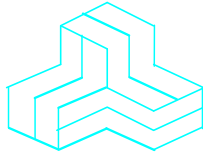


ENGINEERING TEST REPORT



NFCMCU

Model: NFCMCU01

FCC ID: WSSNFCMCU

Applicant:

Mitech Integrated Systems Inc.

219 Robert Hicks Drive

Toronto, Ontario

Canada M2R 3R3

In Accordance With

Federal Communications Commission (FCC)

Part 15, Subpart C

Unlicensed Low Power Transmitter Operating in the Band 13.110-14.010 MHz

UltraTech's File No.: 21MTRD012_FCC15C225

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: November 22, 2021

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: November 22, 2021

Test Date(s):
October 20 - 21, 2021
November 17, 2021

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by any agency of the US Government.*
- *This test report shall not be reproduced, except in full, without a written approval from UltraTech*

UltraTech

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1309



CA0001-2049



AT-1945



SL2-IN-E-1119R



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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Sec. 15.225 - Operation within the band 13.110 – 14.010 MHz.
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication, Part 15, Subpart C - Intentional Radiators
Purpose of Test:	Equipment Certification for FCC Part 15C.
Test Procedures:	ANSI C63.4 and ANSI C63.10
Environmental Classification:	Residential Commercial, industrial or business environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC 47 CFR 15	2021	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	Mitech Integrated Systems Inc.
Address:	219 Robert Hicks Drive Toronto, Ontario Canada M2R 3R3
Contact Person:	Michael Stepanov Phone #: 416-605-4915 Fax #: N/A Email Address: mstepanov@mitechisys.com

Manufacturer	
Name:	Mitech Integrated Systems Inc.
Address:	219 Robert Hicks Drive Toronto, Ontario Canada M2R 3R3
Contact Person:	Michael Stepanov Phone #: 416-605-4915 Fax #: N/A Email Address: mstepanov@mitechisys.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Mitech Integrated Systems Inc.
Product Name:	NFCMCU
Model Name or Number:	NFCMCU01
Serial Number:	Test sample
Type of Equipment:	Part 15 Low Power Communication Device Transmitter
Input Power Supply Type:	3.3 VDC external power supply
Primary User Functions of EUT:	RFID card reader

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Intended Operating Environment:	Residential Commercial, light industry & heavy industry
Power Supply Requirement:	3.3V DC
Field Strength:	55.23 dB μ V/m at 10 m
Operating Frequency Range:	13.56 MHz
RF Output Impedance:	50 Ω
20 dB Bandwidth:	1.474 kHz
Modulation Type:	ASK
Oscillator Frequencies:	27.12 MHz
Antenna Connector Type:	Integral

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	DC and I/O ports	1	7pin connector	Direct connection

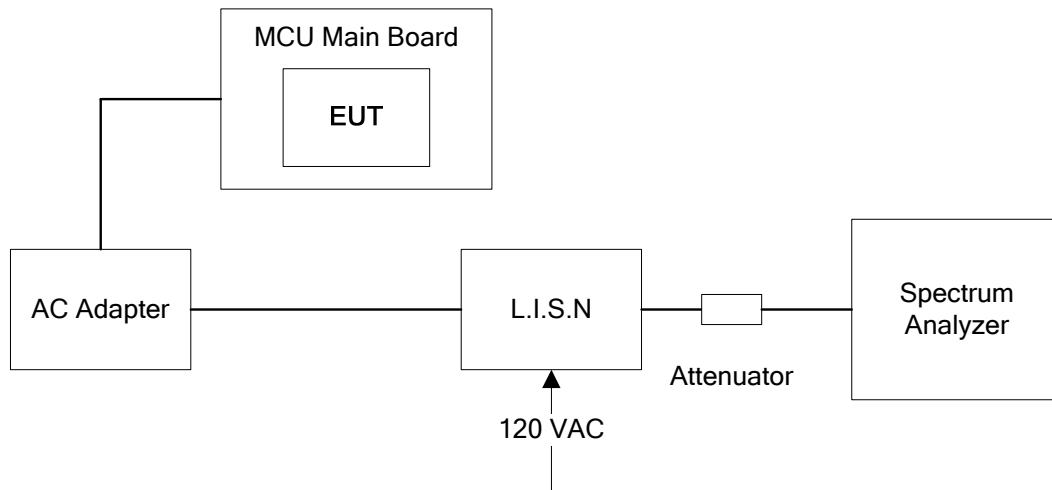
2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

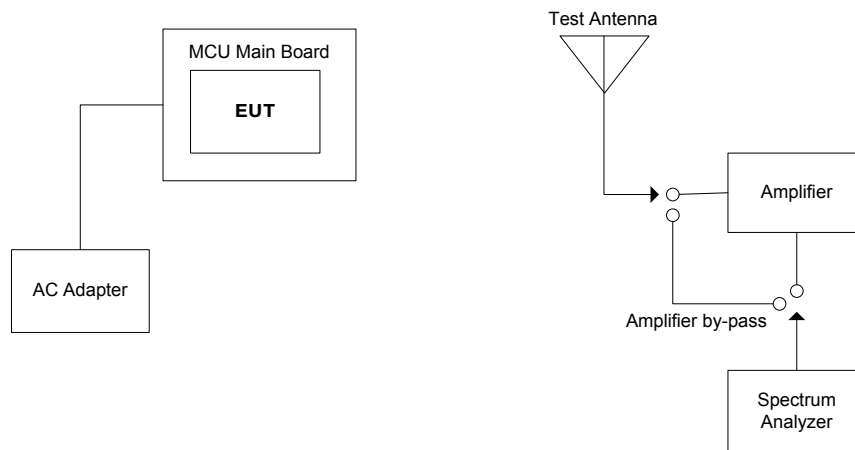
- 1) Mitech Machine Cart Unit (MCU) main board.
- 2) Yesa CCTV Systems AC Adapter, Model: HPD 60-5SX, S/N: 63903

2.6. GENERAL TEST SETUP

2.6.1. Conducted Emissions



2.6.2. Emission Bandwidth / Radiated Emissions



2.6.3. Frequency Stability

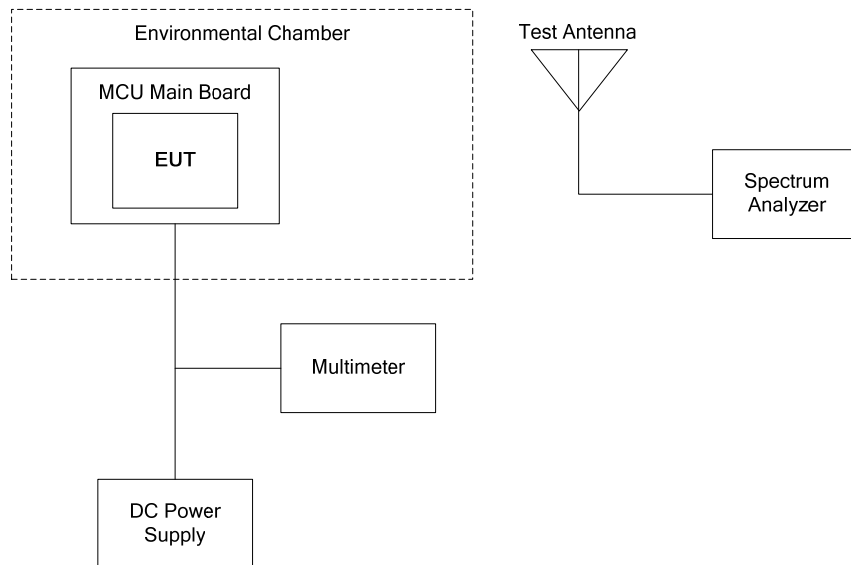


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power input source:	3.3 VDC via MCU Main Board and AC Adapter

3.2. OPEPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was configured for continuous transmission for the duration of testing.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT was tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

Transmitter Test Signals:	
Frequency Band(s):	13.56 MHz
Test Frequency(ies):	13.56 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	55.23 dBμV/m at 10 m
▪ Normal Test Modulation:	ASK
▪ Modulating signal source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Regulations	Test Requirements	Compliance (Yes/No)
15.203 & 15.204	The transmitter shall use a transmitting antenna that is an integral part of the device	Yes*
15.207(a)	Class B - Power Line Conducted Emissions	Yes
15.215(c)	Emission Bandwidth	Yes
15.225(a) – (d)	Field Strength of Emissions Inside and Outside the Permitted Band 13.110 - 14.010 MHz	Yes
15.225(e)	Frequency Stability	Yes

* The EUT complies with the requirement; it employs integral antenna.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

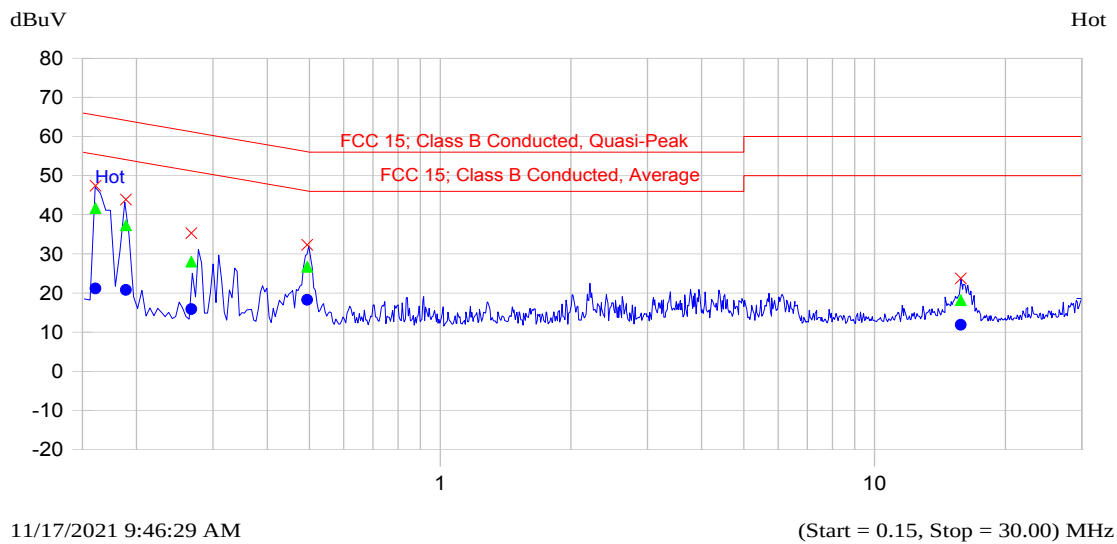
5.1.2. Method of Measurements

ANSI C63.4

5.1.3. Test Data

Plot 5.1.3.1. Power Line Conducted Emissions (EUT with the antenna connected)
Line Voltage 120 VAC; Line Tested: Hot

Current Graph

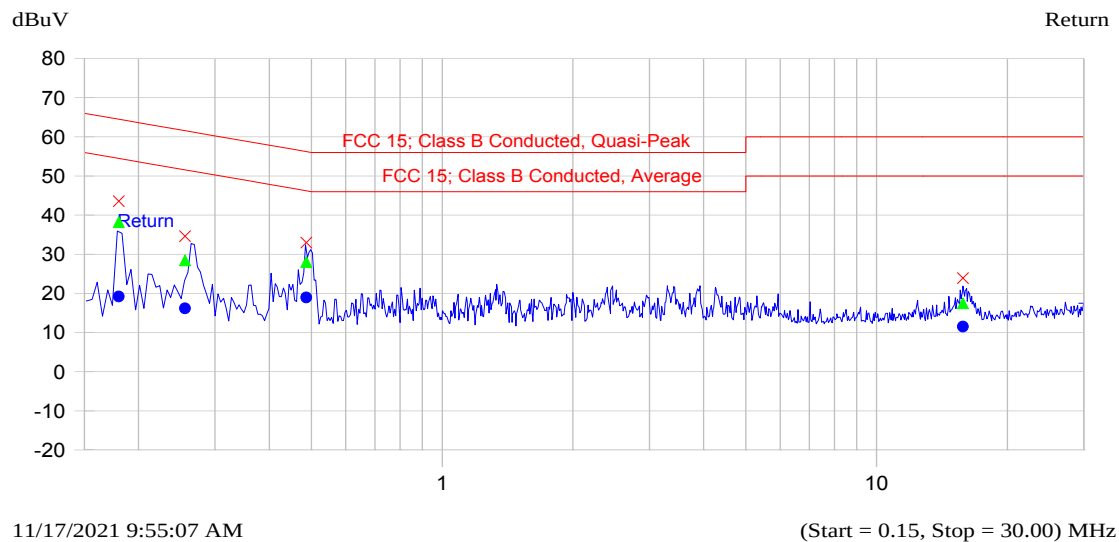


Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.161	47.4	41.7	-23.7	21.2	-34.3	Hot
0.189	43.9	37.3	-26.8	20.8	-33.3	Hot
0.268	35.3	28.0	-33.2	15.9	-35.3	Hot
0.494	32.3	26.7	-29.4	18.2	-27.9	Hot
15.792	23.7	18.2	-41.8	11.9	-38.1	Hot

Plot 5.1.3.2. Power Line Conducted Emissions (EUT with the antenna connected)
Line Voltage 120 VAC; Line Tested: Return

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.180	43.6	38.2	-26.3	19.2	-35.3	Return
0.256	34.6	28.4	-33.2	16.2	-35.4	Return
0.487	33.0	28.0	-28.2	19.0	-27.3	Return
15.803	23.9	17.5	-42.5	11.5	-38.5	Return

5.2. EMISSION BANDWIDTH

5.2.1. Limit(s)

The 20 dB bandwidth of the emission shall be contained within the band 13.110–14.010 MHz.

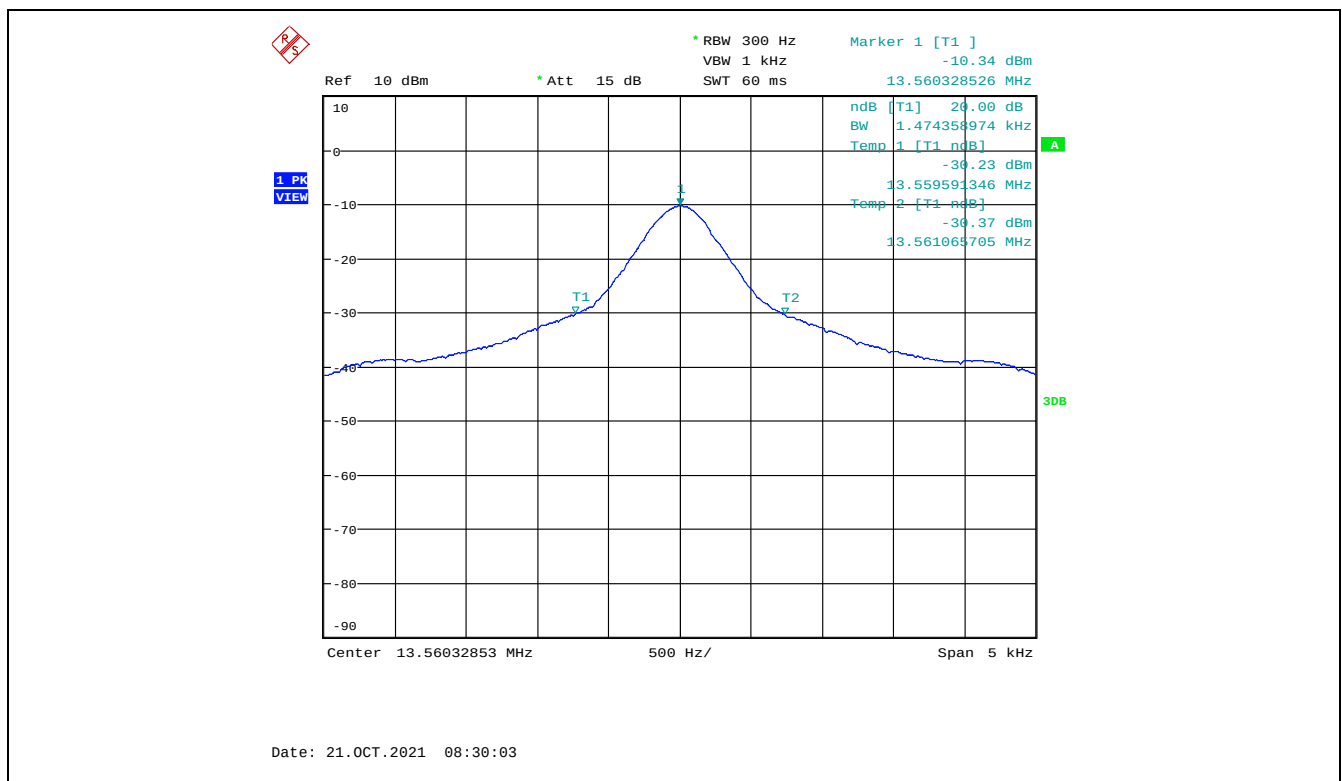
5.2.2. Method of Measurements

ANSI C63.10.

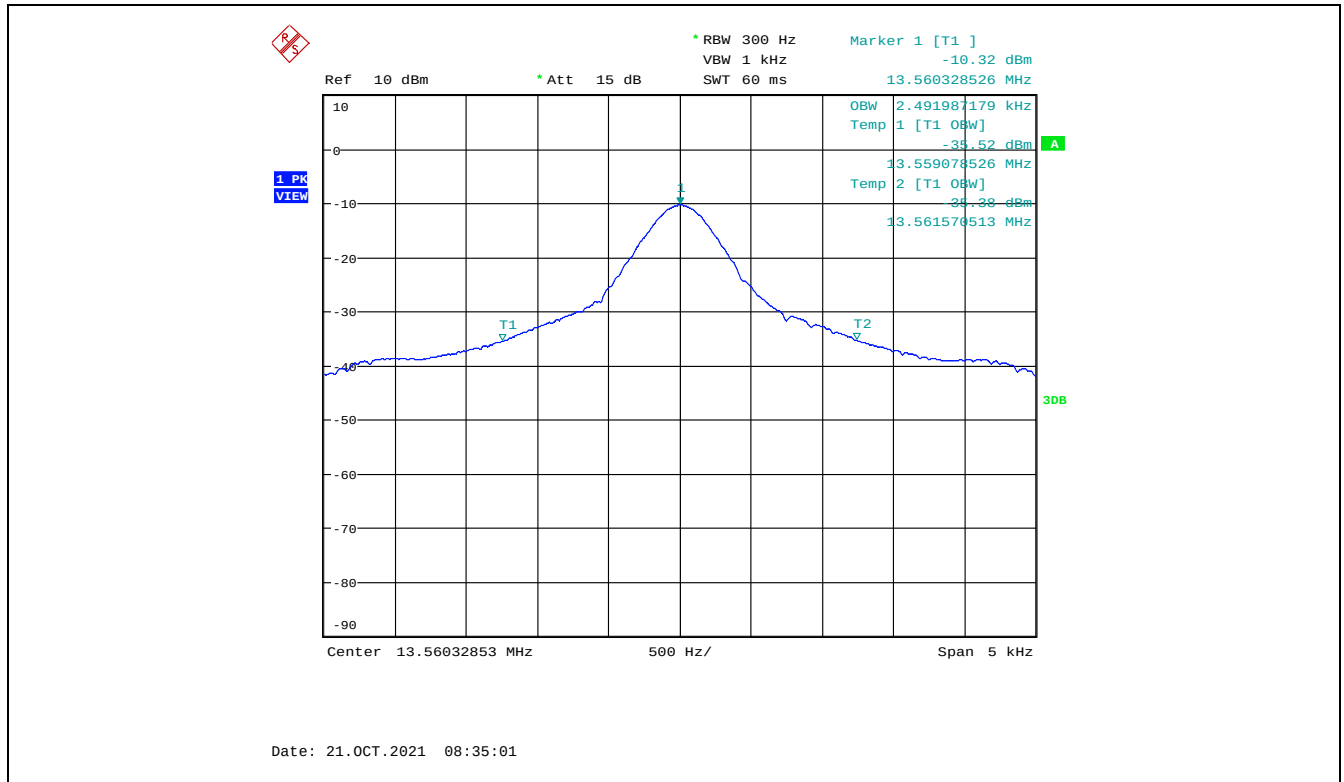
5.2.3. Test Data

Test Frequency	20 dB Bandwidth	99 %Occupied Bandwidth
13.56 MHz	1.474 kHz	2.492 kHz

Plot 5.2.3.1. 20 dB Bandwidth, Fc: 13.56 MHz



Plot 5.2.3.2. 99% Occupied Bandwidth, Fc: 13.56 MHz



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File #: 21MTRD012_FCC15C225

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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.3. FIELD STRENGTH OF EMISSIONS WITHIN & OUTSIDE THE PERMITTED BAND 13.110-14.010 MHz [47 CFR 15.225 (a) to (d)]

5.3.1. Limits

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

47 CFR 15.209(a) – Radiated Emission Limits; general requirements

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / 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

5.3.2. Method of Measurements

ANSI C63.10 and ANSI C63.4 for measurement methods.

5.3.3. Test Data

Remarks:

- Radiated spurious emissions measurements were performed at a measuring distance of 10 m or 3 m, from 10 kHz – 10th harmonic of the fundamental and all spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- For frequencies below 30 MHz, the results measured at 10 m distance shall be extrapolated to the specified distance using an extrapolation factor of 40 dB/decade for determining compliance.

5.3.3.1. Field Strength of Emissions Within the Permitted Band at 10 m

Frequency (MHz)	Measured Field Strength @ 10 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Field Strength Extrapolated Value (dBµV/m)	§ 15.225 Field Strength Limits (dBµV/m)	Margin (dB)
13.56	55.23	Peak	V	36.15	84.0	-47.9
13.56	49.60	Peak	H	30.52	84.0	-53.5

5.3.3.2. Field Strength of Emissions Outside the Permitted Band Below 30 MHz at 10 m

Frequency (MHz)	Measured Field Strength @ 10 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Field Strength Extrapolated Value (dBµV/m)	§ 15.209 Field Strength Limits (dBµV/m)	Margin (dB)
All spurious emissions are more than 20 dB below the specified limit.						

5.3.3.3. Field Strength of Emissions Outside the Permitted Band at or Above 30 MHz at 3 m

Frequency (MHz)	Measured Field Strength @ 3 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	§ 15.209 Field Strength Limits (dBµV/m)	Margin (dB)
40.68	23.02	Peak	V	40.0	-17.0
54.24	30.33	Peak	V	40.0	-9.7
67.80	25.02	Peak	V	40.0	-15.0
81.36	35.13	Peak	V	40.0	-4.9
94.92	32.73	Peak	V	43.5	-10.8
108.48	35.90	Peak	V	43.5	-7.6
108.48	25.79	Peak	H	43.5	-17.7
122.04	32.57	Peak	V	43.5	-10.9
135.60	40.50	QP	V	43.5	-3.0
135.60	29.56	Peak	H	43.5	-13.9

5.4. FREQUENCY STABILITY [47 CFR 15.225(e)]

5.4.1. Limit(s)

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.4.2. Method of Measurements

ANSI C63.10.

5.4.3. Test Data

Frequency Band:	13.56 MHz
Center Frequency:	13.56 MHz
Frequency Tolerance Limit:	$\pm 0.01\%$ (± 1356 Hz)
Max. Frequency Tolerance Measured:	-161 Hz
Input Voltage Rating:	12 VDC on DC input to MCU Main Board

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 12 VDC	Supply Voltage (85 % of Nominal) 10.2 VDC	Supply Voltage (115% of Nominal) 13.8 VDC
-20	-161	--	--
-10	-161	--	--
0	-1	--	--
+10	-1	--	--
+20	0	-1	-1
+30	-161	--	--
+40	-81	--	--
+50	-81	--	--
+60	-81	--	--

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412800103	9 kHz–26.5 GHz	22 Jan 2022
Attenuator	Rhode & Schwarz	EZ-25	830164/07	150kHz-30MHz	06 Aug 2022
LISN Used	EMCO	3825-2	8907-1531	10 kHz–30 MHz	01 Feb 2022
EMI Receiver	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	25 Jan 2022
Loop Antenna	EMCO	6502	9104-2611	0.01 – 30 MHz	24 Jan 2022
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	01 Sep 2022
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	11 Sep 2022
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	04 Jan 2022
Biconilog	EMCO	3142C	00034792	26-2000 MHz	16 May 2022
Horn Antenna	EMCO	3155	9701-5061	1 – 18 GHz	10 Jun 2022
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177°C	25 Aug 2023
Multi-meter	Fluke	8842A	4142058	20mV - 1kV	01 Oct 2022
DC Power Supply	HQ Power	PS613U	NSN	0-30V	See Note 1
Note 1: Internal Verification/Calibration check					

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EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

Test Description	Expanded Uncertainty, K=2 for 95% Confidence Level
Power Line Conducted Emissions	± 2.62
Occupied Bandwidth	± 0.18 Hz
Radiated Emissions	± 2.60 dB (10 kHz – 30 MHz)
	± 4.30 dB (30 MHz – 1 GHz)
	± 3.04 dB (1 – 18 GHz)
Frequency Stability	± 0.18 Hz

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