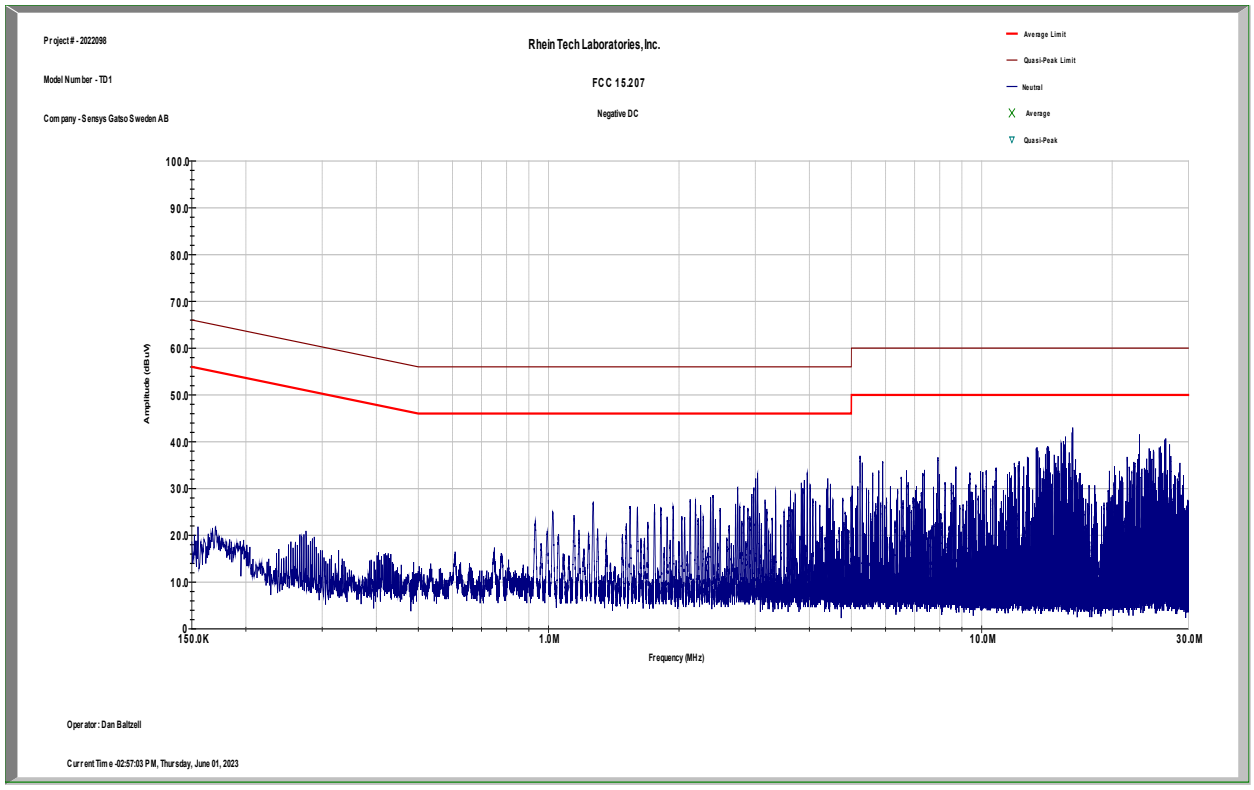
Conducted Emissions: ±3.6 dB

3.4 Conducted Emissions Test Data

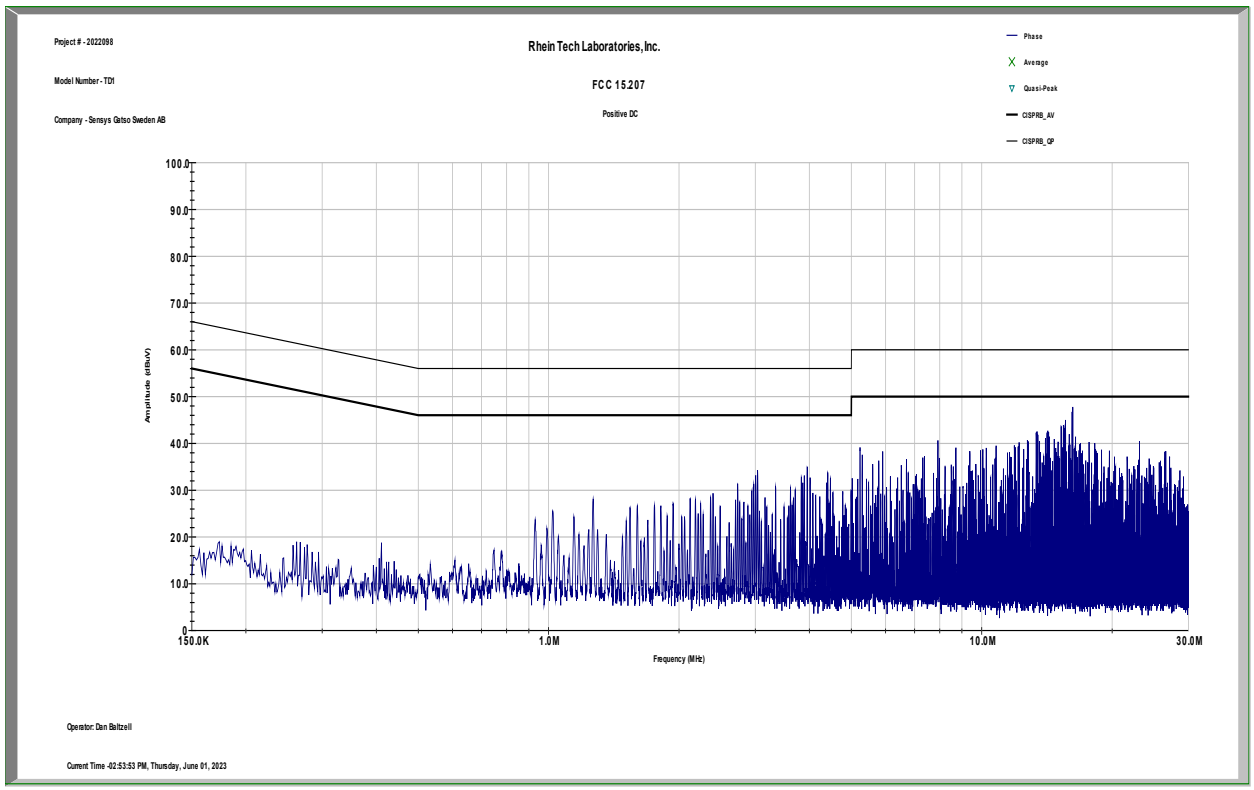
Table 3-2: Conducted Emissions Environmental Conditions

Date	Temperature (°C)	Humidity (%)	Pressure (kPa)
June 1, 2023	24.4	32	101.6

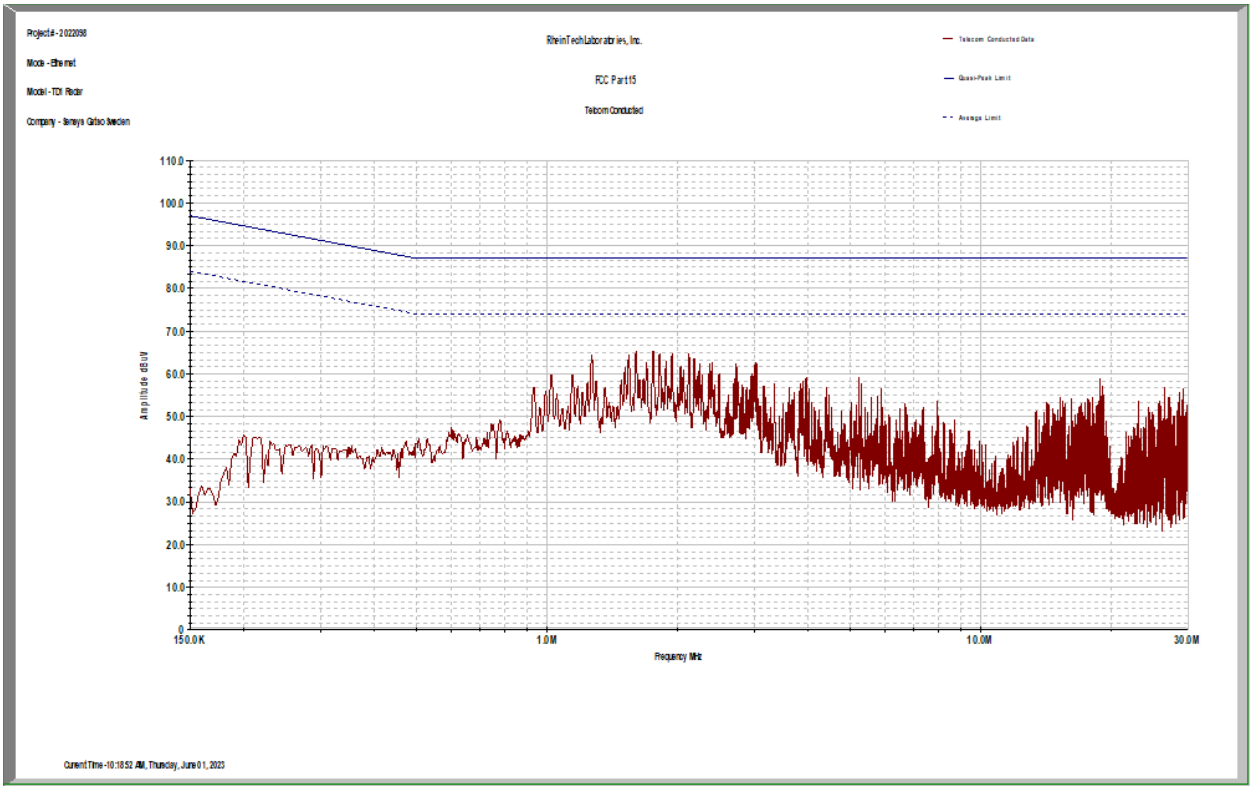
Plot 3-1: Conducted Emissions, DC, Negative, TX



Plot 3-2: Conducted Emissions, DC, Positive, TX



Plot 3-3: Telecom Emissions, Ethernet



Result: PASS

Table 3-3: Conducted Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 1 GHz)	2521A00743	09/16/2024
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	02/26/2024
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	9009303138A07771	02/26/2024
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	02/16/2024
900174	FCC	F-120-9	Current Probe	20	04/30/2024
Test Software	Quantum Change	TILE!7	TILE! Test Software	7.1.3.20	N/A
900728	High Pass Filter	Solar Electronics Co.	Type 8130	947305	05/08/2026

Test Personnel:

Daniel W. Baltzell		June 1, 2023
EMC Test Engineer	**Signature**	**Date of Test**

4 Radiated Emissions – FCC Part 15.209, 15.245(b)

4.1 Radiated Emissions Test Procedure

Before final measurements of radiated emissions were made on the OATS, the EUT was scanned indoors at a 1-meter distance, including handheld antenna scans. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the OATS, at each frequency, in order to ensure that maximum amplitudes were attained.

Final radiated emissions measurements were made on the OATS. The EUT was placed on a non-conductive turntable 0.8 m (for frequencies < 1 GHz)/ 1.5 m (for frequencies >1 GHz) above the ground plane. The spectrum was examined from 9 kHz to the 4th harmonic of the highest fundamental transmitter frequency.

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered between 1 and 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarization. For frequencies between 30 and 1000 MHz, the Spectrum Analyzer's 6 dB bandwidth was set to 120 kHz, and the Spectrum Analyzer was operated in the CISPR QPK detection mode. For emissions above 1 GHz, measurements were taken using the AVG detector functions with a minimum RBW of 1 MHz. No VBW less than 10 times the RBW was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded.

4.2 Radiated Emissions Limits

Table 4-1: Radiated Emissions Limits per FCC Part 15.209

Frequency (MHz)	Field Strength (µV/m)	Measure Distance (m)
0.009 – 0.490	2400/ f (kHz)	300
0.490 – 1.705	2400/ f (kHz)	30
1.705 – 30.000	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1 GHz, the field strength limits are based on AVG detector, however, the PK field strength of any emission shall not exceed the maximum permitted AVG limits specified above by more than 20 dB under any circumstances of modulation.

Table 4-2: Radiated Emissions Limits per FCC Part 15.245

Frequency (MHz)	Field Strength Fundamental (mV/m)	Field Strength Harmonics (mV/m)
902 – 928	500	1.6
2435 – 2465	500	1.6
5785 – 5815	500	1.6
10500 – 10550	2500	25.0
24075 – 24175	2500	25.0

Notes: Field strength limits are specified at a distance of 3 m.

500 mV/m ≈ 114.0 dB µV/m 1.6 mV/m ≈ 64.1 dB µV/m

2500 mV/m ≈ 128.0 dB µV/m 25 mV/m ≈ 88.0 dB µV/m

15.245 (2) Field strength limits are specified at a distance of 3 meters. (3) 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. (4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

Measurements were made at far-field distances for fundamentals and harmonics, then interpolated to three meters to compare to the limit.

4.3 Measurement Uncertainty

Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2.

Radiated Emissions: ±4.6 dB

4.4 Radiated Emissions Test Data

Table 4-3: Radiated Emissions Environmental Conditions

Date	Temperature (°C)	Humidity (%)	Pressure (kPa)
June 1, 2023	31.1	32	101.6

Table 4-4: Radiated Emissions, Average Fundamental

Emission Frequency (MHz)	Analyzer Level Average (dBµV/m)	SCF (dB/m)	Average Corrected (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
24092.069	77.5	40.2	117.7	128.0	-10.3
24133.791	79.3	40.2	119.5	128.0	-8.5
24166.973	77.4	40.2	117.6	128.0	-10.4

Table 4-5: Radiated Emissions, Peak Fundamental

Emission Frequency (MHz)	Analyzer Level Peak (dBµV/m)	SCF (dB/m)	Peak Corrected (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
24092.069	77.8	40.2	118.0	148.0	-30.0
24133.791	79.6	40.2	119.8	148.0	-28.2
24166.973	77.6	40.2	117.8	148.0	-30.2

Table 4-6: Radiated Emissions, Harmonics/Spurious, Average

Frequency (MHz)	Analyzer Level (dBµV)	Site Correction Factor (dB/m)	Corrected Analyzer Level (dBuV/m)	Limit (dBµV)	Margin (dB)
48184.138	-14.9	49.8	34.9	57.6	-22.7
48267.582	22.2	39.9	62.1	88.0	-25.9
48333.946	19.9	39.9	59.8	88.0	-28.2
72276.208	17.5	39.9	57.4	88.0	-30.6
72401.372	23.3	44.1	67.4	88.0	-20.6
72500.918	21.1	44.1	65.2	88.0	-22.8
96368.277	20.2	44.1	64.3	88.0	-23.7
96535.163	23.2	46.8	70.0	88.0	-18.0
96667.891	22.6	46.8	69.4	88.0	-18.6

Table 4-7: Radiated Emissions, Harmonics/Spurious, Peak

Frequency (MHz)	Analyzer Level (dBµV)	Site Correction Factor (dB/m)	Corrected Analyzer Level (dBuV/m)	Limit (dBµV)	Margin (dB)
48184.138	16.1	39.9	56.0	108.0	-52.0
48267.582	14.4	39.9	54.3	108.0	-53.7
48333.946	11.7	39.9	51.6	108.0	-56.4
72276.208	10.0	44.1	54.1	108.0	-53.9
72401.372	15.6	44.1	59.7	108.0	-48.3
72500.918	14.5	44.1	58.6	108.0	-49.4
96368.277	3.5	46.8	50.3	108.0	-57.7
96535.163	17.3	46.8	64.1	108.0	-43.9
96667.891	17.0	46.8	63.8	108.0	-44.2

Table 4-8: Radiated Emissions, Digital Unintentional

Emission Frequency (MHz)	Detector	Azimuth (degrees)	Antenna Polarity (H/V)	Height (meters)	Emission Level (dBuV)	Site Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
30.224	QP	170	H	1.0	38.1	-13.7	24.4	40.0	-15.6	Pass
45.638	QP	225	V	1.0	47.7	-21.6	26.1	40.0	-13.9	Pass
59.167	QP	180	V	1.0	47.5	-22.9	24.6	40.0	-15.4	Pass
62.420	QP	90	V	1.0	47.5	-22.7	24.8	40.0	-15.2	Pass
73.974	QP	180	V	1.0	44.3	-22.3	22.0	40.0	-18.0	Pass
142.789	QP	180	V	1.0	42.2	-19.3	22.9	43.5	-20.6	Pass
151.282	QP	170	V	1.0	42.4	-17.8	24.6	43.5	-18.9	Pass
236.859	QP	225	H	1.5	33.1	-12.6	20.5	46.0	-25.5	Pass
265.064	QP	180	H	1.0	31.4	-12.1	19.3	46.0	-26.7	Pass
276.122	QP	90	V	1.0	33.7	-12.4	21.3	46.0	-24.7	Pass
516.506	QP	90	H	1.5	38.8	-4.8	34.0	46.0	-12.0	Pass
525.641	QP	0	H	1.0	32.0	-4.0	28.0	46.0	-18.0	Pass
533.494	QP	330	V	1.5	32.5	-3.3	29.2	46.0	-16.8	Pass
1166.026	AV	0	H	1.0	30.5	7.0	37.5	54.0	-16.5	Pass
1175.321	AV	0	H	1.0	30.5	7.3	37.8	54.0	-16.2	Pass

Notes: The EUT was scanned from 30 MHz to 20,000 MHz. All emissions not listed were found to have amplitudes attenuated by more than 20 dB below the limit.
Tested at 3 meters.

Result: PASS

Table 4-9: Radiated Emissions Test Equipment

RTL Asset #	Part	Manufacturer	Model	Serial Number	Calibration Due Date
901669	Biconilog Antenna (30 MHz – 6000 MHz)	ETS-Lindgren	3142E	00166065	07/11/2025
900772	Horn Antenna (2 – 4 GHz)	EMCO	3161-02	9804-1044	08/05/2024
900321	Horn Antenna (4.0 – 8.2 GHz)	EMCO	3161-03	9528-1020	08/05/2024
900323	Horn Antenna (8.2 – 12.4 GHz)	EMCO	3160-07	9605-1024	08/05/2024
900356	Horn Antenna (12.4 – 18.0 GHz)	EMCO	3160-08	9607-1044	08/05/2024
901218	Horn Antenna (18.0 – 26.5 GHz)	EMCO	3160-09	960281-003	08/05/2024
901161	Adapter, WG-Coax (26.5 - 40 GHz)	Advanced Technical Materials	28-25K-6	B082304	08/05/2024
901303	Horn Antenna (26.5 - 40.0 GHz) WR-28	EMCO	3160-10	960452-007	08/05/2024
901639	Waveguide (40 – 50 GHz)	Wiltron	35WR19F	N/A	05/03/2024
901256	Horn Antenna (40 - 60 GHz)	ATM	19-443-6	8041704-01	05/03/2024
901586	Harmonic Mixer (50 – 75 GHz)	Rohde & Schwarz	FS-Z75	100098	06/23/2025
900711	Horn Antenna (50 - 75 GHz)	ATM	15-443-6	8051805-1	06/23/2025
900713	Harmonic Mixer (90 - 140 GHz)	RPG	SAM-140	20022	05/03/2024
900826	Horn Antenna, (90 - 140 GHz), Waveguide size WR-8	ATM	08-443-6R	8041904-1	05/03/2024
901581	Spectrum Analyzer (20 Hz – 50 GHz)	Rohde & Schwarz	1166.1660.50	200106	12/01/2024
901729	SMK RF Cables 20’	Insulated Wire Inc.	KPS-1503-3150-KPR	NA	12/29/2023
901235	High Frequency RF Cables	IW Microwave Products	KPS-1503-360-KPS	36"	12/05/2023

Test Personnel:

Daniel W. Baltzell		June 1&27, 2023
EMC Test Engineer	**Signature**	**Dates of Test**

5 20 dB Bandwidth – FCC 15.215(c)

5.1 20 dB Bandwidth Test Procedure

The 20 dB bandwidths were measured using a 50-ohm spectrum analyzer. The modulated carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was auto and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 1 MHz, and the video bandwidth was set to 3 MHz. The table below contains the bandwidth measurement results.

5.2 Measurement Uncertainty

Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2.

MU = ±1.0 x 10^{-6} Hz

5.3 20 dB Bandwidth Test Data

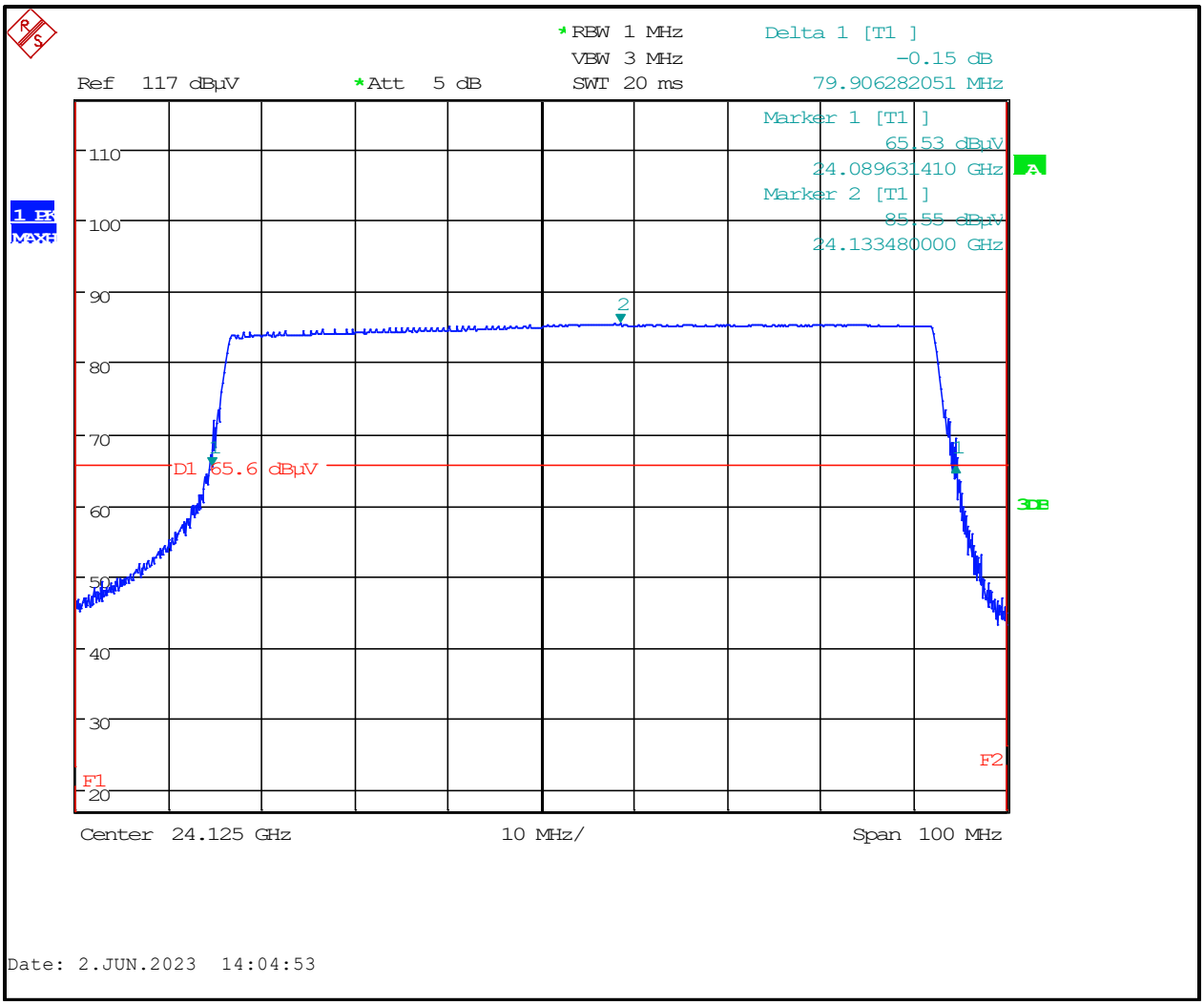
Table 5-1: 20 dB Bandwidth Environmental Conditions

Date	Temperature (°C)	Humidity (%)	Pressure (kPa)
June 2, 2023	24.4	27	100.3

Table 5-2: 20 dB Bandwidth Test Data

Frequency (GHz)	20 dB Bandwidth (MHz)
24.08448	79.9

Plot 5-1: 20 dB Bandwidth



Result: PASS

Table 5-3: 20 dB Bandwidth Test Equipment

RTL Barcode	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer (20 Hz – 50 GHz)	200106	12/01/2024

Test Personnel:

Daniel W. Baltzell		June 2, 2023
EMC Test Engineer	**Signature**	**Date of Test**

6 Conclusion

The data presented in this report shows that the EUT as tested, Sensys Gatso Model: 17-012166 TD1, complies with the applicable requirements of FCC Rules and Regulations Parts 2 and 15.