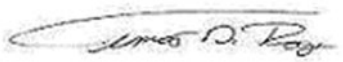
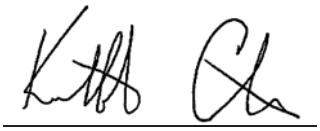
Test Report – FCC Part 15.225 Intentional Radiator
Applicant: Kastle Systems International

Signature:  Sr. EMC Engineer EMC-003838-NE

Name & Title: Tim Royer, EMC Engineer

Date of Signature 02/15/2023

Signature: 

Name & Title: Kristoffer Costa, EMC Technician

Date of Signature 02/15/2023

This test report relates only to the items tested as identified and is not valid for any subsequent changes or modifications made to the equipment under test.

Table of Contents

1. Customer Information

Applicant: Kastle Systems International
Address: 6402 Arlington Blvd.
Falls Church Virginia, 22042, United States

1.1 Test Result Summary

The following regulatory standards were used FCC Title 47 CFR Part 15.225. The following test procedure was used ANSI C63.10-2013, C63.4-2014. Full test results are available in this report.

No additions to the test methods were needed. There were no deviations, or exclusions from the test methods. No test results are from external providers or from the customer. The test results relate only to the items tested. Timco does not offer opinions and interpretations, only a pass/fail statement.

FCC Rule Part No.	Requirement	Result
15.225(a)	Fundamental	Pass
15.225(d)	Harmonics	Pass
2.1055 15.225(e)	Frequency stability	Pass
15.207(a), (c)	AC Powerline Conducted Emissions	N/A
15.203	Antenna Requirement	Pass

2. Location of Testing

2.1 Test Laboratory

Timco Engineering Inc. is a subsidiary of Industrial Inspection & Analysis, Inc. ("IIA"). Testing was performed at Timco's permanent laboratory located at 849 NW State Road 45, Newberry, Florida 32669

FCC test firm # 578780
FCC Designation # US1070
FCC site registration is under A2LA certificate # 0955.01
ISED Canada test site registration # 2056A
EU Notified Body # 1177
For all designations see A2LA scope # 0955.01

2.2 Testing was performed, reviewed by

Dates of Testing: 2/9/2023

3. Test Sample(s) (EUT/DUT)

The test sample was received: 2/9/2023

Dates of Testing: 2/9/2023

3.1 Description of the EUT

A description as well as unambiguous identification of the EUT(s) tested. Where more than one sample is required for technical reasons (such as the use of connected units for the purpose of conducted output power testing where the product units will have integral antennas), each specific test shall identify which unit was tested.

Identification	
FCC ID:	2ALZSKR100-M
Brief Description	Access Control Reader
Model(s) #	KR100-M
Voltage Rating (AC or Batt.)	12V/DC

Technical Characteristics	
Technology	13.56 MHz Card Reader
Number of Channels	1
Antenna Connector	PCB Trace
Voltage Rating (AC or Batt.)	12vDC

Results Summary	
Fundamental	17.4 dBuV/m at 13.56 MHz
Occupied Bandwidth	20dB: 213 kHz
Type of Modulation	ASK
Emission Classification	213KA1D
Transmitter Spurious (worst case) at 3 meters	14.34 dBµV/m at 40.68 MHz (Measured with a Peak detector)
Frequency Tolerance %, Hz, ppm	0.16 kHz

3.2 Configuration of EUT

Band (MHz)	Mode	Number of Ant.
13.56	Transmit	1

Operating conditions during Testing:

No modifications of the device under test (including firmware, specific software settings, and input/output signal levels to the EUT).

Peripherals used during Testing:

No peripherals used.

3.3 Test Setup of EUT

Equipment, antenna, and cable arrangement. The setup of the equipment and cable or wire placement on the test site that produces the highest radiated and the highest ac power-line conducted emissions shall be shown clearly and described. Information on the orientation of portable equipment during testing shall be included. Drawings or photographs may be used for this purpose.

Test Setups are included in the test report.

4. Test methods & Applicable Regulatory Limits

4.1 Test methods/Standards/Guidance

The measurement was performed as per ANSI 63.10. Full test results are available in this report.

Limits and Regulatory Limits:

1) FCC 15.225

5. Measurement Uncertainty

Parameter	Uncertainty (dB)
Conducted Emissions	± 3.14 dB
Radiated Emissions (9kHz – 30 MHz)	± 3.08 dB
Radiated Emissions (30 – 200 MHz)	± 2.16 dB
Radiated Emissions (200 – 1000 MHz)	± 2.15 dB
Radiated Emissions (1 GHz – 18 GHz)	± 2.14 dB
Radiated Emissions (18 GHz – 40 GHz)	± 2.31 dB
Note: The uncertainties provided in this table represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of K=2.	

6. Environmental Conditions

Temperature & Humidity

Measurements performed at the test site did not exceed the following:

Parameter	Measurement
Temperature	23 C +/- 5%
Humidity	55% +/- 5%
Barometric Pressure	30.05 in Hg
Note: Specific environmental conditions that are applicable to a specific test are available in the test result section.	

7. List of Test Equipment and Test Facility

The test equipment used identified by type, manufacturer, serial number, or other identification and the date on which the next calibration or service check is due.

Description of the firmware or software used to operate EUT for testing purposes.

A complete list of all test equipment used shall be included with the test report. The manufacturer's model and serial numbers, and date of last calibration, and calibration interval shall be included. Measurement cable loss, measuring instrument bandwidth and detector function, video bandwidth, if appropriate, and antenna factors shall also be included where applicable.

List of Test Equipment

Test Equipment						
Type	Device	Manufacturer	Model	SN#	Current Cal	Cal Due
Antenna, NSA	Log-Periodic 1243	Eaton	96005	1243	5/4/21	5/3/2024
Antenna	Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	2/25/20	2/24/2023
CHAMBER	CHAMBER	Panashield	3M	N/A	3/12/19	12/21/2023
Pre-amp	Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	2/27/19	7/26/2025
Receiver	EMI Test Receiver R&S ESU 40	Rohde & Schwarz	ESU 40	100320	5/27/21	5/26/2024

Software			
Software	Author	Version	Validation on
ESU Firmware	Rohde & Schwarz	4.43 SP3; BIOS v5.1-24-3	2018
RSCommander	Rohde & Schwarz	1.6.4	2014
ScopeExplorer	LeCroy	v2.25.0.0	2009
Field Strength	Timco	v4.10.7.0	2016

8. Test Results

The results of the test are usually indicated in the form of tables, spectrum analyzer plots, charts, sample calculations, as appropriate for each test procedure.

A description and/or a block diagram of the test setup is usually provided.

The measurement results, along with the appropriate limits for comparison, may be presented in tabular or graphical form. In addition, any variation in the measurement environment may be reported if applicable (e.g., a significant change of temperature that could affect the cable loss and amplifier response).

Units of measurement

Unless noted otherwise in the referenced standard, the measurements of ac power-line conducted emissions and conducted power output will be reported in units of dBµV. Unless noted otherwise in the referenced standard, the measurements of radiated emissions will be reported in units of decibels, referenced to one microvolt per meter (dBµV/m) for electric fields, or to one ampere per meter (dBA/m) for magnetic fields, at the distance specified in the appropriate standards or requirements. The measurements of antenna-conducted power for receivers may be reported in units of dBµV if the impedance of the measuring instrument is also reported. Otherwise, antenna-conducted power will be reported in units of decibels referenced to one milliwatt (dBm). All formulas for data conversions and conversion factors, if used, will be included in this measurement report.

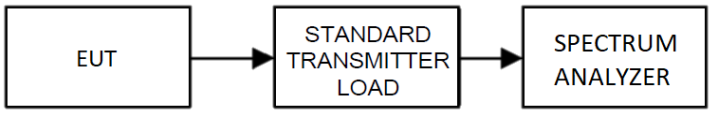
Example:

Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dBµV	+ 10.36 dB/m	+0.40 dB	=30.36 dBµV/m @ 3m

EIRP = Pcond (dBm) + dBi

8.1 20dB Bandwidth

Limits from FCC Part 15.215 (c) as applicable, and test procedure from ANSI C63.10-2013 section 7.8 or 11.8 as applicable.

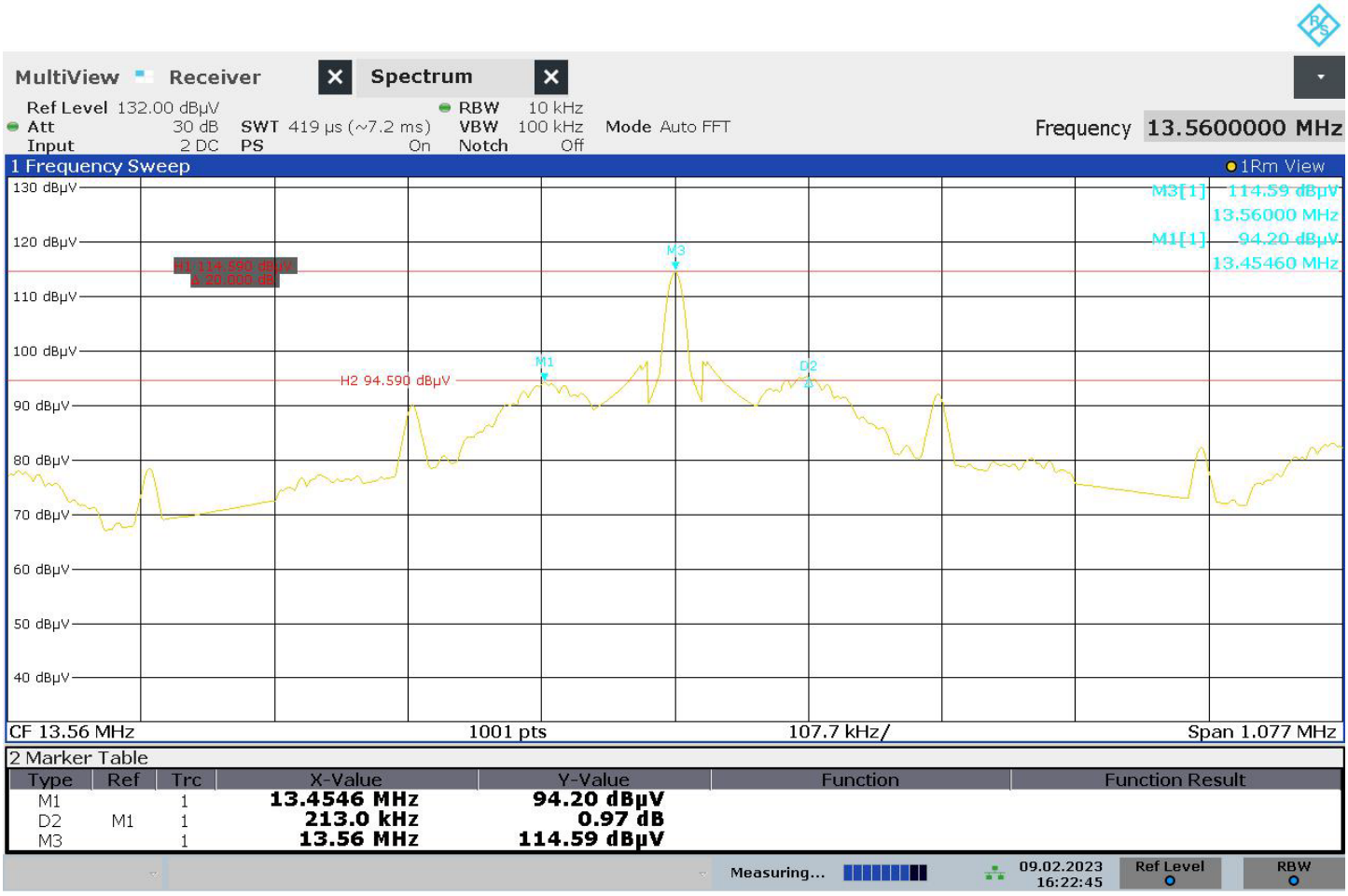
Test Setup


20dB Bandwidth Test Results

Test Results, Mode 1	
Tuned Frequency (MHz)	20dB Bandwidth (kHz)
13.56 MHz	213

20dB Bandwidth, Spectrum Plots

8.1.1 20 dB Bandwidth, 13.56 MHz



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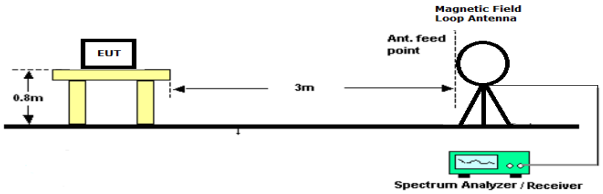
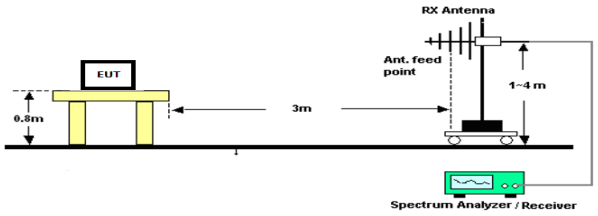
8.2 Radiated Spurious Emissions

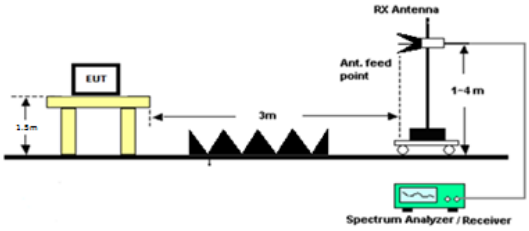
Requirements:

Requirements and limits from FCC part 15.225 (a)(d).

Setup:

Radiated Test Setup, Below 30 MHz


Radiated Test Setup, 30 – 1000 MHz


Radiated Test Setup, Above 1000 MHz


15.225(a) Radiated Emissions Tabular Data

8.2.1 Fundamental Data

Tuned Frequency (MHz)	Detector	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13.56	PK	H	0.70	10.60	3.00	17.40	104.00	86.60

15.225(b)(c) Radiated Emissions Tabular Data

8.2.2 Field Strength at 3 Meters, 13.56 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13.56	13.45	PK	17.55	V	0.70	10.60	3.00	28.85	70.50	41.65
13.56	13.52	PK	16.09	V	0.70	10.60	3.00	27.39	70.50	43.11
13.56	13.61	PK	29.37	V	0.70	10.60	3.00	40.67	70.50	29.83

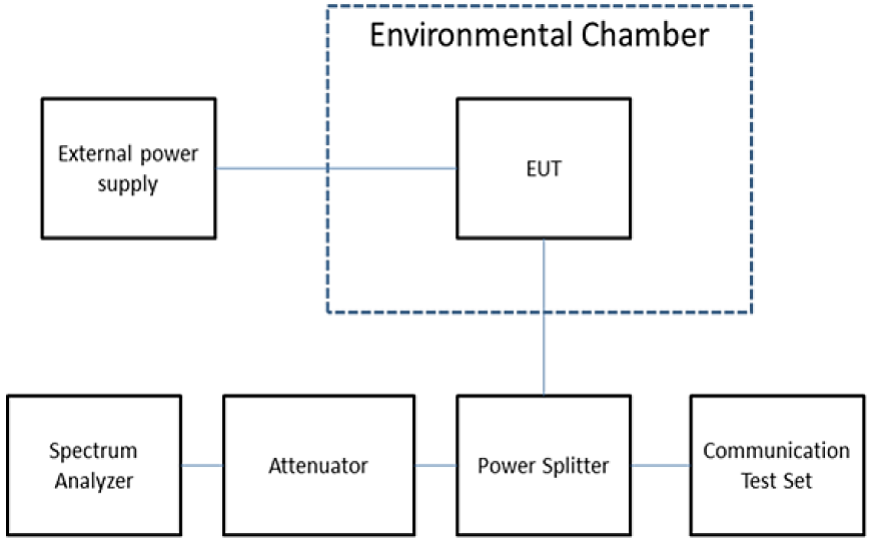
15.225(d) Radiated Emissions Tabular Data

8.2.3 Field Strength at 3 Meters, 13.56 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13.56	27.12	PK	0.30	H	0.71	8.89	3.00	9.90	49.54	39.64
13.56	40.68	PK	0.40	H	0.71	13.23	3.00	14.34	40.00	25.66
13.56	40.68	PK	0.40	V	0.71	13.23	3.00	14.34	40.00	25.66
13.56	54.24	PK	0.50	H	0.86	9.70	3.00	11.06	40.00	28.94
13.56	54.24	PK	1.70	V	0.86	9.70	3.00	12.26	40.00	27.74
13.56	67.80	PK	0.10	H	0.97	5.92	3.00	6.99	40.00	33.01
13.56	67.80	PK	0.90	V	0.97	5.92	3.00	7.79	40.00	32.21
13.56	81.36	PK	0.30	H	1.09	8.87	3.00	10.26	40.00	29.74
13.56	81.36	PK	1.20	V	1.09	8.87	3.00	11.16	40.00	28.84
13.56	94.92	PK	1.20	H	1.15	10.80	3.00	13.15	43.52	30.37
13.56	94.92	PK	0.90	V	1.15	10.80	3.00	12.85	43.52	30.67
13.56	108.48	PK	1.60	H	1.19	10.25	3.00	13.05	43.52	30.48
13.56	108.48	PK	0.90	V	1.19	10.25	3.00	12.35	43.52	31.18
13.56	108.48	AVG	-12.00	H	1.19	10.25	3.00	-0.55	43.52	44.08
13.56	108.48	AVG	-12.10	V	1.19	10.25	3.00	-0.65	43.52	44.18
13.56	122.04	PK	0.70	H	1.26	11.11	3.00	13.07	43.52	30.46
13.56	122.04	PK	0.50	V	1.26	11.11	3.00	12.87	43.52	30.66
13.56	135.60	PK	1.50	H	1.32	14.42	3.00	17.24	43.52	26.28
13.56	135.60	PK	1.90	V	1.32	14.42	3.00	17.64	43.52	25.88
13.56	135.60	AVG	-11.70	H	1.32	14.42	3.00	4.04	43.52	39.48
13.56	135.60	AVG	-11.70	V	1.32	14.42	3.00	4.04	43.52	39.48

8.3 Frequency Stability

Requirements and limits from FCC 15.225(e) and test method from ANSI C63.10

Conducted Test Setup


Test Results, Mode 1		
Tuned Frequency (MHz)	Max Deviation (kHz)	Limit (ppm)
13.56	0.16	100

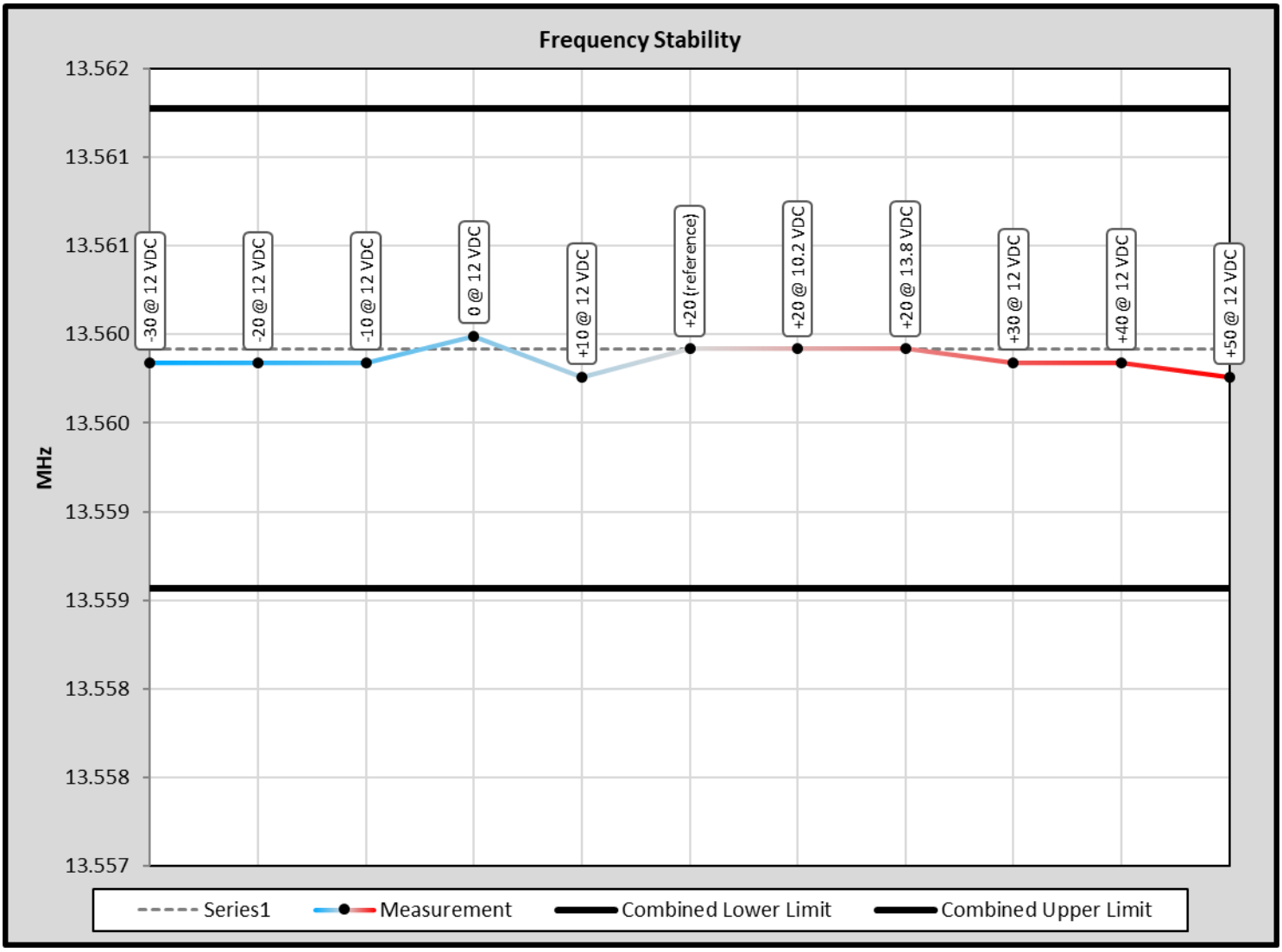
8.3.1 Frequency Stability Data

Limit	100.0	ppm
Limit, as ppb	100000	ppb (Parts per Billion)
Limit, as %	0.01000	%
Strictest Combined Limit, as Hz	1355.992	Hz
Combined Lower Limit	13.558564	MHz
Combined Upper Limit	13.561276	MHz
Rated Supply Voltage	12.0	○ AC ◉ DC

Temperature / Voltage Variation

Temperature (°C)	Supplied Voltage (V)	Frequency (MHz)	Deviation (kHz)
-30	12.0	13.559840	0.080
-20	12.0	13.559840	0.080
-10	12.0	13.559840	0.080
0	12.0	13.559990	-0.071
+10	12.0	13.559760	0.160
+20 (reference)	12.0	13.559920	0.000
+20	10.2	13.559920	0.000
+20	13.8	13.559920	0.000
+30	12.0	13.559840	0.080
+40	12.0	13.559840	0.080
+50	12.0	13.559760	0.160

8.3.2 Frequency Stability Plot



9. ANNEX-A - Photographs of the EUT

Photographs of the EUT and any manufacturer supplied accessories to be used with the EUT are in a separate document.

10. ANNEX-B – Test Setup Photographs

Test setup photographs are located in a separate document.

11. History of Test Report Changes

Test Report #	Revision #	Description	Date of Issue
TR_6481-23-M_FCC 15.225_	1	Initial release	2/15/2023

END OF TEST REPORT