

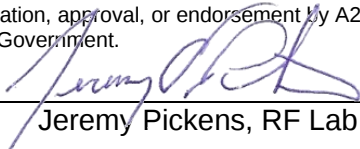
EMC Test Report

Project Number: 4793556**Proposal: SUW-202106001146****Report Number: 4793556EMC01****Revision Level: 2****Client: HBC-radiomatic GmbH****Equipment Under Test: Industrial Remote Control****Model: technos A****HVIN: TECA01****FCC ID: NO9TECA01****IC ID: 2977A-TECA01****Applicable Standards: FCC Part 15 Subpart C, §15.225****RSS-210, Issue 10, April 2020****ANSI C63.10: 2013****RSS-GEN, Issue 5, February 2021****Report issued on: 16 September 2022****Test Result: Compliant**

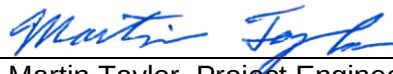
FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by:


Jeremy Pickens, RF Lab Manager

Reviewed by:


Martin Taylor, Project Engineer

Remarks: This report details the results of the testing carried out on one sample; the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
	FCC	ISED	
Bandwidth	15.215(c)	RSS-GEN 6.7	Reported
Field Strength of the Fundamental	15.225(a)	RSS-210 B.6(a)(i)	Compliant
Radiated Spurious Emissions / Restricted Bands	15.35(b),15.209, 15.215(b)	RSS-GEN S6.13 RSS-GEN S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S8.3	Compliant ¹
Frequency Stability	15.225(e)	RSS-210 B.6(b)	Compliant
AC Powerline Conducted Emission	15.207	RSS-GEN S8.8	NA ²

1) The antenna is an integral loop antenna.

2) The device is battery-powered with no facility for connection to the AC mains.

1.1 Modifications Required to Compliance

None

2 General Information

2.1 Client Information

Name: HBC-radiomatic GmbH
Address: Haller Strasse 45-53
City, State, Zip, Country: Crailsheim 74564, Germany

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA
CAB Identifier: US0186

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01

2.3 General Information of EUT

Type of Product: Industrial Remote Control
Model: technos A
HVIN: TECA01
Serial Number: 000-2100275

RFID Frequency Range: 13.56 MHz
Data Modes: RFID
Antenna(s): Integral Loop

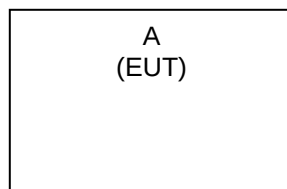
Rated Voltage: 3.6Vdc (Battery)

Sample Received Date: 28 June 2021
Dates of testing: 28 June – 16 July 2021

2.4 Operating Modes and Conditions

Once the EUT was powered on, the RFID automatically turned on to ensure that the radio module was properly installed in the device. The transmission was modulated and continuous without special software or firmware.

2.5 EUT Connection Block Diagram



2.6 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	HBC-radiomatic GmbH	Industrial Remote Control	technos A	000-2100275

3 Occupied Bandwidth

3.1 Test Result

Test Description	Basic Standards	Test Result
99% Bandwidth	RSS-GEN 6.7	Reported
20dB Bandwidth	15.215(c)	Compliant

3.2 Test Method

The 99% occupied bandwidth or 20dB down measurement function of the spectrum analyzer was employed.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.4 °C

Relative Humidity: 52.7 %

Atmospheric Pressure: 98.1 kPa

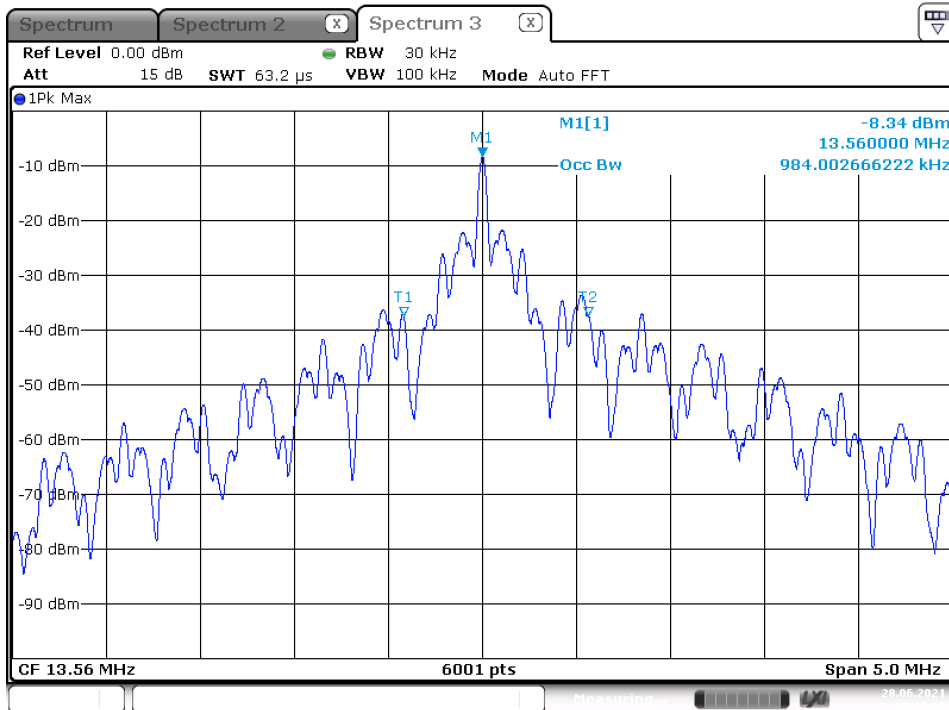
3.4 Test Equipment

Test End Date: 28-Jun-2021

Tester: JOP

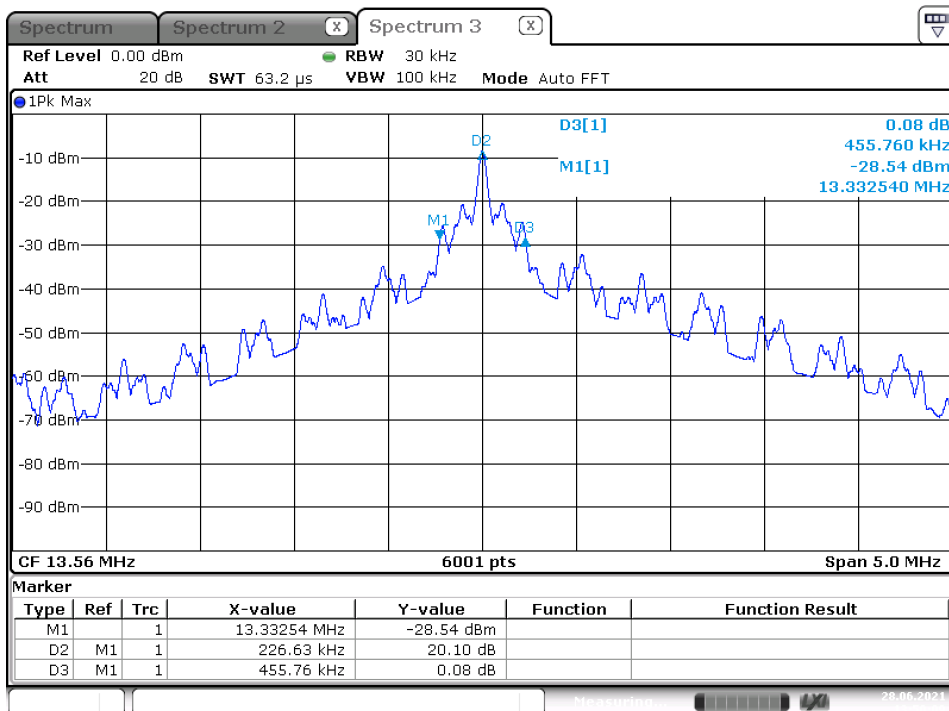
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

3.5 Test Data



Date: 28.JUN.2021 13:48:22

99% Occupied Bandwidth = 984.00kHz



Date: 28.JUN.2021 13:50:09

20dB Bandwidth = 455.76kHz (This falls entirely within the designated frequency band 13.110-14.010MHz)

4 Field Strength of the Fundamental

4.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart C RSS-210 ANSI C63.10:2013	Compliant

4.2 Test Method

For measuring the fundamental, the receiver's resolution bandwidth was set to 9kHz. A loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). The antenna height was fixed at 1 m and the EUT was rotated 360° to find the maximum emitting point. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits

Frequency Range (MHz)	Limits (μV/m) Quasi-Peak or Average	Measurement Distance (m)
13.110 – 13.410	106	30
13.410 – 13.553	334	30
13.553 – 13.567	15,848	30
13.567 – 13.710	334	30
13.710 – 14.010	106	30

Note: Limits were converted to dBμV/m at a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 13.56MHz, the limit is expressed as 15,848μV/m at 30m

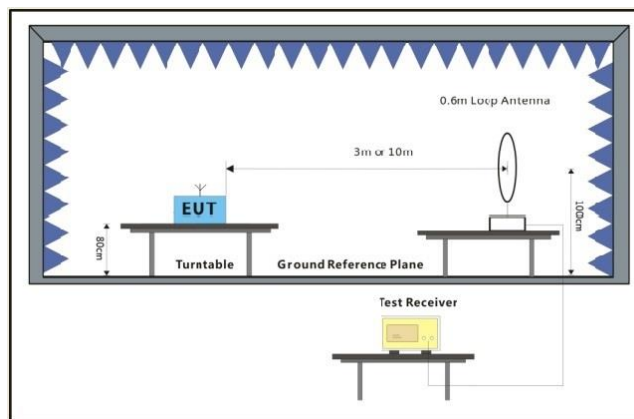
$20 \cdot \log(15,848) = 84 \text{ dB}\mu\text{V/m}$

30 to 3 meters is a single decade, so $84 + 40 = 124 \text{ dB}\mu\text{V/m}$

4.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Temperature: 23.4 °C
Relative Humidity: 52.7 %
Atmospheric Pressure: 98.1 kPa



Below 30MHz

4.4 Test Equipment

Test End Date: 28-Jun-2021

Tester: PL

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF Cable Nm to Nf, 0.01-18GHz	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-157	TELEDYNE STORM MICROWAVE	20121	17-Feb-2021	17-Feb-2022
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	21-Jun-2021	21-Jun-2022
ANTENNA, LOOP, ACTIVE	6502	ETS Lindgren	B085752	20-Aug-2020	20-Aug-2022

Software:

“RSE 9k - 30M Active Red Loop 210302” TILE! profile dated 03 March 2021

4.5 Test Data

Frequency MHz	Raw Peak dBuV	Azimuth degrees	Height cm	AF dB	CL dB	Peak Value dBuV/m	QP Limit dBuV/m	Margin dB	Antenna (CA/CPV/CPH)	DUT Orientation
13.56	51.2	293.0	100.0	10.7	0.3	62.3	124.0	-61.7	CA	X
13.56	52.2	268.0	0.0	10.7	0.3	63.2	124.0	-60.8	CPV	X
13.56	54.0	264.0	0.0	10.7	0.3	65.0	124.0	-59.0	CPH	X
13.56	36.4	56.0	0.0	10.7	0.3	47.4	124.0	-76.6	CA	Y
13.56	39.3	44.0	0.0	10.7	0.3	50.3	124.0	-73.7	CPV	Y
13.56	40.0	221.0	0.0	10.7	0.3	51.0	124.0	-73.0	CPH	Y
13.56	50.3	115.0	0.0	10.7	0.3	61.3	124.0	-62.7	CA	Z
13.56	51.4	91.0	0.0	10.7	0.3	62.4	124.0	-61.6	CPV	Z
13.56	54.3	262.0	0.0	10.7	0.3	65.3	124.0	-58.7	CPH	Z

CA: Co-Axial

CPV: Co-Planar / Vertical

CPH: Co-Planar / Horizontal

5 Radiated Emissions

5.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart C ANSI C63.4:2014	Compliant

5.2 Test Method

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receiver's resolution bandwidth was set to 1kHz for measurements taken below 150kHz, 9kHz for in the 150kHz to 30MHz range, 120 kHz in the 30MHz to 1GHz frequency range, and 1MHz for measurements of 1GHz and higher. For testing below 30MHz, a loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). Above 30MHz, a biconilog antenna was used and measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits

Frequency Range (MHz)	Limits (μV/m) Quasi-Peak or Average	Measurement Distance (m)
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

Note: Limits were converted to dBμV/m using the equation $20 \cdot \text{LOG}(x)$. Additionally, for measurements below 30MHz, the limits were adjusted to a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 20MHz, the limit is expressed as 30μV/m at 30m

$$20 \cdot \log(30) = 29.5 \text{ dB}\mu\text{V/m}$$

30 to 3 meters is a single decade, so $29.5 + 40 = 69.5 \text{ dB}\mu\text{V/m}$

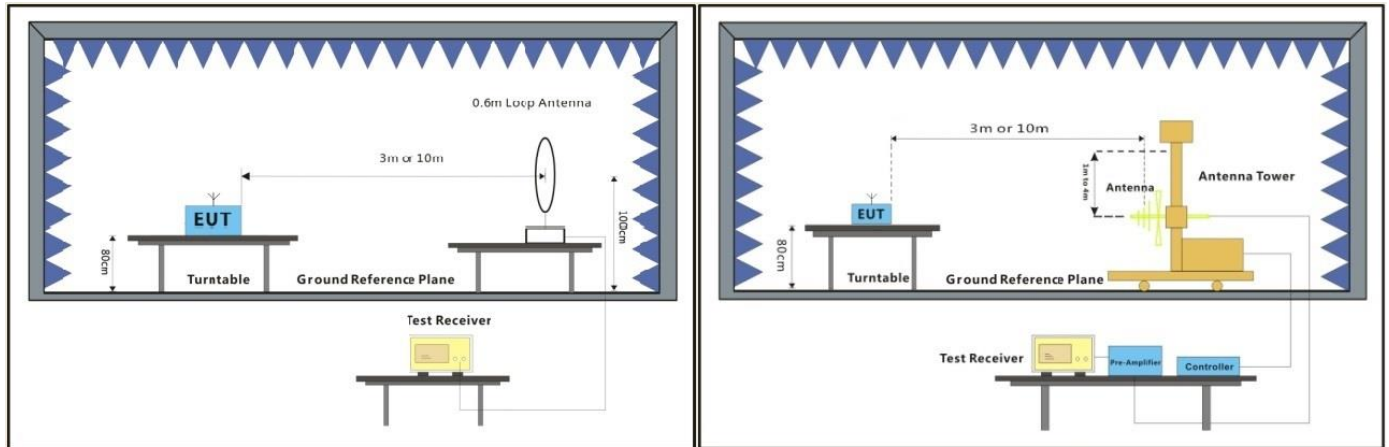
5.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Temperature: 23.4 °C

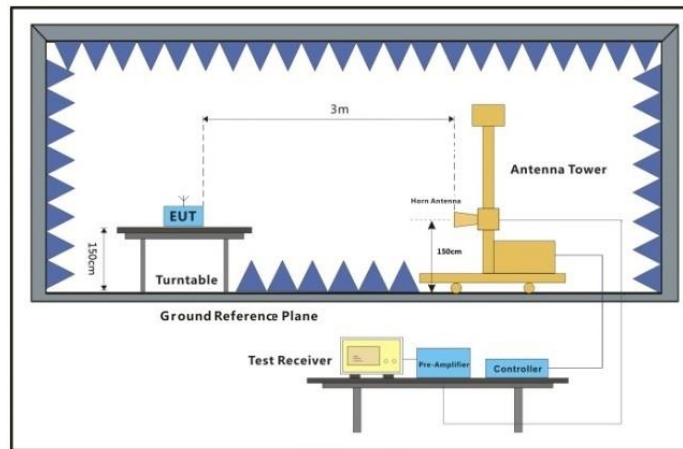
Relative Humidity: 52.7 %

Atmospheric Pressure: 98.1 kPa



Below 30MHz

30MHz-1GHz



Above 1GHz

5.4 Test Equipment

Test End Date: 28-Jun-2021

Tester: PL

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF Cable Nm to Nf, 0.01-18GHz	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-157	TELEDYNE STORM MICROWAVE	20121	17-Feb-2021	17-Feb-2022
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	21-Jun-2021	21-Jun-2022
ANTENNA, BILOG	JB6	SUNOL	B079689	5-Nov-2020	5-Nov-2022
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079800	7-Jul-2021	7-Jul-2022
ANTENNA, LOOP, ACTIVE	6502	ETS Lindgren	B085752	20-Aug-2020	20-Aug-2022
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	3-Sep-2020	3-Sep-2021

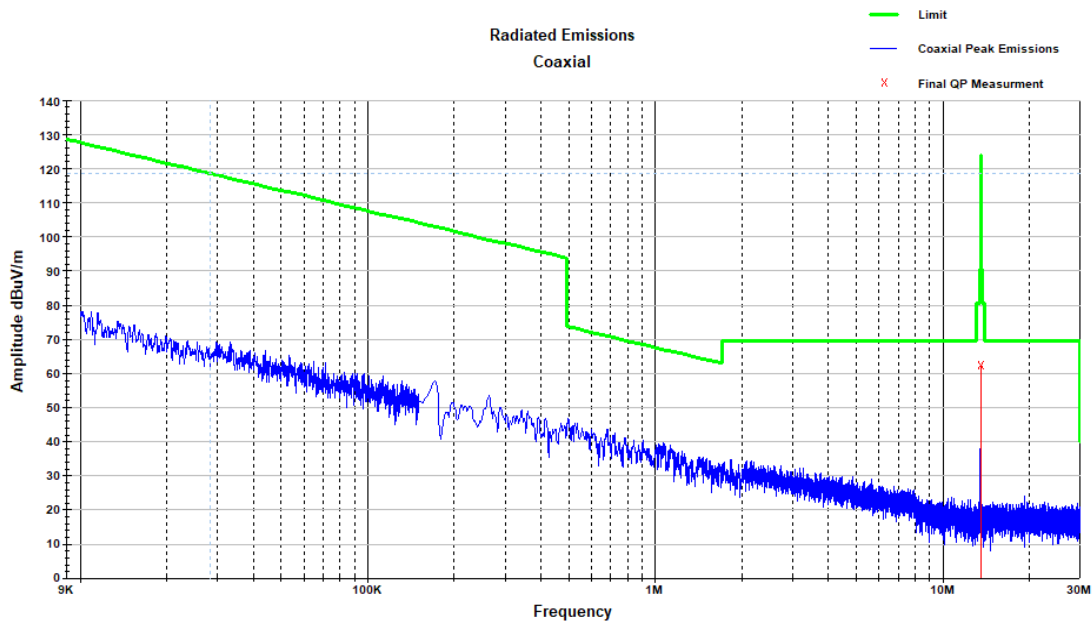
Software:

“RSE 9k - 30M Active Red Loop 210302” TILE! profile dated 03 March 2021

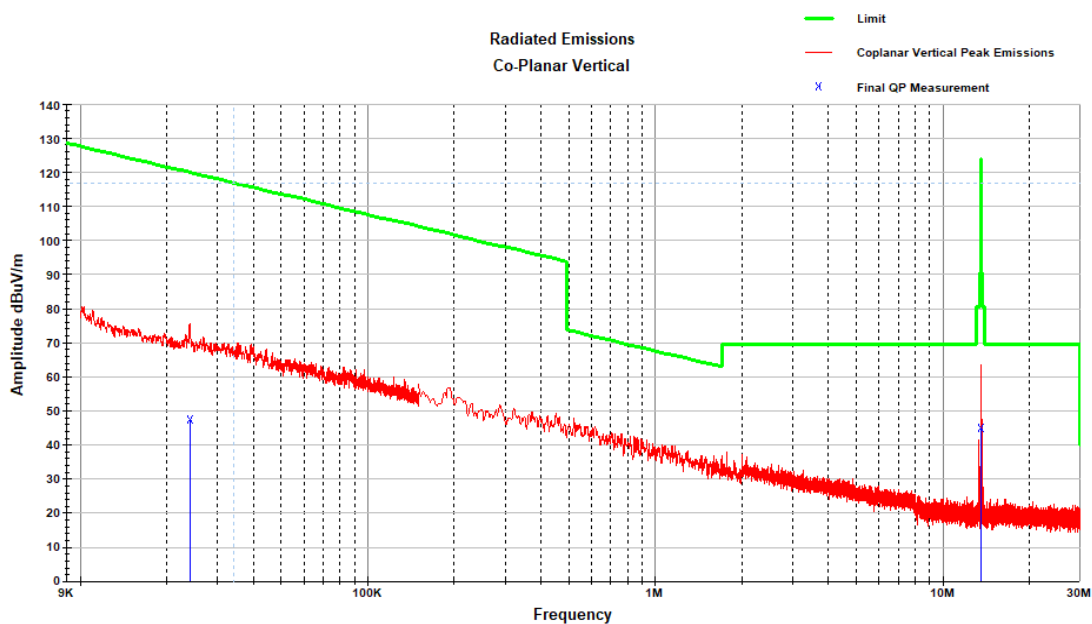
“RSE 30-1000 MHz T7 200710” TILE! profile dated 10 July 2020

5.5 Test Data

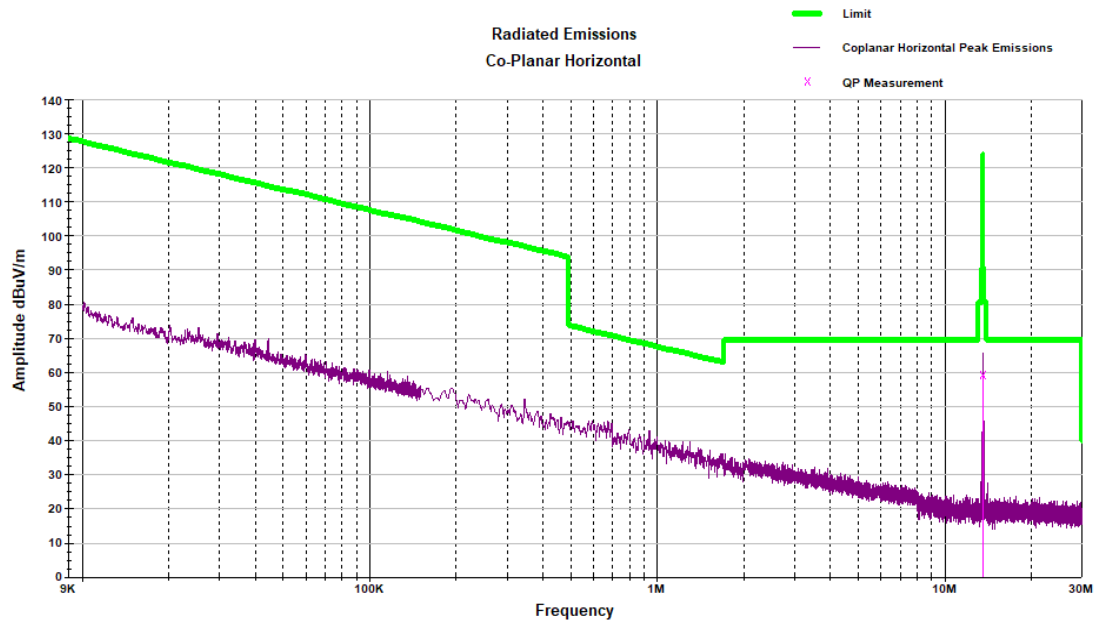
Worst-Case Co-Axial Radiated Emissions Data (9kHz-30MHz) – 3 meters



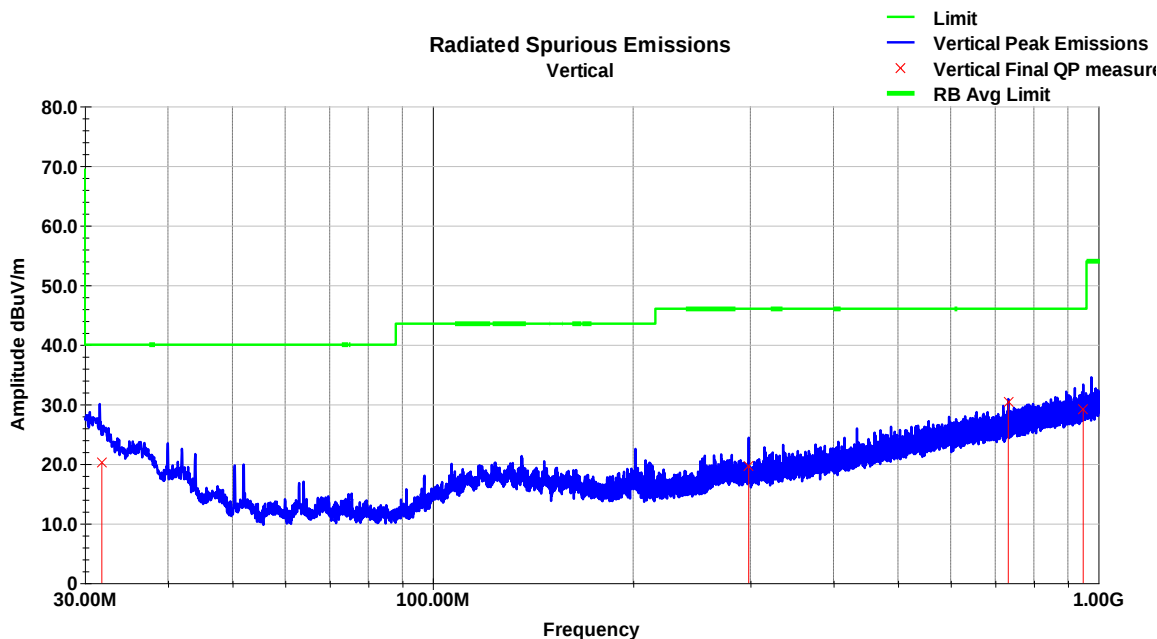
Worst-Case Co-Planar Vertical Radiated Emissions Data (9kHz-30MHz) – 3 meters



Worst-Case Co-Planar Horizontal Radiated Emissions Data (9kHz-30MHz) – 3 meters



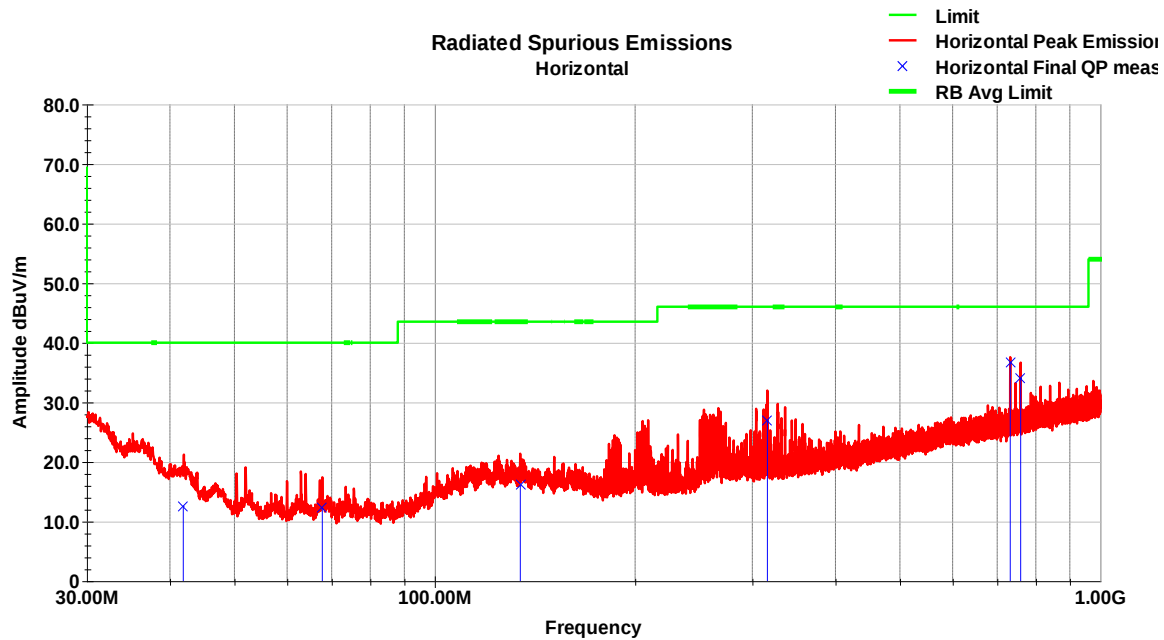
Worst-Case Vertical Radiated Emissions Plot (30-1000MHz)



Vertical Radiated Emissions Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.82	30.0	V	315.0	204.0	20.9	0.6	31.3	20.2	40.0	-19.8
298.33	34.4	V	302.0	213.0	14.2	1.9	30.9	19.6	46.0	-26.5
732.23	36.5	V	60.0	232.0	21.2	3.0	30.2	30.5	46.0	-15.5
949.13	32.3	V	317.0	231.0	23.5	3.4	30.0	29.2	46.0	-16.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Worst-Case Horizontal Radiated Emissions Plot (30-1000MHz)



Horizontal Radiated Emissions Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
41.89	30.1	H	294.0	128.0	13.2	0.7	31.3	12.6	40.0	-27.4
67.77	34.6	H	206.0	384.0	8.1	0.9	31.3	12.3	40.0	-27.7
134.45	32.4	H	125.0	216.0	13.6	1.3	31.1	16.1	43.5	-27.4
316.08	41.2	H	154.0	100.0	14.6	2.0	30.9	26.9	46.0	-19.1
732.20	42.8	H	342.0	100.0	21.2	3.0	30.2	36.7	46.0	-9.3
759.35	39.7	H	353.0	100.0	21.5	3.0	30.2	34.1	46.0	-11.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

6 Frequency Stability

6.1 Test Result

Test Description	Basic Standards	Test Result
Frequency Stability	FCC 15.225(e) RSS-210 B.6(b) ANSI C63.10	Compliant

6.2 Test Method

The EUT was placed inside the Environmental Chamber and allowed to stabilize to each set temperature for a minimum of thirty minutes before any measurements were made. The EUT fundamental transmission was coupled to the spectrum analyzer using a near field probe.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

6.4 Test Equipment

Test End Date: 15-Jul-21

Tester: JOP

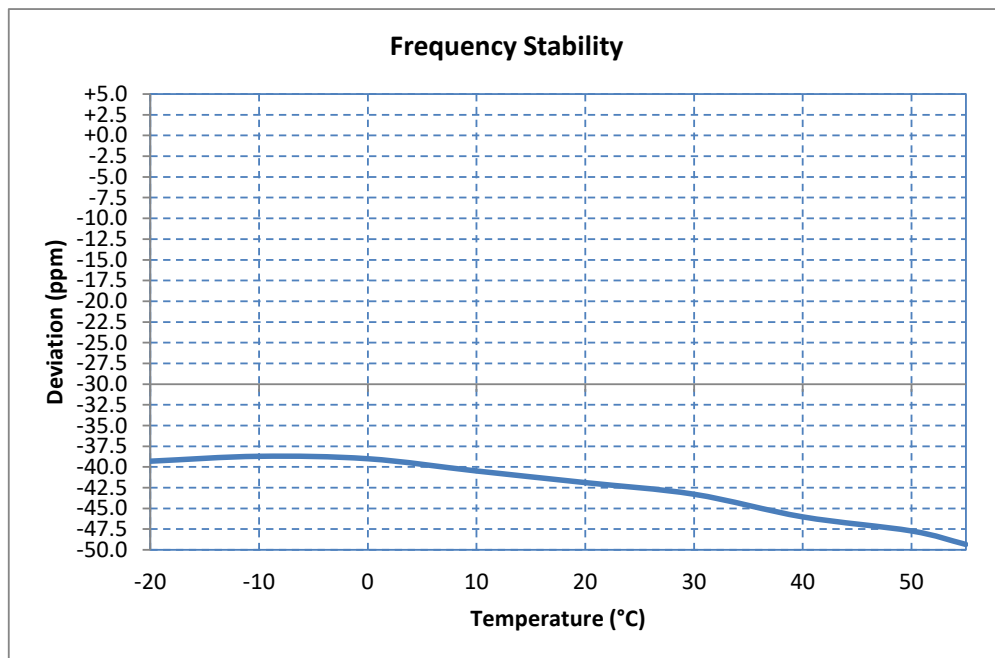
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBU	VBU
TRUE RMS MULTIMETER	87V	Fluke	21011	17-Feb-21	17-Feb-22
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-19	27-Dec-21
ENVIRONMENTAL CHAMBER	S 1.20	Thermotron	SAF-ENV-08	23-Nov-2020	23-Nov-2021

6.5 Test Data

The carrier frequency shall not depart from the reference frequency by more than ± 100 ppm.

RFID 13.56 MHz

Voltage %	Power V_{DC}	Temp °C	Frequency Hz	Freq Dev Hz	Freq Dev ppm	Deviation %
100%	3.60	+20 (Ref)	13,559,432	-568	-41.89	-0.004189
100%	3.60	-20	13,559,467	-533	-39.31	-0.003931
100%	3.60	-10	13,559,475	-525	-38.72	-0.003872
100%	3.60	0	13,559,471	-529	-39.01	-0.003901
100%	3.60	+10	13,559,451	-549	-40.49	-0.004049
100%	3.60	+20	13,559,432	-568	-41.89	-0.004189
100%	3.60	+30	13,559,413	-587	-43.29	-0.004329
100%	3.60	+40	13,559,376	-624	-46.02	-0.004602
100%	3.60	+50	13,559,353	-647	-47.71	-0.004771
100%	3.60	+55	13,559,331	-669	-49.34	-0.004934
115%	4.14	+20	13,559,342	-658	-48.53	-0.004853
85%	3.06	+20	13,559,338	-662	-48.82	-0.004882



7 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 7.25 \times 10^{-8}$
2	Duty cycle	$\pm 0.37\%$
3	Occupied Bandwidth	$\pm 3\%$
4	Conduction emission	$\pm 3.0\text{dB}$ (150kHz to 30MHz)
5	RF conducted power	$\pm 0.75\text{dB}$
6	RF power density	$\pm 2.84\text{dB}$
7	Conducted Spurious emissions	$\pm 0.75\text{dB}$
8	RF Radiated power	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
9	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
10	Temperature test	$\pm 1^{\circ}\text{C}$
11	Humidity test	$\pm 3\%$
12	Supply voltages	$\pm 1.5\%$
13	Time	$\pm 3\%$

8 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	22 July 2021
1	- Updated HVIN/Model reference throughout report	22 July 2022
2	- Updated EUT description, Model and HVIN throughout report - Corrected FCC ID on title page	16 September 2022