13.56MHz RFID
Test Report

for the

Maztech Industries
X4 Fire Control System (Model: X4-FCS)

Tested under
the FCC Certification Rules
contained in
15.225 Subpart C
for Intentional Radiators

Veer Patel, EMC/Wireless Engineer
Electromagnetic Compatibility Lab

Nancy LaBrecque
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	1/30/2025	Initial Issue.
1	3/19/2025	Customer Requested Changes.

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Maztech Industries X4 Fire Control System, with the requirements of Part 15, §15.225. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. The following data is presented in support of the Certification of the X4 Fire Control System. Maztech Industries should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the X4 Fire Control System, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.225 and RSS-210, in accordance with Maztech Industries, under purchase order number IRV12896. All tests were conducted using measurement procedures ANSI C63.4-2014 and C63.10-2013.

FCC Reference	Description	Compliance	Note
Part 15 §15.203	Antenna Requirement	**Compliant**	**None**
Part 15 §15.207(a)	Conducted Emission Limits	**N/A**	**Battery Powered EUT**
Part 15 §15.215	20dB Occupied Bandwidth	**Compliant**	**None**
---	99% Occupied Bandwidth	**Compliant**	**None**
Part 15 §15.225(a)	Field Strength emissions within the band 13.553 – 13.567 MHz	**Compliant**	**None**
Part 15 §15.225(b)	Field Strength emissions within the band 13.410 – 13.553 MHz and 13.567 – 13.710 MHz	**Compliant**	**None**
Part 15 §15.225(c)	Field Strength emissions within the band 13.110 – 13.410 MHz and 13.710 – 14.010 MHz	**Compliant**	**None**
Part 15 §15.225(d)	Outside-Band Field Strength emissions per 15.209 - 13.110 – 14.010 MHz	**Compliant**	**None**
Part 15 §15.225(e)	Frequency Tolerance of the Carrier	**Compliant**	**None**

Table 1. Executive Summary

Equipment Configuration

A. Overview

Eurofins E&E North America was contracted by Maztech Industries to perform testing on the X4 Fire Control System.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Maztech Industries X4 Fire Control System.

The results obtained relate only to the item(s) tested.

Product Name:	X4 Fire Control System	
Model(s) Tested:	X4-FCS	
FCCID:	2BKWD- FCS01	
Equipment Specifications:	Primary Power:	4-18VDC
	Type of Modulation(s):	OOK
	Equipment Code:	DXX
	Maximum field Strength:	40.12dBuV/m
	Antenna Type:	loop
	EUT Frequency Ranges:	13.56MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor and Sergio Gutierrez	
Test Date(s):	3/19/2025	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

Eurofins MET Laboratories Inc. (Eurofins E&E North America) is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

All testing was performed at Eurofins E&E North America, 13501 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

Correlation between semi-anechoic chamber and OATS:

Two calibrated Loop antennas were used on an OATS. One antenna was driven by a signal generator with a known power. The receive antenna was initially placed 1m away from the transmit antenna. The two antennas were placed parallel to each other. The receive antenna was in turn connected to a calibrated spectrum analyzer. The emissions were swept from 9 kHz to 30 MHz. The receive antenna was then rotated 90 degrees and measurements re-taken. Additional measurements were taken when the receive antenna was placed at 3meters.
This same setup was taken to inside the semi-anechoic chamber and the measurements repeated.

The data was used to correlate the semi-anechoic chamber and OATS.

ISED Lab Info:
CAB Identifier: US0004
Company Number: 2043D

FCC Lab Info:
Designation Number: US1127

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Occupied Bandwidth Measurements	±4.52 Hz	2	95%
Conducted Power Measurements	±2.74 dB	2	95%
Power Spectral Density Measurements	±2.74 dB	2	95%
Conducted Spurious Emissions	±2.80 dB	2	95%
Conducted Emissions (Mains)	±2.97 dB	2	95%
Radiated Spurious Emissions (9kHz – 1GHz)	±2.95 dB	2	95%
Radiated Spurious Emissions (1GHz - 40GHz)	±3.54 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

X4 Fire Control System is a ballistic mount heads-up display for sportsmen target shooters. It has wireless interfaces to communicate with accessories: UWB (3.1 GHz-5.8 GHz), NFC (13.56 MHz) and to communicate with smartphone for a command/control app: NFC (13.56 MHz), BLE 5.0 (2.4 GHz).

The RFID tag was not part of this evaluation and is considered a separate device subject to its own authorization.

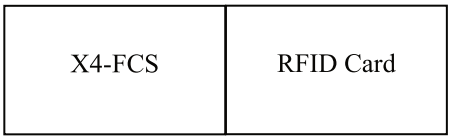


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

A 13.56MHz Credential was placed in front of the X4 Fire Control System to force a continuous reading operation.

G. Support Equipment

The X4 Fire Control System was tested in a stand-alone configuration. No support equipment was used during the evaluation.

H. Ports and Cabling Information

The X4 Fire Control System was tested in a stand-alone configuration. No cables were connected during the evaluation.

I. Mode of Operation

The RF Credential was placed in front of the X4 Fire Control System in order to force continuous reading operations.

Transmit Band	Modulation	Channel Frequencies Tested	Exercising Method
13.56MHz	OOK	13.56MHz	13.56MHz RFID Credential

Table 5. Test Channels Utilized

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Maztech Industries upon completion of testing.

Antenna Requirements

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The X4 Fire Control System as evaluated, was compliant as the antenna was permanently attached.

Test Engineer(s): Bryan Taylor

Test Date(s): 12/16/2024

Occupied Bandwidth Measurements

§ 15.215(c) 20 dB Occupied Bandwidth

Test Requirement(s): **§ 15.215 (c)** Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer. Per ANSI C63.10: 2020 the RBW should be between 1% and 5% of the occupied bandwidth.

Test Results: The X4 Fire Control System was compliant with this requirement. The 20dB Bandwidth is shown on the plots on the following pages.

Test Engineer(s): Bryan Taylor and Veer Patel

Test Date(s): 12/16/2024

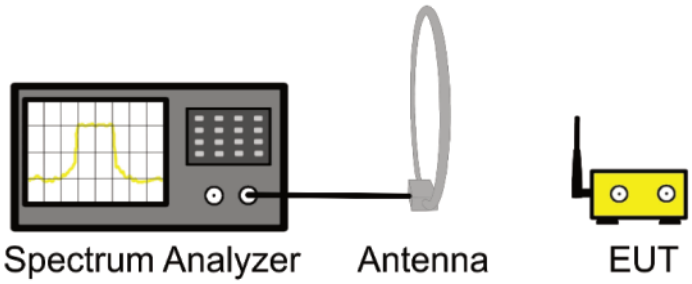
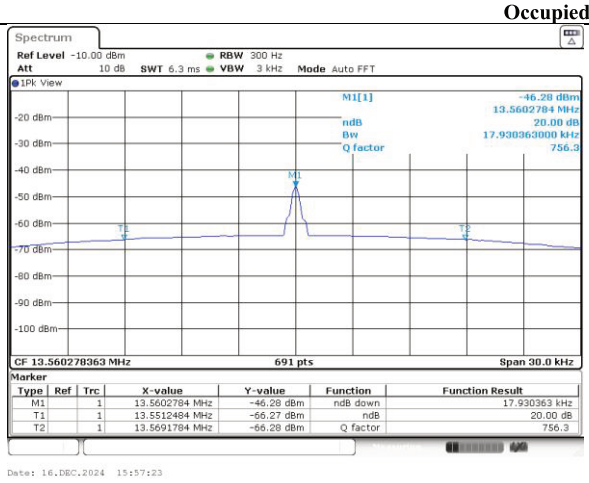


Figure 2. 20 dB Bandwidth and 99% Bandwidth Test Setup

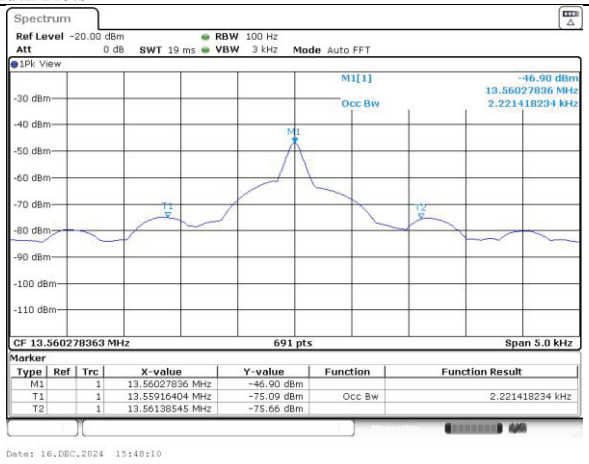
Center Frequency (MHz)	20 dB Bandwidth	99% Bandwidth
13.56MHz	17.930263kHz	2.221418234 kHz

Table 6. Occupied Bandwidth Test Results

Occupied Bandwidth Plots



20dB Bandwidth



99% Bandwidth

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.225(a-d) Field Strength of Radiated Emissions

Test Requirement(s):

15.225 (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.

15.225 (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.

15.225 (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.

15.225 (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.

Test Procedure:

The EUT was set to transmit and placed on a 0.8 m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.10: 2013 were used. For measurements below 30 MHz a loop antenna placed 3m away from the unit was used. For measurements above 30 MHz a biconalog antenna placed 10 m away from the unit was used. Measurements below 30 MHz were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. Measurements above 30 MHz were conducted with the biconalog antenna in the vertical and horizontal polarizations. A peak detector was used to perform a pre-scan from 9 kHz to 10 times the fundamental frequency. Spurious emissions within 20 dB of the applicable limit were measured using a quasi-peak detector and recorded in the subsequent section.

The measurements made at 3 m with the loop antenna (below 30MHz) were then extrapolated to 30m or 300 m using the following correction factors which were applied to the limit.

40log (30/3) = 40 dB
40log (300/3) = 80 dB

The measurements made at 10 m with the biconilog antenna (above 30MHz) were then extrapolated to 3m using the following correction factor.

20log (10/3) = 10.46 dB

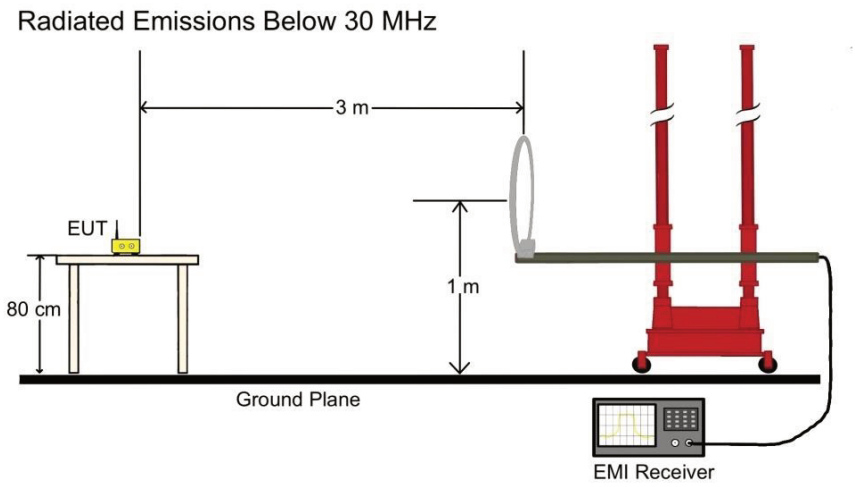


Figure 3: Radiated Emissions (Below 30MHz), Test Setup

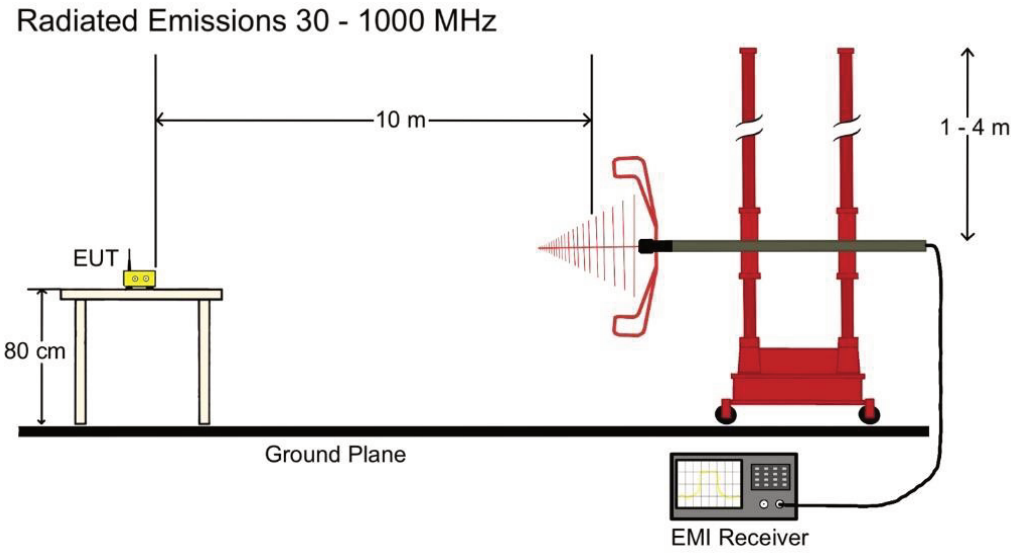


Figure 4. Radiated Emissions (Above 30MHz), Test Setup

Test Results: The X4 Fire Control System was compliant with the requirements of **§15.225(a - d)**.

Test Engineer(s): Bryan Taylor and Veer Patel

Test Date(s): 12/17/2024 - 1/24/2025

Radiated Field Strength Test Results

Frequency [MHz]	Peak Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
13.133	18.22	80.50	62.28	10.62	V	259.1	1	9.000	Pass
13.250	18.30	80.50	62.20	10.62	H	305.5	1	9.000	Pass
13.466	17.98	90.50	72.52	10.61	H	360.3	1	9.000	Pass
13.470	18.19	90.50	72.31	10.61	V	105.7	1	9.000	Pass
13.560	34.70	124.00	89.30	10.61	H	200.5	1	9.000	Pass
13.560	39.71	124.00	84.29	10.61	V	289.2	1	9.000	Pass
13.641	17.50	90.50	73.00	10.60	H	248.3	1	9.000	Pass
13.668	17.73	90.50	72.77	10.60	V	337.4	1	9.000	Pass
13.790	18.27	80.50	62.23	10.60	H	28.3	1	9.000	Pass
13.979	17.48	80.50	63.02	10.59	V	352.2	1	9.000	Pass

Figure 5. Worst Case In-Band Field Strength

Frequency [MHz]	Peak Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.018	63.77	122.73	58.96	15.31	V	105.2	1	0.200	Pass
0.209	53.51	101.22	47.71	11.37	H	128.6	1	9.000	Pass
13.560	17.20	69.50	52.30	10.61	H	30	1	9.000	Pass
13.560	40.12	69.50	29.38	10.61	V	119.7	1	9.000	Pass

Figure 6. Worst Case Field Strength Below 30MHz

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
30.150	12.88	29.55	16.67	-0.21	H	211.2	1.05	120.000	Pass
77.160	3.04	29.55	26.51	-12.62	V	252.6	1.27	120.000	Pass
103.470	10.07	33.07	23.00	-9.09	H	154.2	3.71	120.000	Pass
103.500	11.24	33.07	21.83	-9.68	V	253.1	1.83	120.000	Pass
298.740	10.77	35.57	24.80	-5.76	H	356.7	2.74	120.000	Pass
513.060	16.45	35.57	19.12	-0.51	V	269.9	2.49	120.000	Pass

Figure 7. Worst Case Field Strength 30MHz – 1GHz

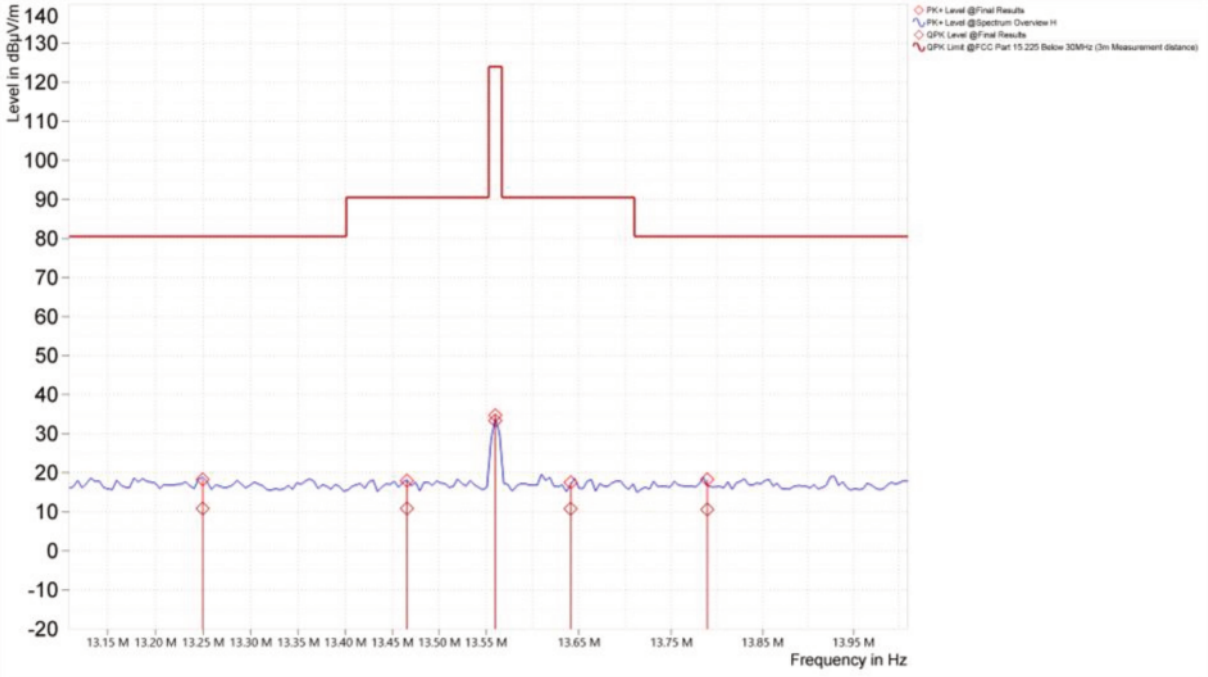


Figure 8. In-Band Emission Mask (Coplanar Loop)

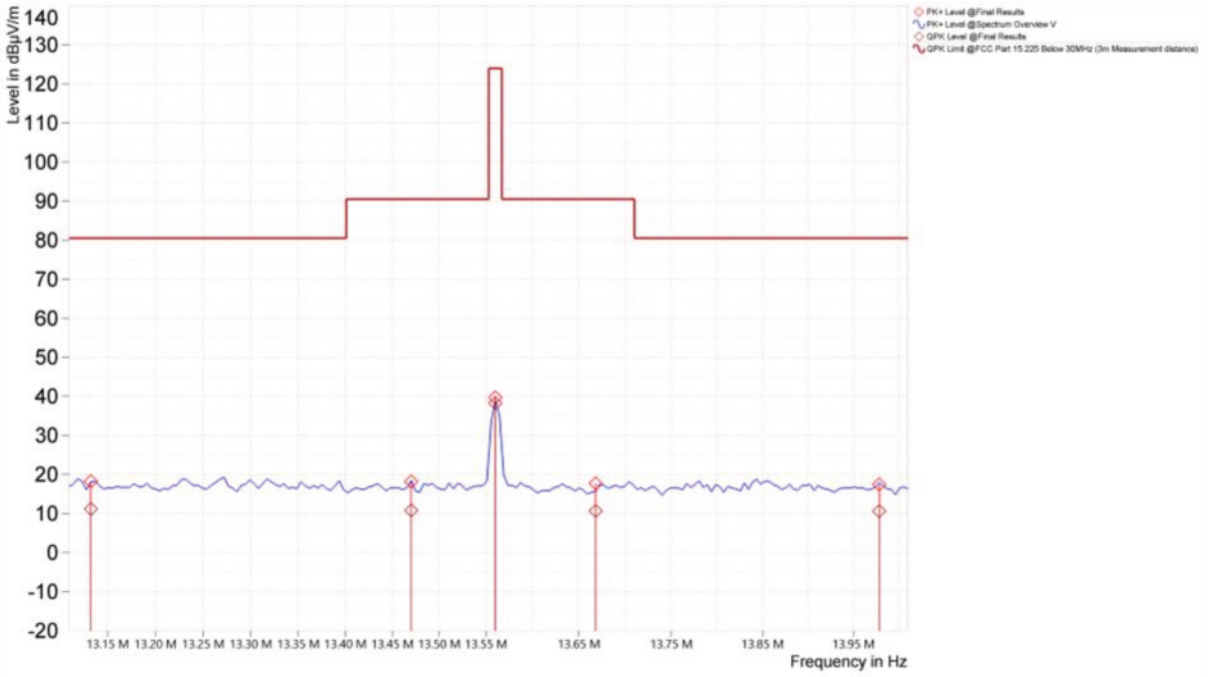


Figure 9. In-Band Emission Mask (Coaxial Loop)

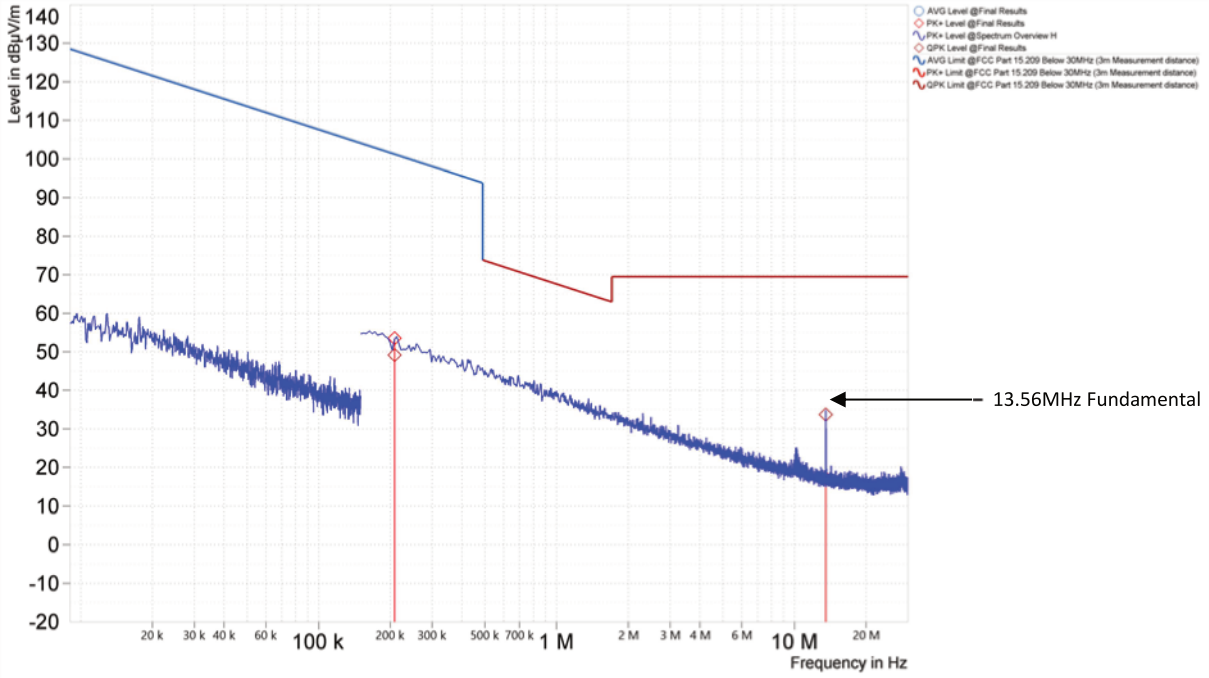


Figure 10. Out of Band Emissions Below 30MHz (Coplanar Loop)

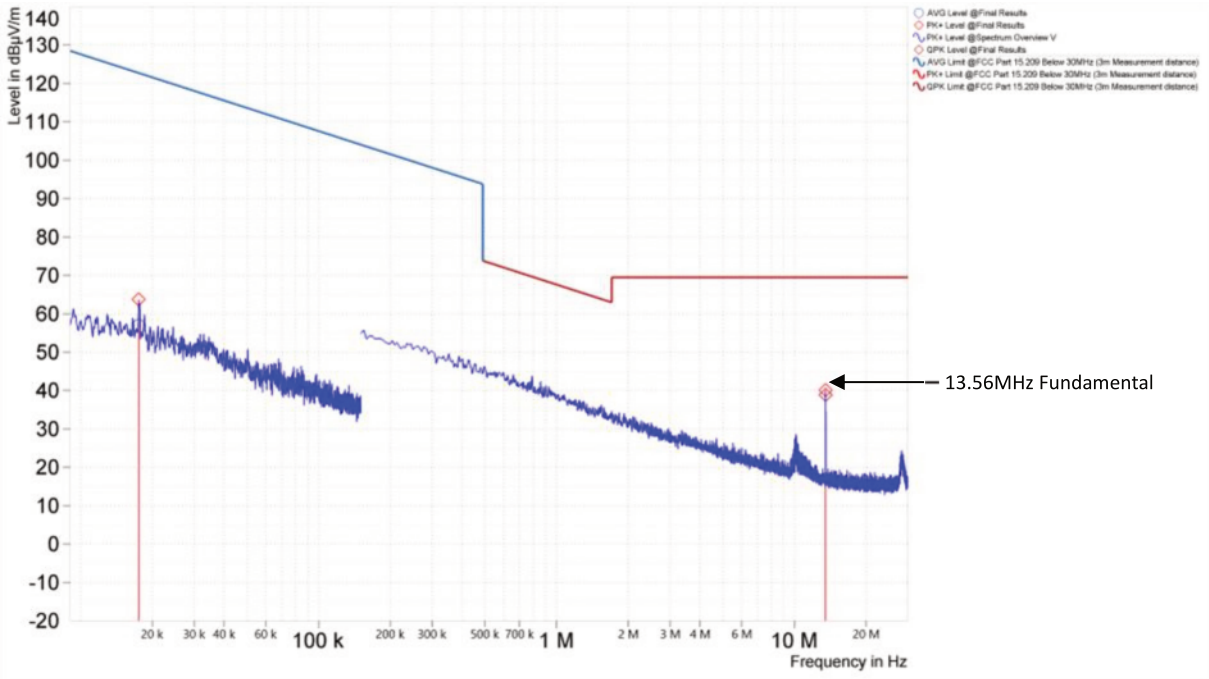


Figure 11. Out of Band Emissions Below 30MHz (Coaxial Loop)

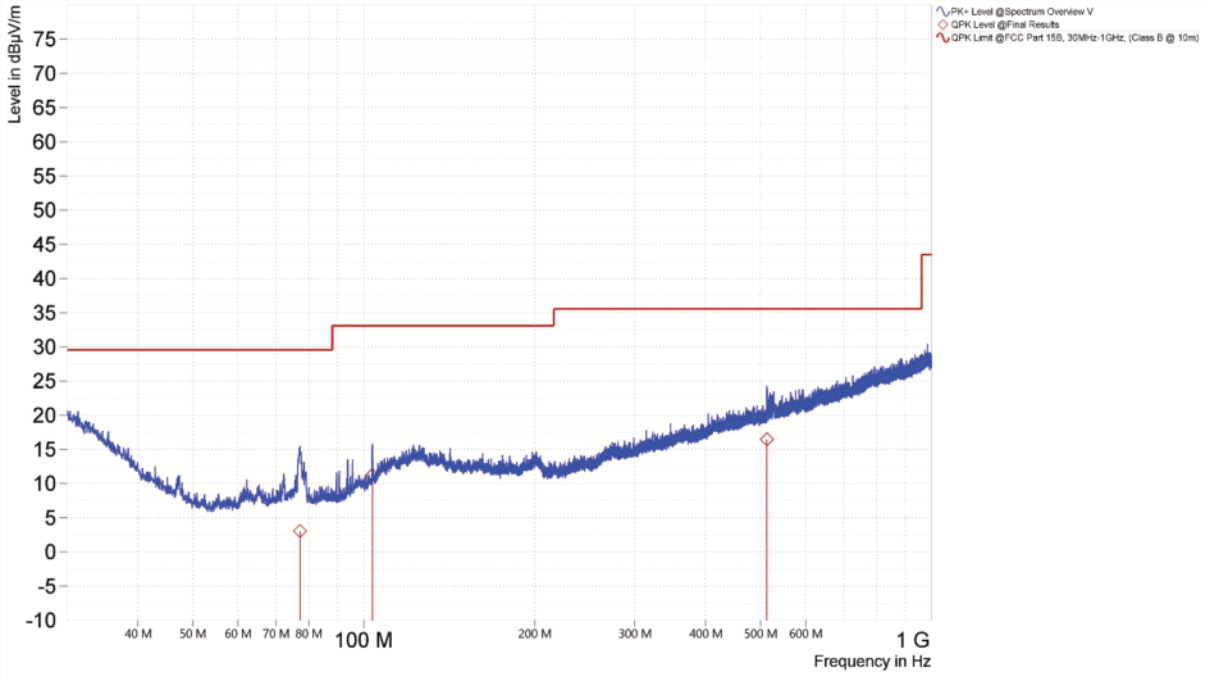


Figure 12. Out of Band Emissions 30MHz – 1GHz (Vertical)

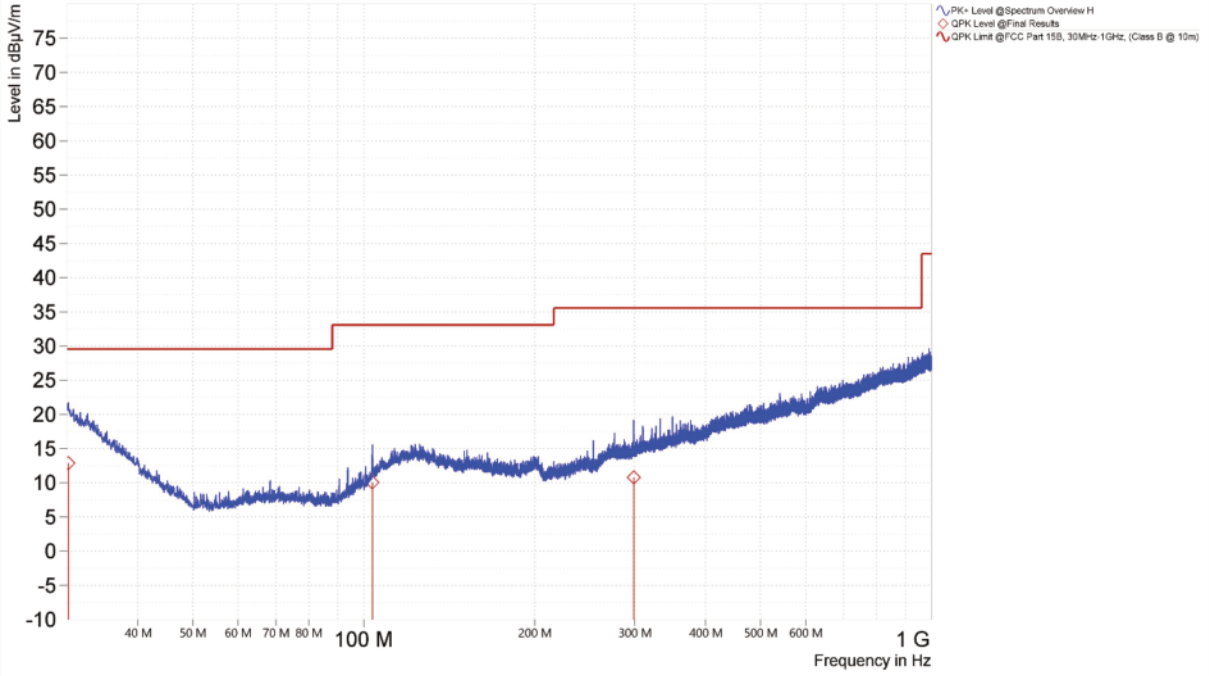


Figure 13. Out of Band Emissions 30MHz – 1GHz (Horizontal)

Electromagnetic Compatibility Criteria for Intentional Radiators

Frequency Stability

Test Requirement(s): **15.225(e)** 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.

Test Procedure: Measurements are in accordance with section 6.8 of ANSI C63.10. The EUT was placed in the Environmental Chamber and allowed to reach desired temperature. A spectrum analyzer was used to measure the frequency drift. The EUT was set to transmit in the operating frequency range. Frequency drift was investigated for the extreme temperatures and nominal temperature, until the unit is stabilized then recorded the reading in tabular format with the temperature range of -20º to 50ºC.

Test Results: The X4 Fire Control System was compliant with Part 15.225 (e) requirement(s) of this section.

Test Engineer(s): Bryan Taylor

Test Date(s): 12/16/2024

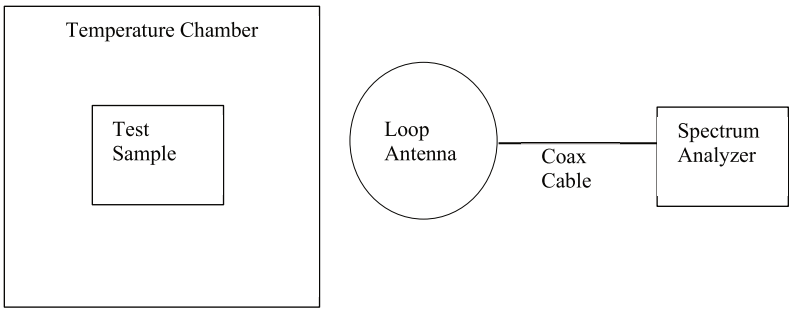


Figure 14. Temperature Stability Test Setup

Operating Freqeuncy:	13,560,000	Hz	
Reference Voltage:	8	VDC	Fully Charged Battery
Deviation Limit:	0.01	%	

Voltage %	Voltage (VDC)	Temp (°C)	Measured Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	Limit (%)
100%	8	-20	13,560,361	361	0.0027	0.01
100%	8	-10	13,560,340	340	0.0025	0.01
100%	8	0	13,560,321	321	0.0024	0.01
100%	8	10	13,560,305	305	0.0022	0.01
100%	8	20	13,560,281	281	0.0021	0.01
100%	8	30	13,560,223	223	0.0016	0.01
100%	8	40	13,560,217	217	0.0016	0.01
100%	8	50	13,560,145	145	0.0011	0.01

Figure 15. Frequency Stability Test Results

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

MET Asset #	Description	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1234	Signal Analyzer	Rohde & Schwarz	FSV40	01/23/2023	01/23/2025[1]
1A1250	Receiver	Rohde & Schwarz	ESW44	04/08/2024	04/08/2025
1A1176	Active Loop Antenna (9KHz-30MHz)	ETS-Lindgren	6502	8/22/2024	08/22/2026
1A1147	Bi-Log Antenna	Suno Sciences Corp	JB3	04/06/2023	04/06/2025
1A1047	Horn Antenna (1GHz – 18GHz)	ETS - Lindgren	3117	06/26/2024	06/26/2025
1A1161	Horn Antenna (18GHz – 40GHz)	ETS Lindgren	3116C	08/01/2024	08/01/2026
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	08/20/2024	08/20/2025
1A1225	Environmental Chamber	Espec	EXP-2H/New	5/15/2024	05/15/2025
1A1099	Generator	Com-Power	CGO-51000	See Note	
1A1088	Preamplifier	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	Com-Power	CG-520	See Note	
1A1073	Multi Device Controller	ETS	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1080	Multi-Device	ETS	2090	See Note	
1A1180	Preamplifier	Miteq	AMF-7D-01001800-22-10P	See Note	

Table 7. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

[1] The calibration on this item expired after 1/23/2025. It was not used for any measurements after that date.

End of Report