FCC 47 CFR PART 15 SUBPART F
ISED RSS-220 ISSUE 1 + A1

TEST REPORT

FOR

ULTRA-WIDEBAND RAM

MODEL NUMBER: HD5110

FCC ID: YGP5110-01
IC: 9016A-HD5110-01

REPORT NUMBER: R15655515-E4

ISSUE DATE: 2025-06-26

Prepared for
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CERT #0751.06

Revision History

Rev.	Issue Date	Revisions	Revised By
1	2025-05-08	Initial Issue	M. Antola
2	2025-06-13	Misc. editorial update	M. Antola
3	2025-06-26	Revised Section 2 to state AC mains is N/A due to device being battery operated	B. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CROWN EQUIPMENT CORP
44 S WASHINGTON ST
BERMEN, OH, 45869-1247 USA

EUT DESCRIPTION: ULTRA-WIDEBAND RAM

MODEL: HD5110

SERIAL NUMBER: Non-serialized product unit

DATE TESTED: 2025-02-06 to 2025-03-28

SAMPLE RECEIPT DATE: 2025-02-04 to 2025-03-25

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart F	Refer to Section 2
ISED RSS-220 Issue 1 + A1	Refer to Section 2
ISED RSS-GEN Issue 5 + A1 + A2	Refer to Section 2

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
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2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer. Below is a list of the data provided by the customer:

- Antenna gain and type (see section 5.4)

FCC Clause	ISED Clause	Requirement	Results	Comment
-	RSS-Gen Section 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.4
15.503 & 15.517 (b)	RSS-220 Section 5.1 (a)	-10 dB Bandwidth	Complies	ANSI C63.10 Section 10.1
15.517 (c) (e)	RSS-220 Section 5.2.1 (d) (g)	Pk and Max Av Emissions	Complies	ANSI C63.10 Section 10.3
15.517 (c) & 15.209	RSS-220 Section 3.4 & 5.2.1 (c)	Emissions Below 960 MHz	Complies	ANSI C63.10 Section 10.2
15.517 (c) (d)	RSS-220 Section 5.2.1 (d) (e)	Emissions Above 960 MHz	Complies	ANSI C63.10 Section 10.3
15.207 (a)	RSS-Gen Section 8.8	AC Line Conducted Emissions	N/A	Device is battery operated.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2020, KDB 393764 D01, RSS-GEN Issue 5 + A1 + A2, and RSS-220 Issue 1 + A1.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Certificate Number 0751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☒	Building 2800 Suite Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A	US0067	27265	825374

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5. DECISION RULE AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

EIRP (dBm) = Meter Reading (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB) + dBm-to-dBm Unit Conversion Factor @ 3m (dB)

-60 dBm + 28 dB/m + 2 dB – 30 dB + 11.8 = -48.2 dBm

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

5.3. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. Measurement uncertainty is not taken into account when stating conformity with a specified requirement.

5.4. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emissions, All ranges	6.0 dB
Conducted Emissions, Mains	3.4 dB

Uncertainty figures are valid to a confidence level of 95%.

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6. EQUIPMENT UNDER TEST

6.1. DESCRIPTION OF EUT

The RAM utilizes UWB technology for the purpose of location sensing on forklifts. The RAM communicates only with an Anchor device that is intended for indoor use, permanently mounted in a warehouse environment. The UWB transceiver allows for 10cm accuracy.

The RAM utilizes a single wiring harness which (a) provides power from the 18Vdc forklift battery and (b) provides CAN communication to the PCM for truck information.

The system consists of single RF board containing two (2) unique UWB tranceiver chipsets. Only one transceiver is permitted to transmit at a time and each chipset shares the same antenna. Transceiver part number DW1000 is used to cover channels 3 and 5 and transceiver QM33 covers channel 5 and 9.

6.2. OPERATING FREQUENCY RANGE

The UWB radio operates at the following channels, bandwidths:

Channel	Center Frequency	Bandwidth	Frequency range	Region
3	4492.8 MHz	499.2 MHz	4243.2 ~ 4742.4 MHz	US only
5	6489.6 MHz	499.2 MHz	6240 ~ 6739.2 MHz	US, Canada
9	7987.2 MHz	499.2 MHz	7737.6 ~ 8236.8 MHz	US, Canada

6.3. MAXIMUM OUTPUT POWER

The UWB transmitter has a maximum radiated average output power as follows:

Transceiver	Channel	Center Frequency	Average Power (dBm EIRP)
DW1000	3	4492.8 MHz	-41.95
	5	6489.6 MHz	-42.06
QM33	5	6489.6 MHz	-41.89
	9	7987.2 MHz	-41.58

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The radio utilizes an integral omnidirectional custom copper PCB antenna, P/N 067843-002, with a maximum gain of 0 dBi.

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6.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was D-856, Rev. A.

6.6. WORST-CASE CONFIGURATION

Since the EUT is intended to be mounted from a ceiling, it has only a single installation orientation – pointing down. It is in this orientation that all testing was performed. Each transceiver module is intended to be configured using the following settings. It is these settings that were used during testing and will be implemented in the field:

- PRF = 64
- Preamble Code = 9
- Preamble Length = 64
- Data Rate = 6810
- PHR Rate Bit = Locked
- PHR Rate Value = 850
- Std SFD = Non-Std 8
- Std PHR = False
- Packet Length 127

6.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number
DC Power Supply	BVSecurity	POE-I100G-LITE	202211POEI100GL0966
Laptop	Dell	Latitude E6540	JMYWH12
Resistive Load	--	--	--

I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Length	Remarks
1	CAN BUS	1	Stranded Wire	> 3M	Power & communication. CAN portion of the harness was terminated into a representative load
2	USB	1	USB	< 3M	Not typically an available port. Used for test purposes only

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TEST SETUP

The EUT is a stand-alone device. Test software exercised the radio transceivers.

SETUP DIAGRAM FOR TESTS

Refer to R15655515-EP2 for setup diagram.

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Morrisville Radiated Emissions – Chamber 1

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
135144	Active Loop Antenna	ETS-Lindgren	6502	2024-10-02	2025-10-02
	30-1000 MHz				
90629	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-01-30	2026-01-30
	1-18 GHz				
135143	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2024-02-07	2026-02-07
	Gain-Loss Chains				
91974	Gain-loss string: 0.009-30MHz	Various	Various	2024-05-08	2025-05-08
91976	Gain-loss string: 25-1000MHz	Various	Various	2024-05-08	2025-05-08
91979	Gain-loss string: 1-18GHz	Various	Various	2024-05-08	2025-05-08
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2024-08-29	2025-08-29
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2024-02-04	2025-02-28
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2025-03-14	2026-03-14
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
241205	Environmental Meter	Fisher Scientific	15-077-963	2023-09-05	2025-09-05
261056	9GHz High Pass Filter	RF-Lambda	RHPF23G09G18	2025-04-01	2026-04-01

Note: All equipment was in calibration at the time of test

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Test Equipment Used - Morrisville mmWave – Chamber 3

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
204907	Horn Antenna, 18-26.5GHz	Com Power	AH-826	2024-02-14	2025-02-28
204908	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2024-02-14	2025-02-28
240019	18-40GHz Amplifier	Amplical	AMP18G40-50	2024-03-05	2025-03-31
	Receiver & Software				
206459	Spectrum Analyzer	Rohde & Schwarz	FSW50	2024-12-23	2025-12-23
mmWave	mmWave Software	UL	V2022.7.29		
	Additional Equipment used				
239539	Environmental Meter	Fisher Scientific	15-077-963	2023-07-19	2025-07-19

Note: All equipment was in calibration at the time of test

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8. LIMITS AND RESULTS

8.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

ANSI C63.10 Section 6.9.3

All measurements are made via radiated method. The RBW is in the range of 1% to 5% of the occupied bandwidth. The VBW is set to ≥ 3*RBW. The sweep time is coupled.

RESULTS

Employee IDs: 11322
Location: Chamber 1
Test Date: 2025-02-18

Transceiver	Channel	Center Frequency	99% Bandwidth
DW1000	3	4492.8 MHz*	683.298 MHz*
	5	6489.6 MHz	778.038 MHz
QM33	5	6489.6 MHz	707.781 MHz
	9	7987.2 MHz	632.097 MHz

*-For information only. Channel 3 not intended for use/certification in Canada

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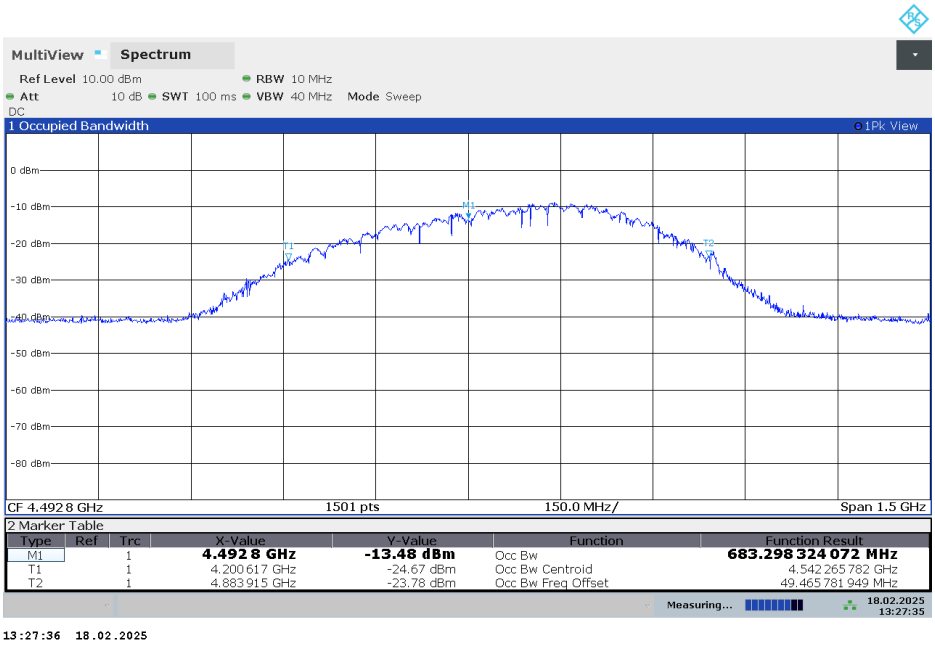
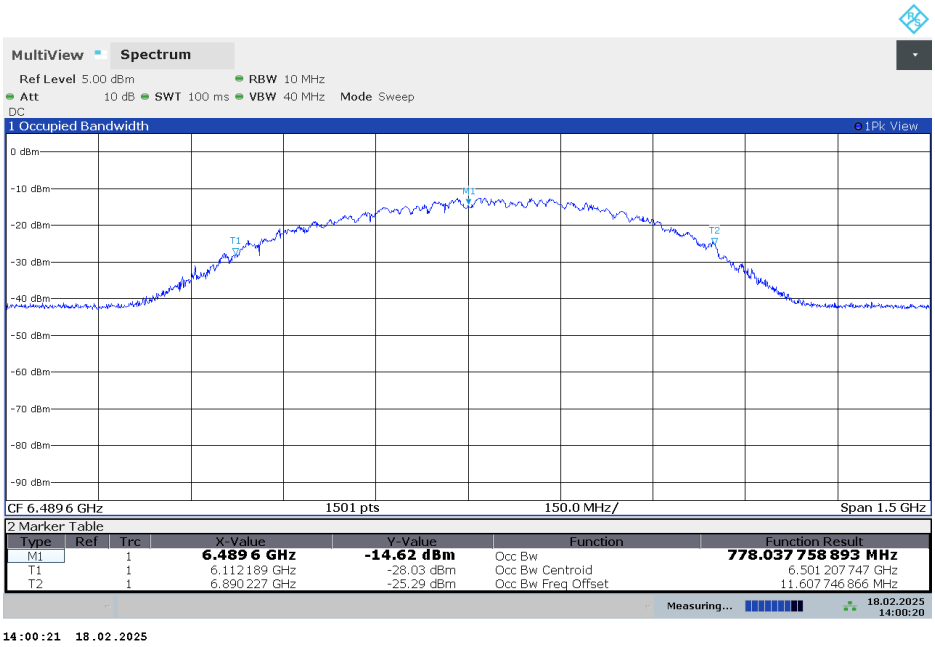


DW1000 Transceiver, Channel 3



DW1000 Transceiver, Channel 5

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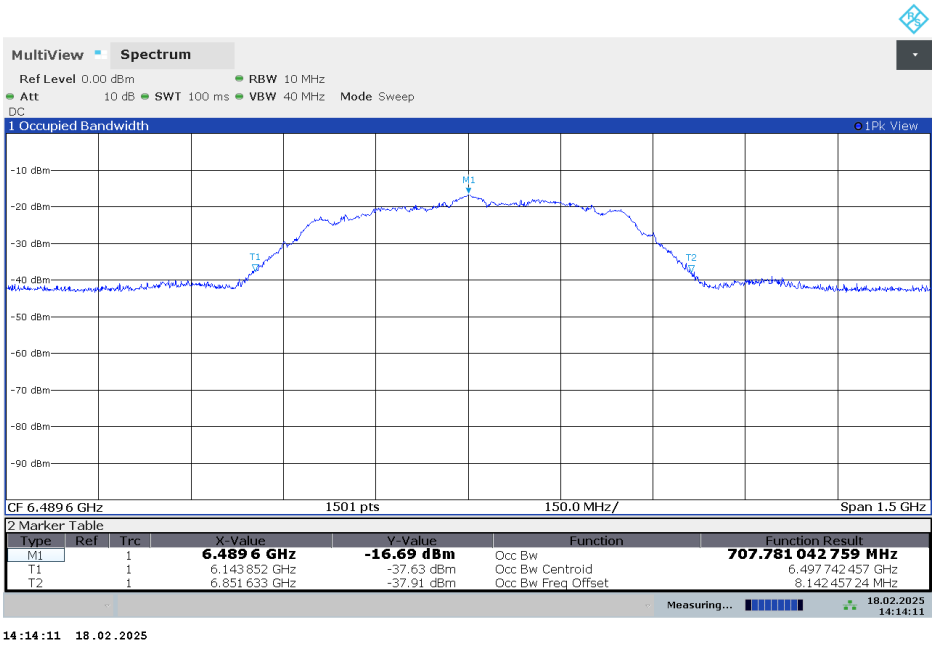
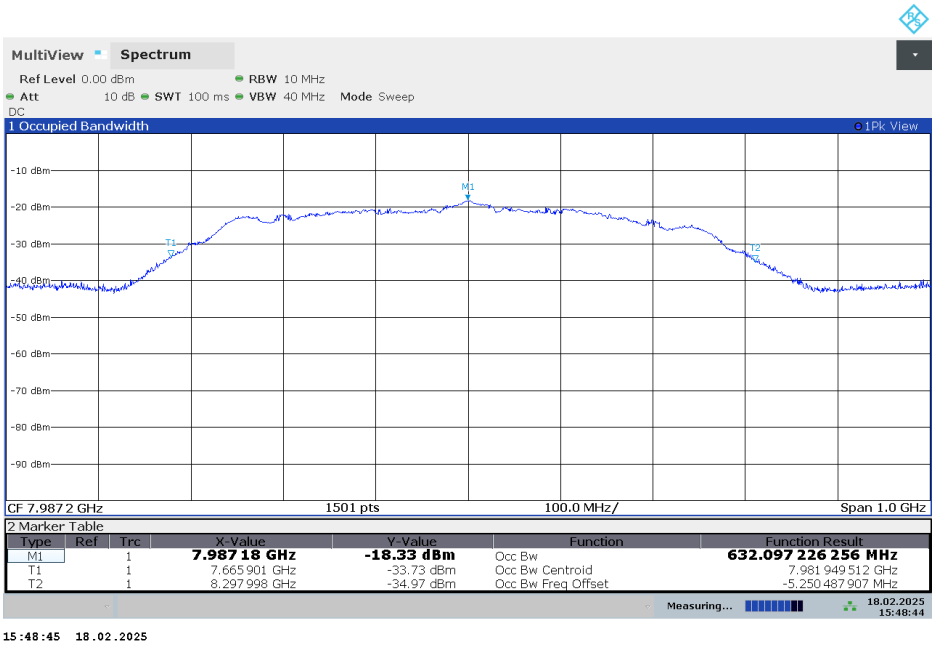


QM33 Transceiver, Channel 5



QM33 Transceiver, Channel 9

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8.2. OPERATING BANDWIDTH

LIMITS

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§15.503 (a) *UWB Bandwidth*. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated fH and the lower boundary is designated fL. The frequency at which the highest radiated emission occurs is designated fM.

§15.503 (b) *Center frequency*. The center frequency, fC, equals (fH + fL)/2.

§15.503 (c) *Fractional bandwidth*. The fractional bandwidth equals 2(fH - fL)/ (fH + fL).

§15.503 (d) *Ultra-wideband (UWB) transmitter*. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

§15.517 (b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

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Section 2 A *UWB* device is an intentional radiator that has either a *-10 dB bandwidth* of at least 500 MHz or a *-10 dB fractional bandwidth* greater than 0.2.

Section 5.1 (a) The -10 dB bandwidth of the device shall be totally contained in the band 3.1 – 10.6 GHz.

"-10 dB bandwidth B_{-10}" and "-10 dB fractional bandwidth μ_{-10}" are defined as follows:

$$B_{-10} = f_H - f_L$$
$$\mu_{-10} = B_{-10}/f_C$$

where:

f_M is the frequency of maximum UWB transmission;
f_H is the highest frequency at which the power spectral density of the UWB transmission is -10 dB relative to f_M;
f_L is the lowest frequency at which the power spectral density of the UWB transmission is -10 dB relative to f_M; and
$f_C = (f_H + f_L)/2$ is the centre frequency of the -10 dB bandwidth.

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TEST PROCEDURE

ANSI C63.10 Clause 10.1

RSS-220 Section 2 of the Annex

Radiated measurements are made using the procedures described above. The detection mode is set to peak detection, the sweep time is AUTO, and the Max Hold trace function is utilized.

The frequency at which the maximum EIRP is measured is designated as f_M. A major graticule line of the plot is adjusted to exactly equal the peak EIRP at f_M. The spectral envelope at the major graticule line that is 10 dB below the reference graticule is examined to determine the frequency band bounded by the points that are 10 dB below the highest radiated emission. The upper boundary is designated f_H and the lower boundary is designated f_L.

The center frequency, f_C, is calculated as $(f_H + f_L)/2$.

The antenna polarization that yields the highest EIRP at f_M is used to calculate the above parameters.

Calculations are made independently for each channel.

RESULTS

Employee IDs: 11322
Location: Chamber 1
Test Date: 2025-02-18

Transceiver	Channel	F_M (GHz)	F_L (GHz)	F_H (GHz)	F_C (GHz)	-10dB BW (MHz)	Min. BW (MHz)	Margin (MHz)
DW1000	3	4.6577	4.2955	4.8391	4.5673	543.6	500	43.6
	5	6.5186	6.1550	6.8332	6.4941	678.2	500	178.2
QM33	5	6.6615	6.2223	6.7646	6.4935	542.3	500	42.3
	9	7.9872	7.7083	8.2467	7.9775	538.4	500	38.4

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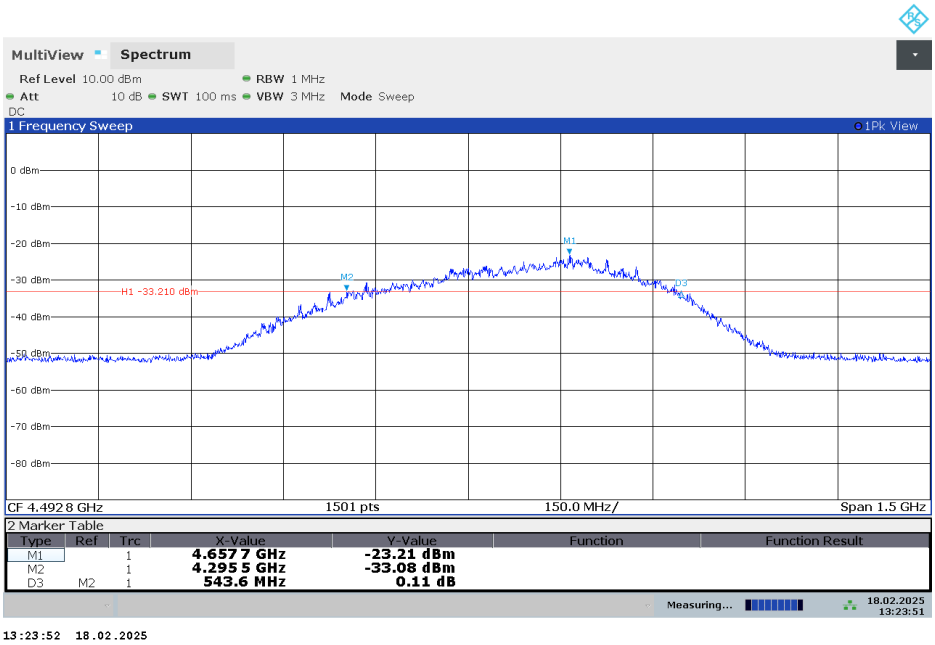
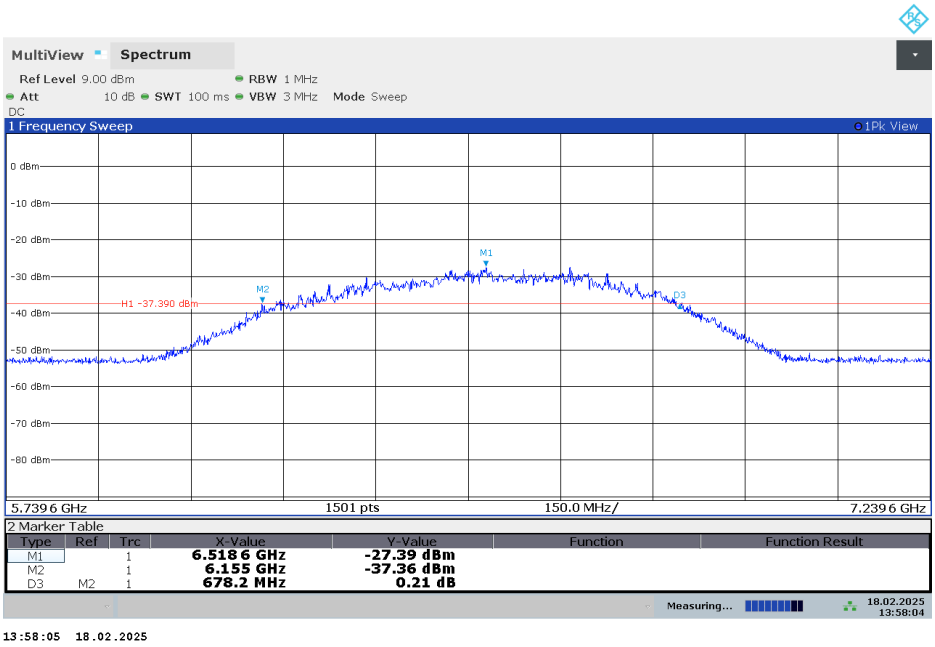


DW1000 Transceiver, Channel 3



DW1000 Transceiver, Channel 5

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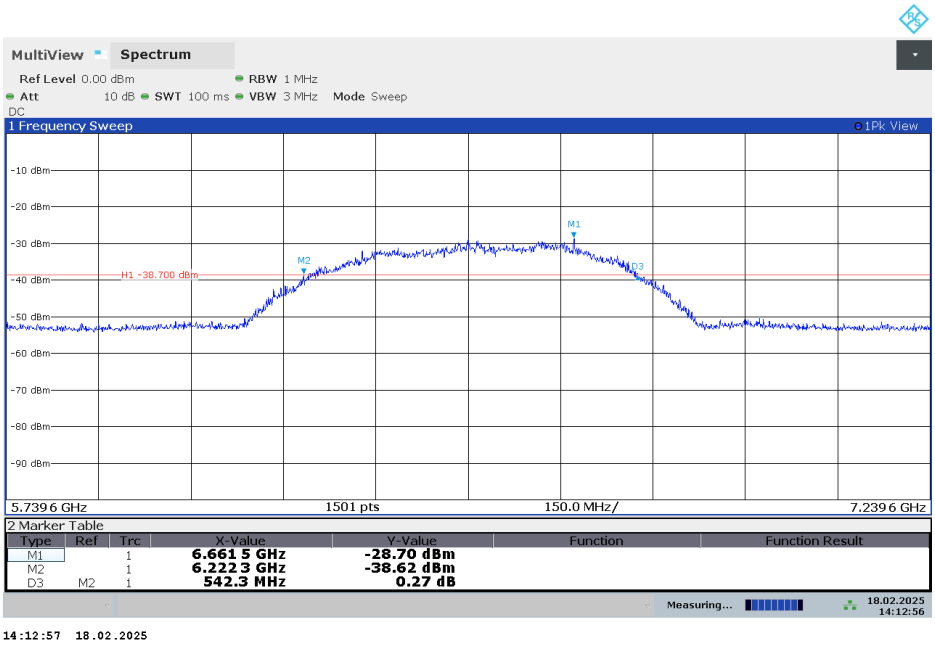
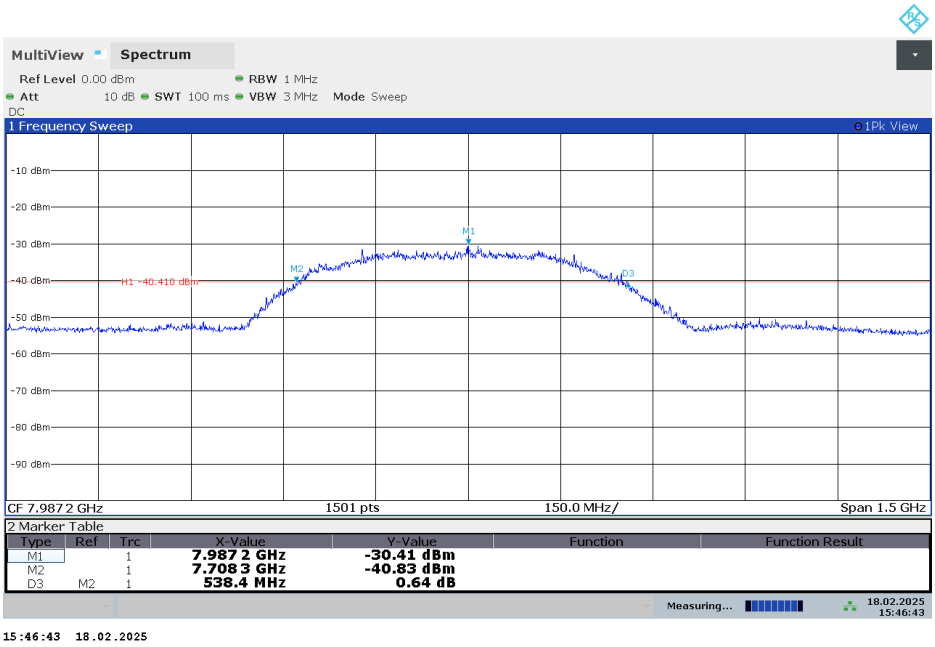


QM33 Transceiver, Channel 5



QM33 Transceiver, Channel 9

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8.3. PEAK POWER & MAXIMUM AVERAGE EMISSIONS

LIMIT

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§15.517 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

§15.517 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
3100 – 10600	-41.3

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Annex, Section 4 (c) Peak measurements shall be made in addition to average measurements. Transmissions shall not exceed 0 dBm e.i.r.p. in any 50 MHz bandwidth when the average limit is -41.3 dBm/MHz.

Section 5.2.1 (d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Indoor Communication, Measurement, Location Sensing and Tracking Devices	
Frequency	**EIRP in Resolution Bandwidth of 1 MHz**
4.75 – 10.6 GHz	-41.3 dBm

TEST PROCEDURE

ANSI C63.10 Clause 10.3

RSS-220 Annex

Peak EIRP power is measured using an RBW of 50 MHz. Radiated emissions of these in-band measurements are performed at a 3-meter distance.

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RESULTS

Employee IDs: 11322, 23854
Location: Chamber 1
Test Date: 2025-03-07 to 2025-03-28

DW1000 Transceiver									
Channel	**Antenna Polarity**	**F_M (GHz)**	**Pk Value (dBm)**	**Pk Limit (dB)**	**Margin (dB)**	**F_M (GHz)**	**Av Value (dBm)**	**Av Limit (dB)**	**Margin (dB)**
3	H	4.68	-2.62	0	-2.62	4.67	-42.60	-41.3	-1.3
3	V	4.62	-3.38	0	-3.38	4.65	-41.95	-41.3	-0.65
5	H	6.50	-7.25	0	-7.25	6.49	-49.22	-41.3	-7.92
5	V	6.49	-2.06	0	-2.06	6.49	-42.06	-41.3	-0.76
QM33 Transceiver									
Channel	**Antenna Polarity**	**F_M (GHz)**	**Pk Value (dBm)**	**Pk Limit (dB)**	**Margin (dB)**	**F_M (GHz)**	**Av Value (dBm)**	**Av Limit (dB)**	**Margin (dB)**
5	H	6.49	-9.82	0	-9.82	6.55	-51.02	-41.3	-9.72
5	V	6.49	-2.77	0	-2.77	6.55	-41.89	-41.3	-0.59
9	H	7.99	-8.36	0	-8.36	7.97	-53.75	-41.3	-12.45
9	V	7.99	-0.91	0	-0.91	7.87	-41.58	-41.3	-0.28

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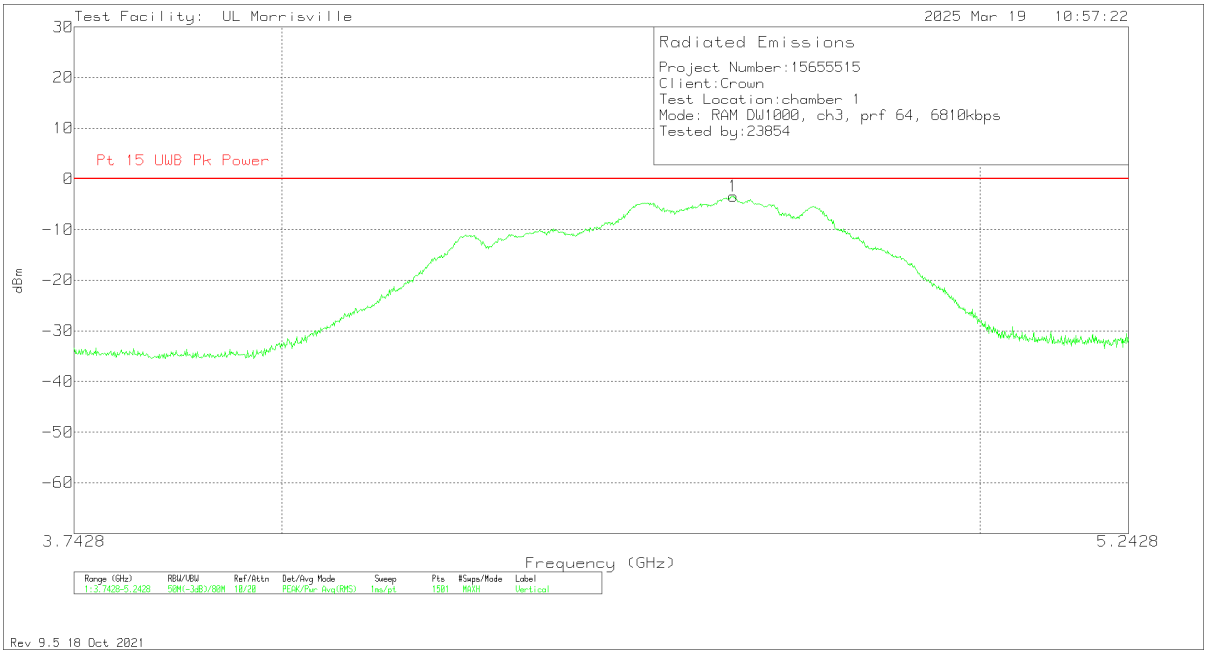
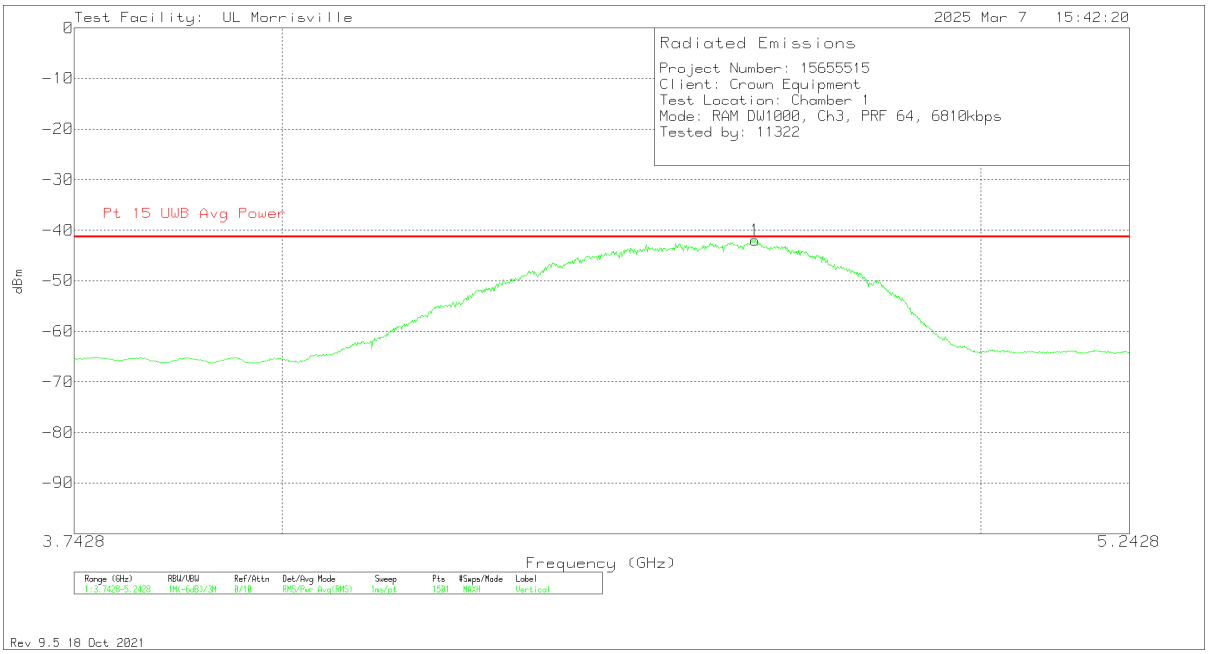


Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	Corrected Reading dBm	Pt 15 UWB Pk Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	4.6208	-.88	Pk	33.8	-48.1	11.8	-3.38	0	-3.38	360	166	V

Pk - Peak detector

DW1000 Transceiver, Channel 3, Peak



Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	Corrected Reading dBm	Pt 15 UWB Avg Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	4.6518	-39.45	RMS	33.8	-48.1	11.8	-41.95	-41.3	-.65	359	121	V

RMS - RMS detection

DW1000 Transceiver, Channel 3, Average

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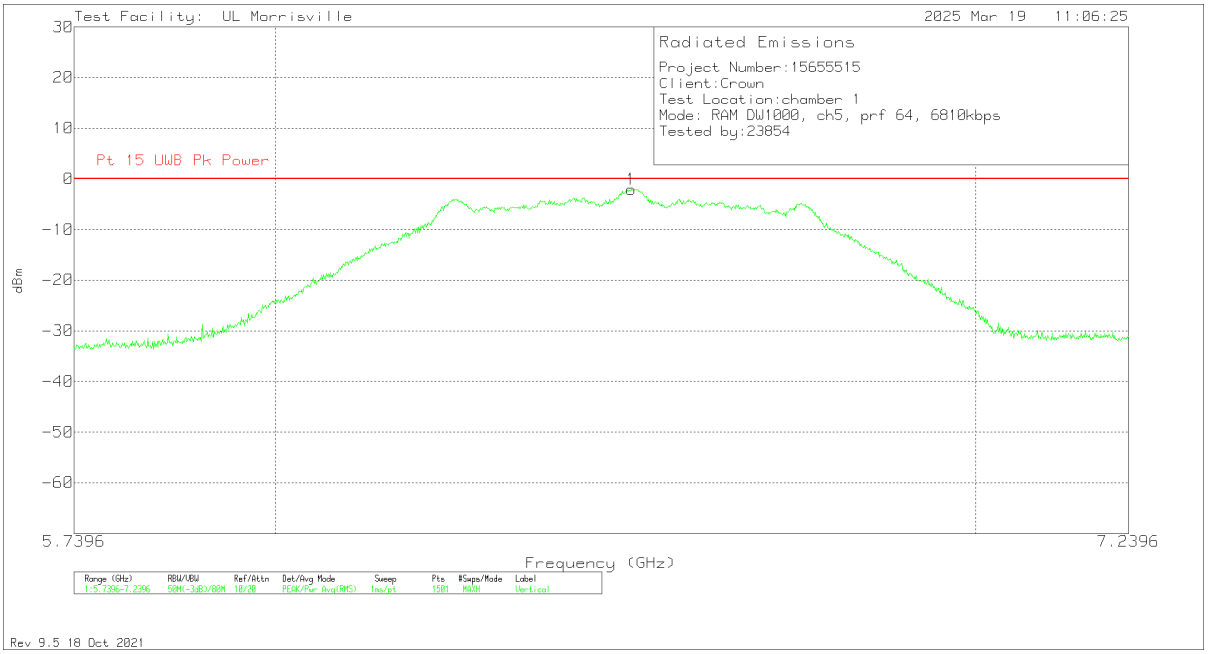
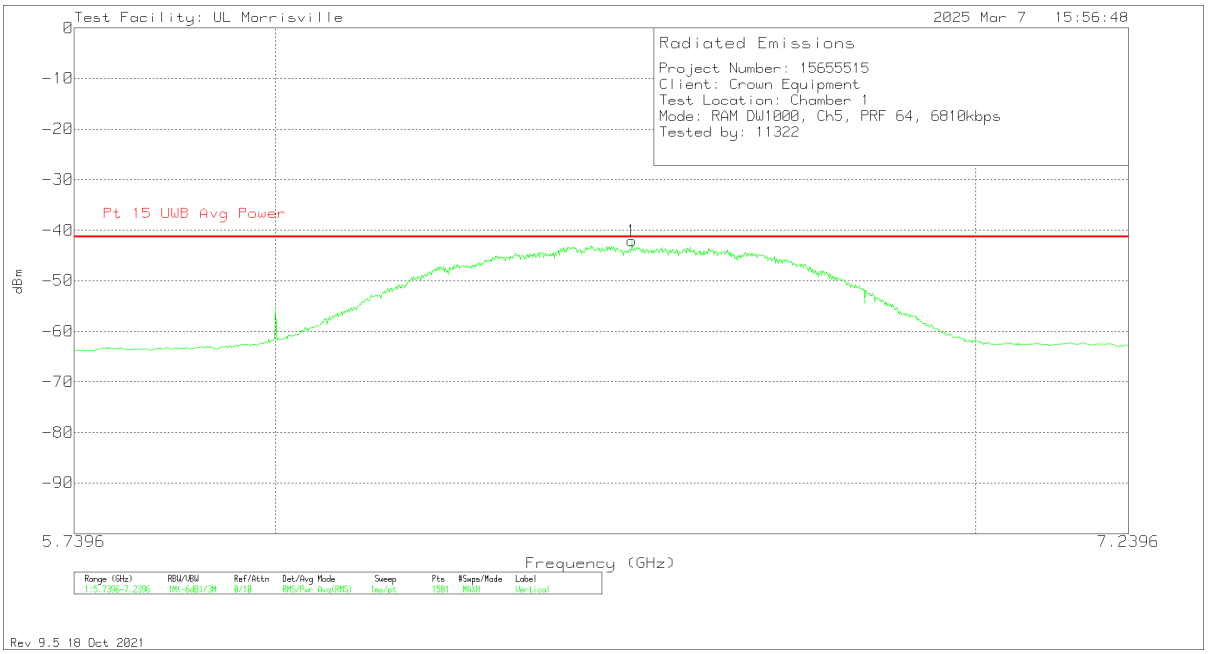


Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	Corrected Reading dBm	Pt 15 UWB Pk Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	6.4886	-3.86	Pk	35.6	-45.6	11.8	-2.06	0	-2.06	329	130	V

Pk - Peak detector

DW1000 Transceiver, Channel 5, Peak



Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	Pt 15 UWB Avg Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	6.4896	-43.96	RMS	35.6	-33.7	-42.06	-41.3	-.76	330	129	V

RMS - RMS detection

DW1000 Transceiver, Channel 5, Average

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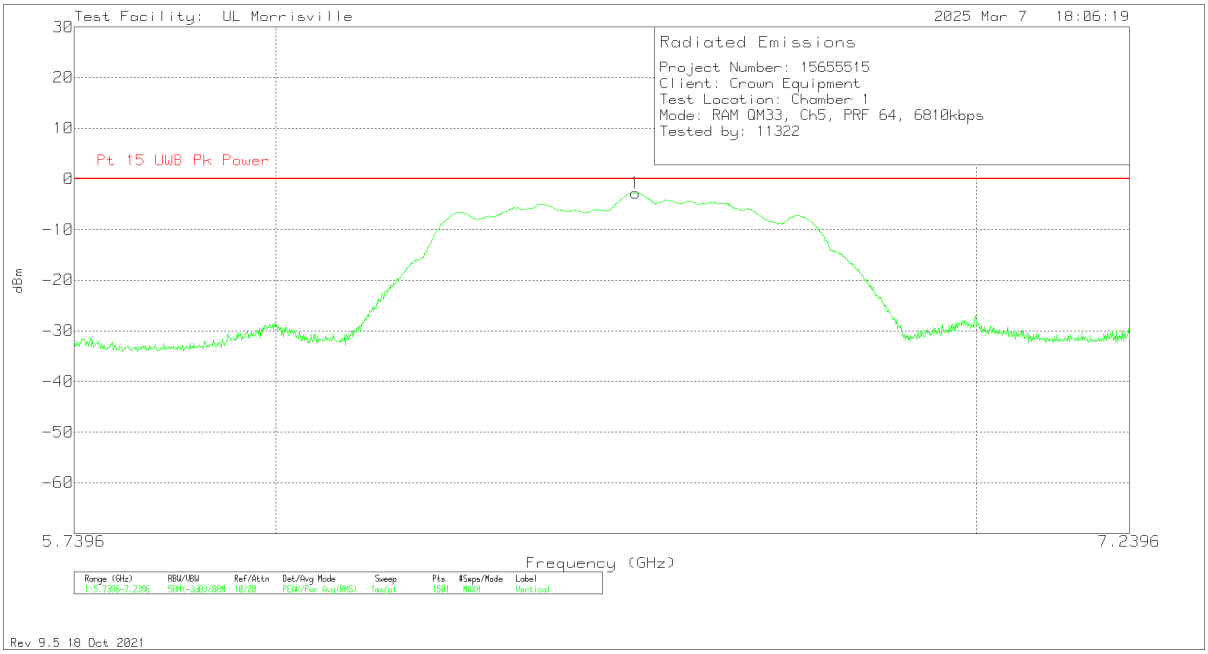
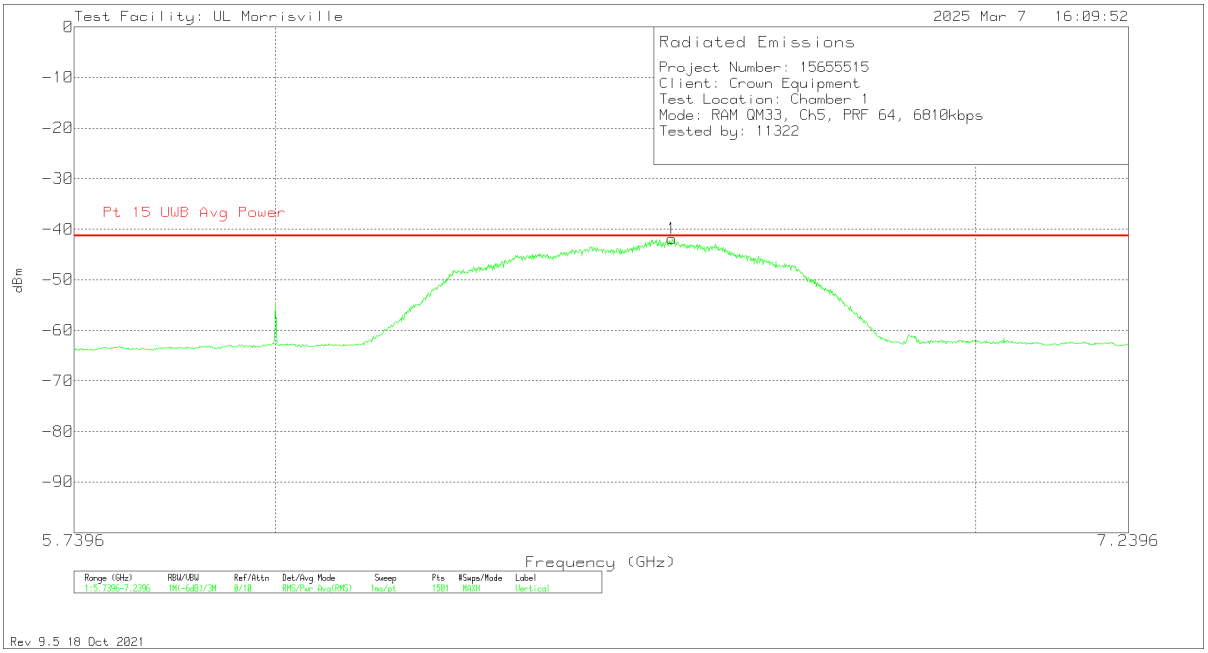


Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	Pt 15 UWB Pk Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	6.4941	-4.67	Pk	35.6	-33.7	-2.77	0	-2.77	151	125	V

Pk - Peak detector

QM33 Transceiver, Channel 5, Peak



Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	Pt 15 UWB Avg Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	6.5476	-43.69	RMS	35.6	-33.8	-41.89	-41.3	-.59	150	124	V

RMS - RMS detection

QM33 Transceiver, Channel 5, Average

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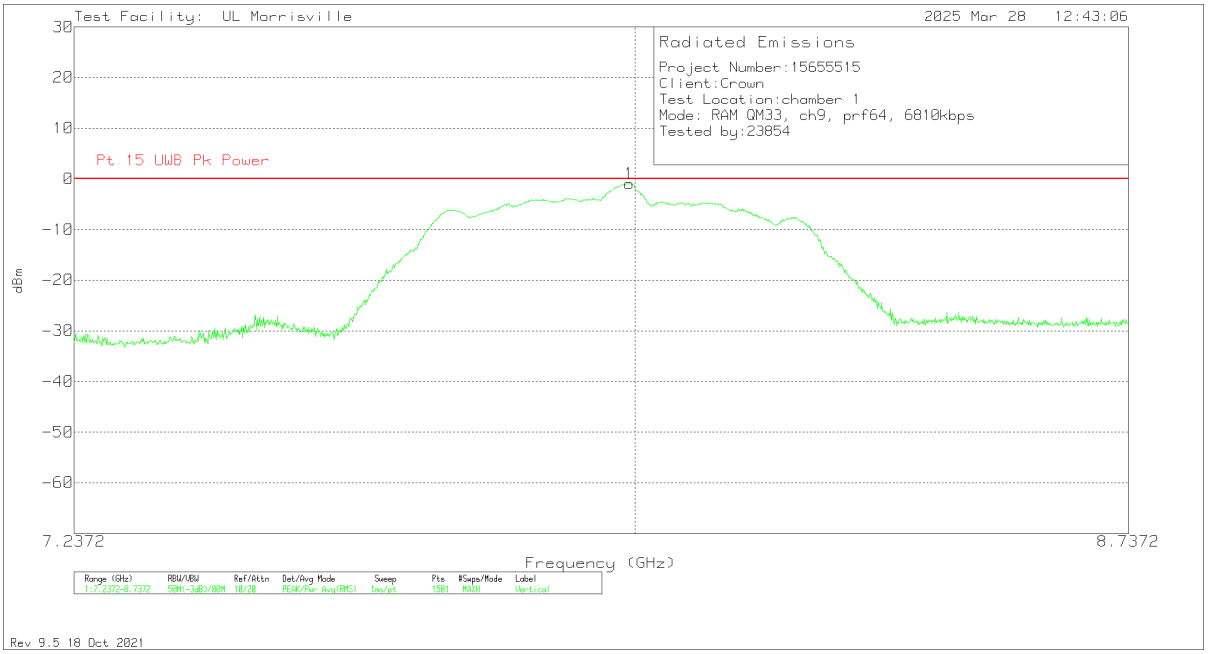
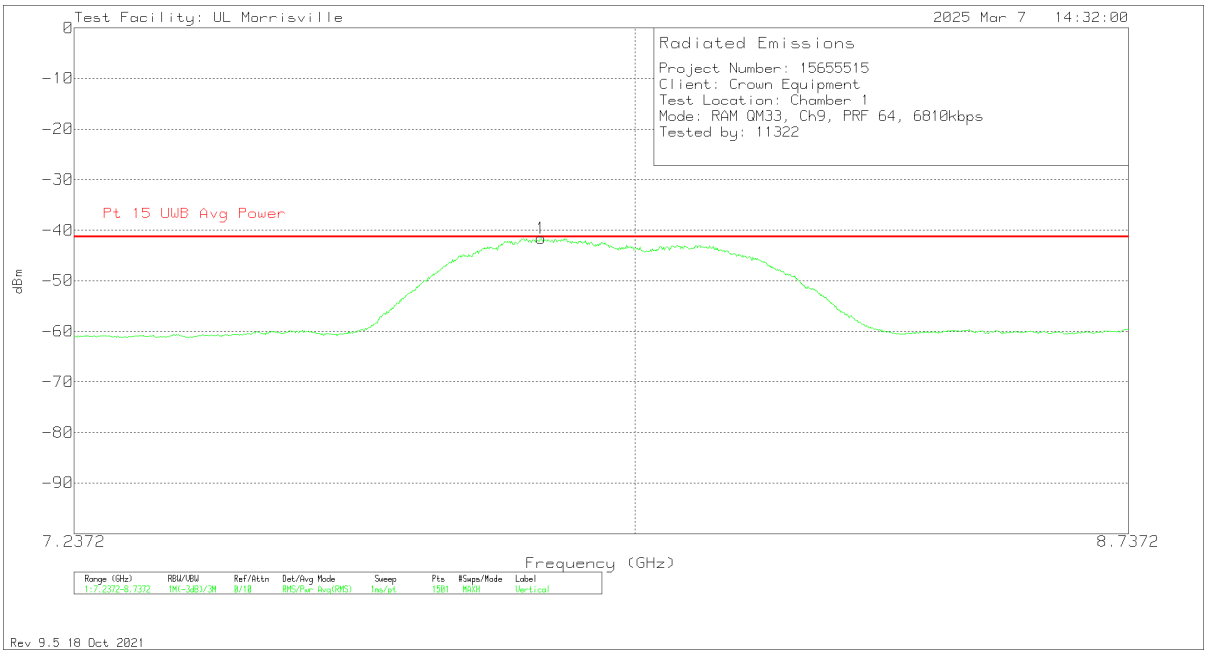


Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	Corrected Reading dBm	Pt 15 UWB Pk Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	7.9922	-4.71	Pk	35.9	-43.9	11.8	-.91	0	-.91	129	278	V

Pk - Peak detector

QM33 Transceiver, Channel 9, Peak



Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	Pt 15 UWB Avg Power	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	7.8672	-45.08	RMS	35.8	-32.3	-41.58	-41.3	-.28	293	156	V

RMS - RMS detection

QM33 Transceiver, Channel 9, Average

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8.4. RADIATED EMISSIONS AT OR BELOW 960 MHz

LIMITS

FCC

§15.517 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measument distance (meters)
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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

RSS-220

Section 3.4 Radiated emissions at or below 960 MHz for all subclauses of UWB device shall not exceed the following limits. Measurements of radiated emissions at and below 960 MHz are to be made using a CISPR quasi-peak detector. CISPR measurement bandwidth specifications are to be used.

Frequency (MHz)	Field Strength (microvolts/meter)	Measument distance (meters)	E.i.r.p. (dBmW)
0.009-0.490	2400/F (F in kHz)	300	10 log (17.28 / F^2) (F in kHz)
0.490-1.705	24000/F (F in kHz)	30	10 log (17.28 / F^2) (F in kHz)
1.705-30.0	30	30	-45.7
30-88	100	3	-55.2
88-216	150	3	-51.7
216-960	200	3	-49.2

Note; The emission limits for the bands 9-90kHz and 110-490kHz are based on measurements employing an average detector.

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TEST PROCEDURE

ANSI C63.10 Clause 10.2

RSS-220 Annex

Measurements are made with the antenna feeding a spectrum analyzer via a preamplifier and cables, at a maximum distance of 3m from the EUT.

For below 30 MHz testing, investigation was done on three antenna orientations: RX antenna Face-on, Face-off and horizontal (parallel to ground).

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 meter open area test site. Therefore, sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

A final test is made at any frequencies at which emissions are found. During this final scan, the antenna is kept no further from the EUT than the maximum distance calculated for each band that yields a minimum system noise floor.

Testing was performed on both transceivers only that the channel that yielded the highest power as worst-case. This was found to be:

DW1000 Transceiver: Channel 3
QM33 Transceiver: Channel 9

RESULTS

Employee IDs:	23854
Location:	Chamber 1
Test Date:	2025-03-26

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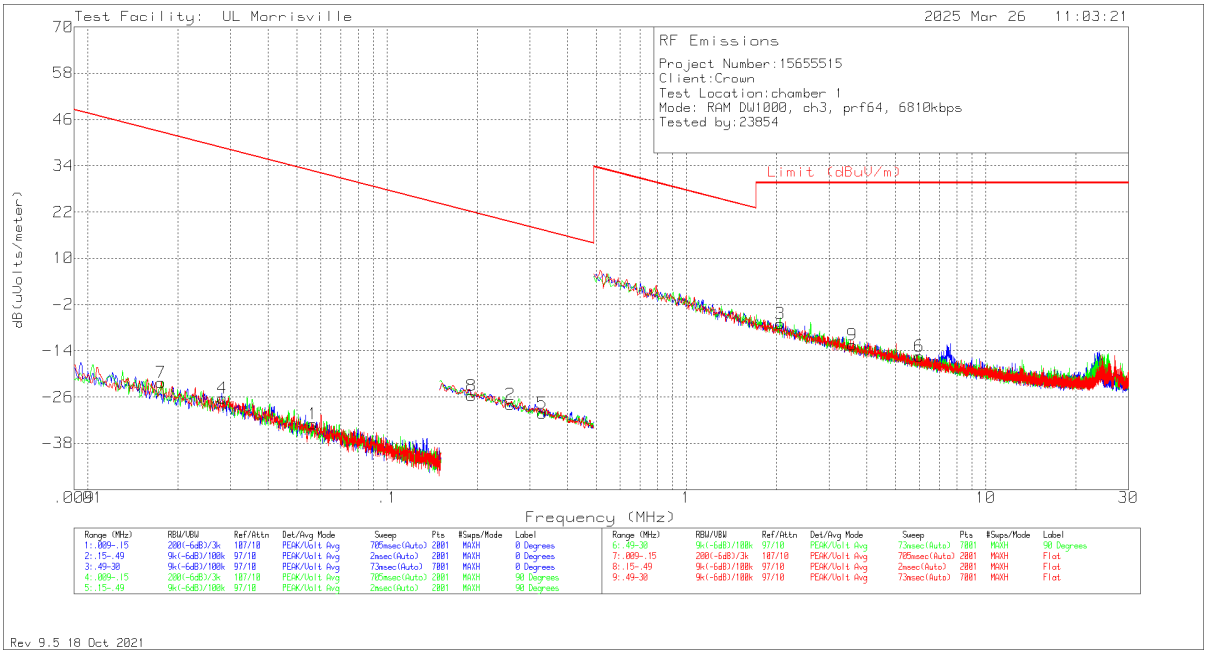
8.4.1. RADIATED EMISSIONS 9 kHz – 30 MHz



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
7	.01759	42.73	Pk	14.9	.1	-80	-22.27	42.7	62.7	-64.97	0-360	404	Flat
4	.02817	40.42	Pk	13.2	.1	-80	-26.28	38.61	58.61	-64.89	0-360	404	90 degs
1	.0565	35.51	Pk	11.4	.1	-80	-32.99	32.56	52.56	-65.55	0-360	404	0 degs
8	.19157	43.22	Pk	11	.1	-80	-25.68	21.96	21.96	-47.64	0-360	404	Flat
2	.25795	41.05	Pk	10.9	.1	-80	-27.95	19.37	39.37	-47.32	0-360	404	0 degs
5	.33012	38.77	Pk	10.9	.1	-80	-30.23	17.23	37.23	-47.46	0-360	404	90 degs
3	2.06257	21.76	Pk	11.1	.2	-40	-6.94	29.54	-	-36.48	0-360	404	0 degs
9	3.58876	16.17	Pk	11	.3	-40	-12.53	29.54	-	-42.07	0-360	404	Flat
6	5.98766	13.46	Pk	10.7	.4	-40	-15.44	29.54	-	-44.98	0-360	404	90 degs

Pk - Peak detector

DW1000 Transceiver, Channel 3

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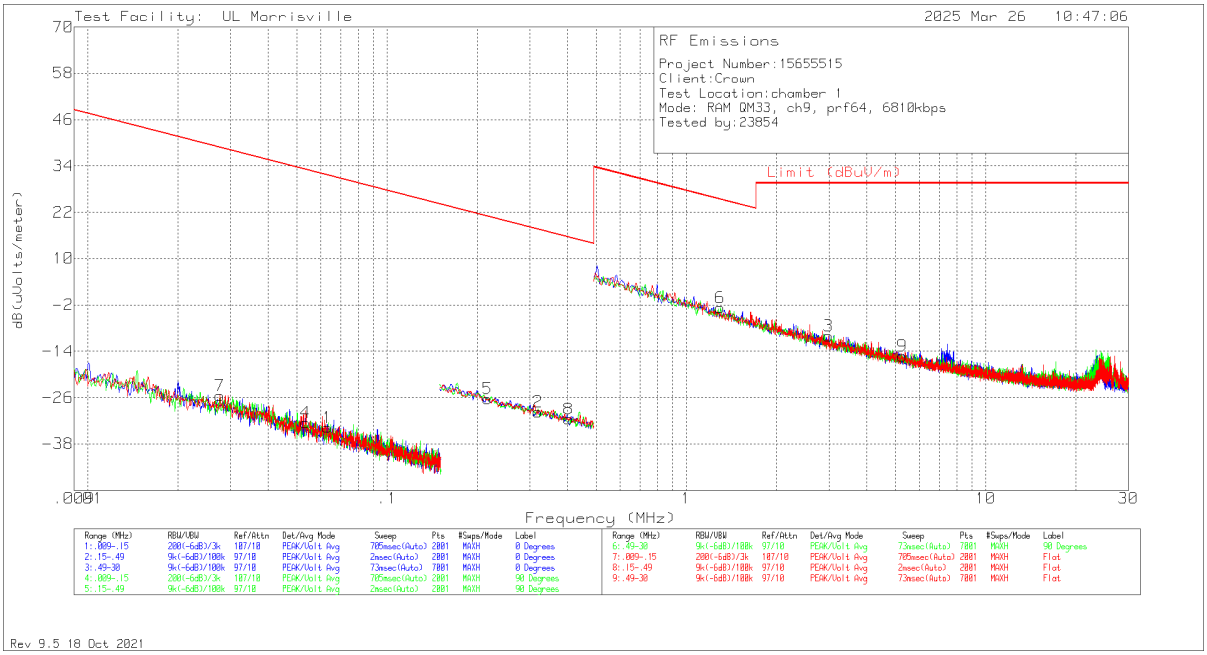

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
7	.0276	41.17	Pk	13.3	.1	-80	-25.43	38.79	58.79	-64.22	0-360	404	Flat
4	.05345	35.92	Pk	11.5	.1	-80	-32.48	33.05	53.05	-65.53	0-360	404	90 degs
1	.06324	34.89	Pk	11.3	.1	-80	-33.71	31.58	51.58	-65.29	0-360	404	0 degs
5	.21656	42.65	Pk	10.9	.1	-80	-26.35	20.89	40.89	-47.24	0-360	404	90 degs
2	.31975	39.24	Pk	10.9	.1	-80	-29.76	17.51	37.51	-47.27	0-360	404	0 degs
8	.405	37.33	Pk	11	.1	-80	-31.57	15.45	35.45	-47.02	0-360	404	Flat
6	1.29947	26.06	Pk	11	.2	-40	-2.74	25.33	-	-28.07	0-360	404	90 degs
3	2.99009	18.51	Pk	11.1	.3	-40	-10.09	29.54	-	-39.63	0-360	404	0 degs
9	5.26251	13.52	Pk	10.8	.4	-40	-15.28	29.54	-	-44.82	0-360	404	Flat

Pk - Peak detector

QM33 Transceiver, Channel 9

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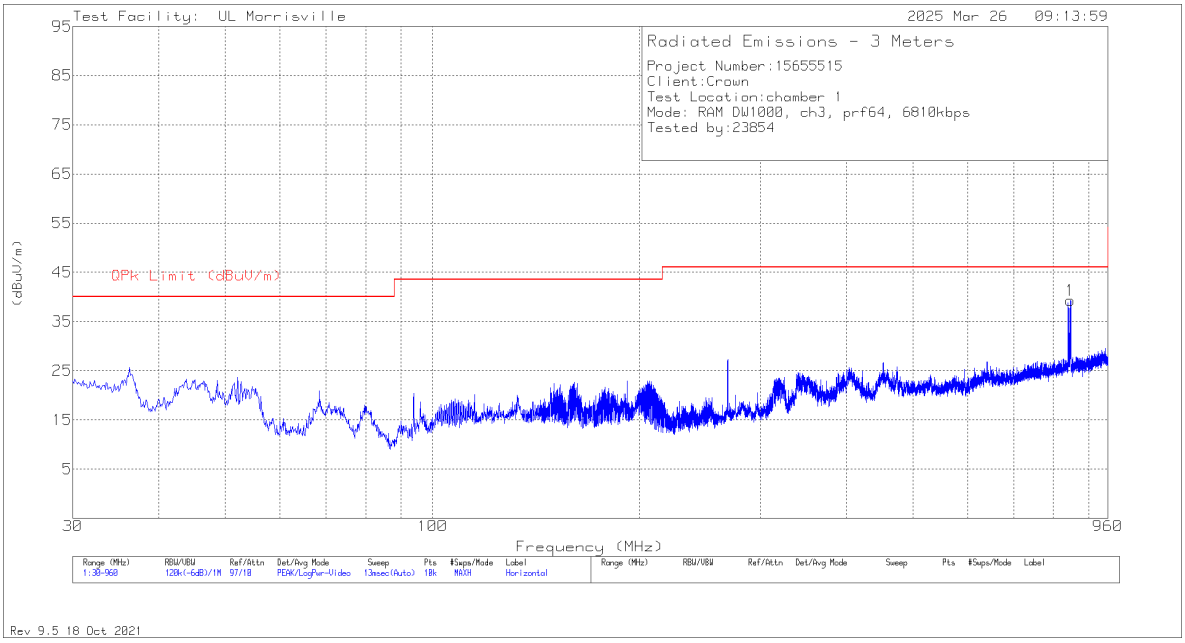
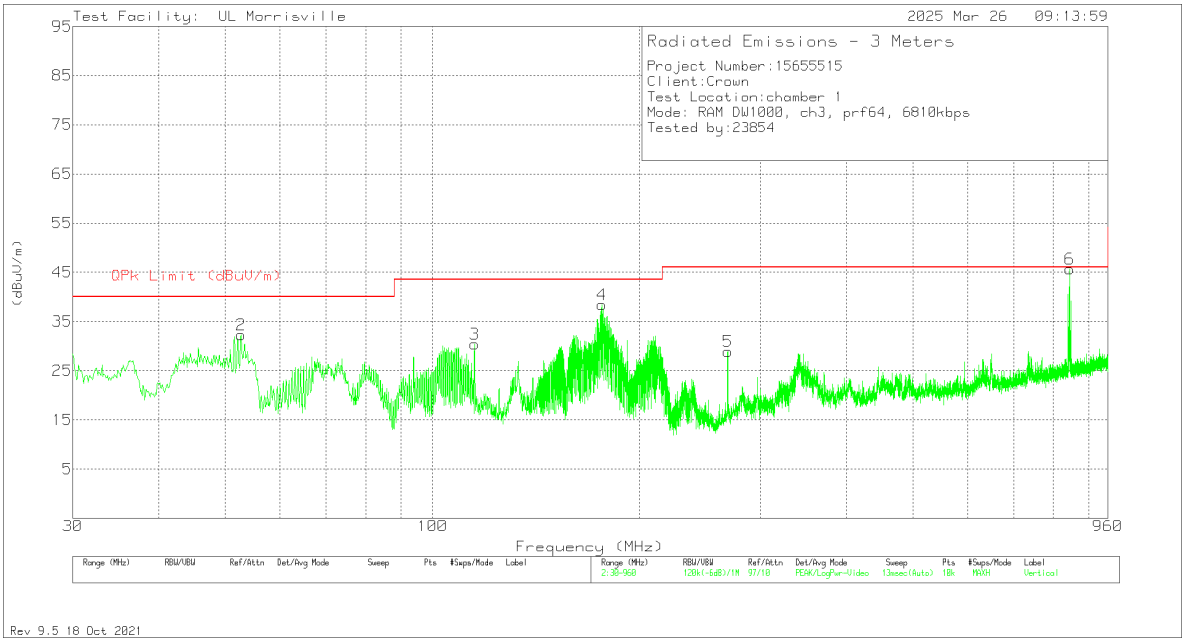
8.4.2. RADIATED EMISSIONS 30 – 960 MHz





Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90629 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	52.692	50.3	Pk	13.7	-31.7	32.3	40	-7.7	0-360	100	V
3	115.188	42.03	Pk	19.5	-31.1	30.43	43.52	-13.09	0-360	100	V
4	176.6476	45.69	Qp	17.7	-29.9	33.49	43.52	-10.03	3	100	V
5	268.824	38.93	Pk	19.2	-29.2	28.93	46.02	-17.09	0-360	100	V
6	844.1177	19.45	Qp	27.9	-27.2	20.15	46.02	-25.87	61	291	V
1	847.005	38.68	Pk	27.9	-27.3	39.28	46.02	-6.74	0-360	300	H

Pk - Peak detector
Qp - Quasi-Peak detector

DW1000 Transceiver, Channel 3

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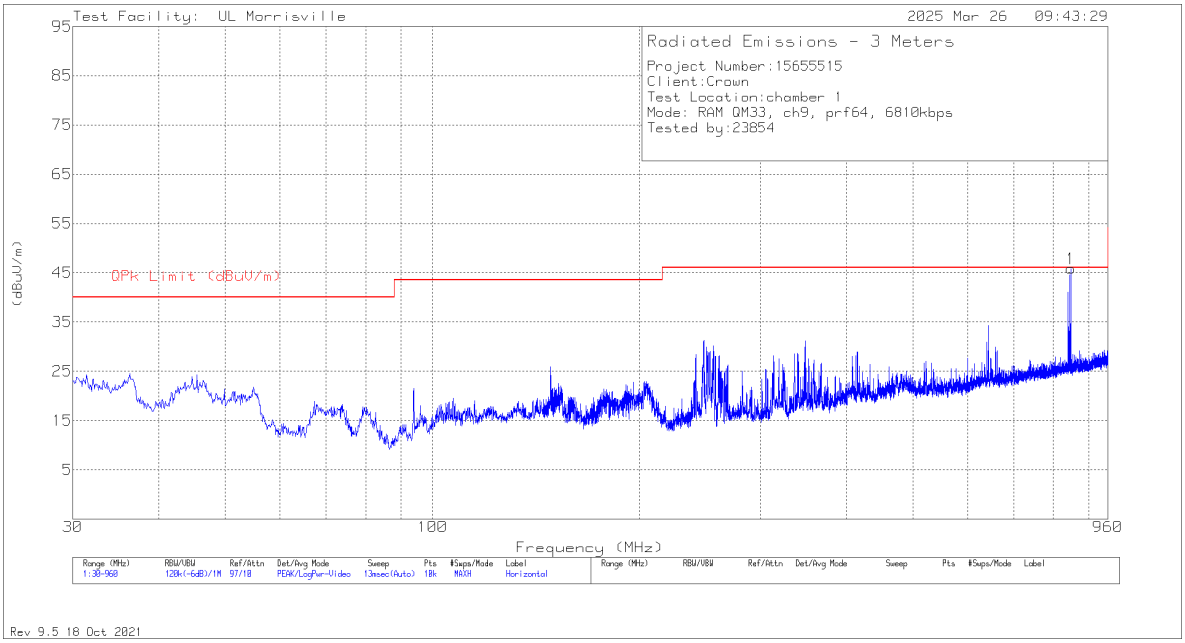

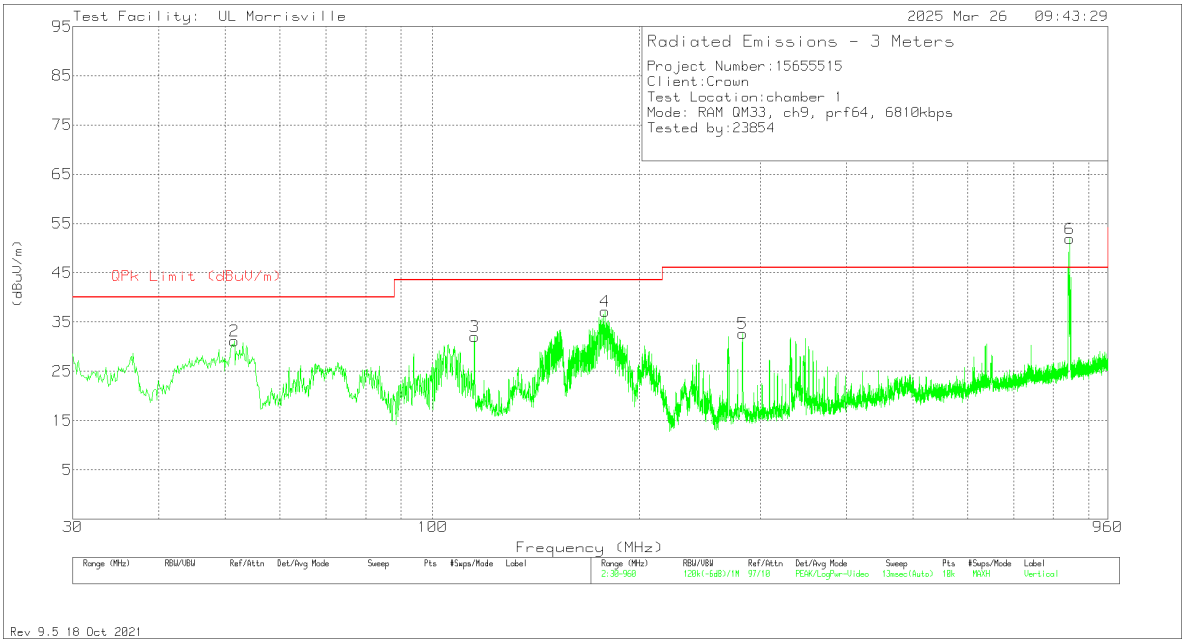

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90629 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	51.483	48.95	Pk	13.7	-31.5	31.15	40	-8.85	0-360	100	V
3	115.188	43.63	Pk	19.5	-31.1	32.03	43.52	-11.49	0-360	100	V
4	178.242	49.89	Pk	17.6	-30.3	37.19	43.52	-6.33	0-360	100	V
5	282.495	42.39	Pk	19.5	-29.2	32.69	46.02	-13.33	0-360	100	V
6	844.4729	19.53	Qp	27.9	-27.5	19.93	46.02	-26.09	197	229	V
1	847.9848	19.15	Qp	27.9	-27.2	19.85	46.02	-26.17	96	148	H

Pk - Peak detector
Qp - Quasi-Peak detector

QM33 Transceiver, Channel 9

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8.5. RADIATED EMISSIONS ABOVE 960 MHz

LIMITS

FCC

§15.517 (c) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-53.3
1990-3100	-51.3
3100-10600	-41.3
Above 10600	-51.3

§15.517 (d) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

RSS-220

Section 5.2.1. (d) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Indoor Communication, Measurement, Location Sensing and Tracking Devices	
Frequency	**EIRP in a Resolution Bandwidth of 1 MHz**
960-1610 MHz	-75.3 dBm
1.61-4.75 GHz	-70.0 dBm
4.75-10.6 GHz	-41.3 dBm
Above 10.6 GHz	-51.3 dBm

Section 5.2.1. (e) In addition to the limits specified in paragraph (d) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

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Frequency	EIRP in a Resolution Bandwidth of no less than 1 kHz
1164-1240 MHz	-85.3 dBm
1559-1610 MHz	-85.3 dBm

Section 5.2.1. (f) Within the tables in paragraphs (d) and (e) above, the tighter emission limit applies at the band edges.

TEST PROCEDURE

ANSI C63.10 Clause 10.3

RSS-220 Annex

PROCEDURE FOR 0.96 TO 18 GHz

Measurements are made with the antenna feeding a spectrum analzyer via a preamplifier and cables at a maximum distance of 0.5-meter from the EUT per ANSI C63.10 Section 6.6.4.2. A high pass filter with a pass band frequency beyond 9 GHz was used to suppress the fundamental and perform measurements up to 18 GHz. A RBW of 1MHz and VBW of 3MHz was used for these measurements.

PROCEDURE FOR 1.164 TO 1.240 GHz & 1.559 TO 1.610 GHz

Measurements are made with the antenna feeding a spectrum analzyer via a preamplifier and cables at a maximum distance of 1-meter from the EUT per ANSI C63.10 Section 6.6.4.2. A RBW of 3 kHz and VBW of 10 kHz was used for the pre-scans. A RBW of 3kHz and VBW of 10kHz was used for these measurements.

PROCEDURE FOR 18 TO 40 GHz

Measurements are made with the antenna feeding a spectrum analzyer via a preamplifier and cables at a maximum distance of 0.5-meters from the EUT per ANSI C63.10 Section 6.6.5.

EIRP values are derived using equations G.7, G.8, G.9 from Annex G of ANSI C63.10. Correction factors are pre-loaded onto the spectrum analyzer.

Distance correction factor from 3-meter to 0.5-meter = 20 log (0.5/3) = -15.56dB
Distance correction factor from 3-meter to 1-meter = 20 log (1/3) = -9.5dB

RESULTS

Employee IDs: 23854, 11322
Location: Chamber 1, 3
Test Date: 2025-02-19 to 2025-03-28

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8.5.1. RADIATED EMISSIONS 1164 - 1240 MHz & 1559 - 1610 MHz

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	DCF (dB)	Corrected Reading dBm	EIRP Limit (RMS)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	1.16727	-80.52	RMS	28.4	-49.5	11.8	-9.5	-99.32	-85.3	-14.02	31	101	V
1	1.17016	-80.34	RMS	28.4	-49.6	11.8	-9.5	-99.24	-85.3	-13.94	30	101	H
4	1.56155	-79.58	RMS	28	-49.4	11.8	-9.5	-98.68	-85.3	-13.38	264	200	V
3	1.57856	-81.09	RMS	28	-49.2	11.8	-9.5	-99.99	-85.3	-14.69	338	101	H

RMS - RMS detection

DW1000 Transceiver, Channel 3

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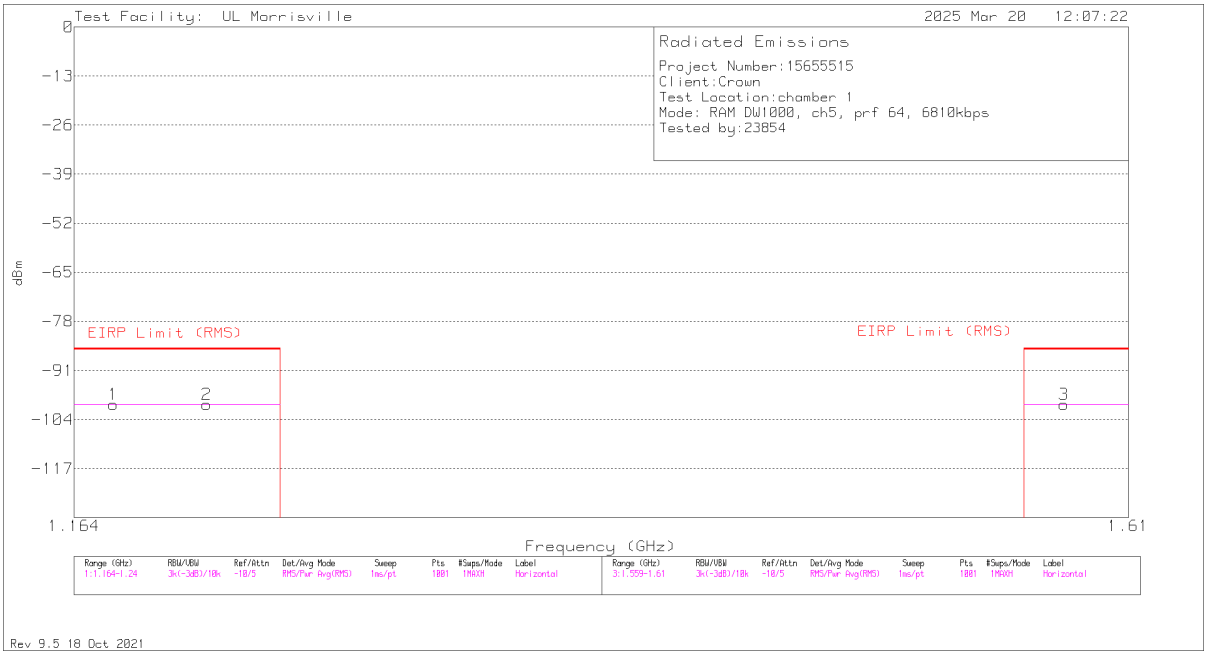

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	DCF (dB)	Corrected Reading dBm	EIRP Limit (RMS)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.17825	-75.09	RMS	28.5	-49.6	11.8	-15.6	-99.99	-85.3	-14.69	22	155	H
4	1.19246	-75.09	RMS	28.6	-49.7	11.8	-15.6	-99.99	-85.3	-14.69	338	155	V
2	1.21237	-75.59	RMS	28.8	-49.4	11.8	-15.6	-99.99	-85.3	-14.69	22	155	H
5	1.22552	-75.19	RMS	28.9	-49.9	11.8	-15.6	-99.99	-85.3	-14.69	338	155	V
3	1.5783	-74.99	RMS	28	-49.2	11.8	-15.6	-99.99	-85.3	-14.69	22	155	H
6	1.60095	-75.09	RMS	28.1	-49.2	11.8	-15.6	-99.99	-85.3	-14.69	339	155	V

RMS - RMS detection

DW1000 Transceiver, Channel 5

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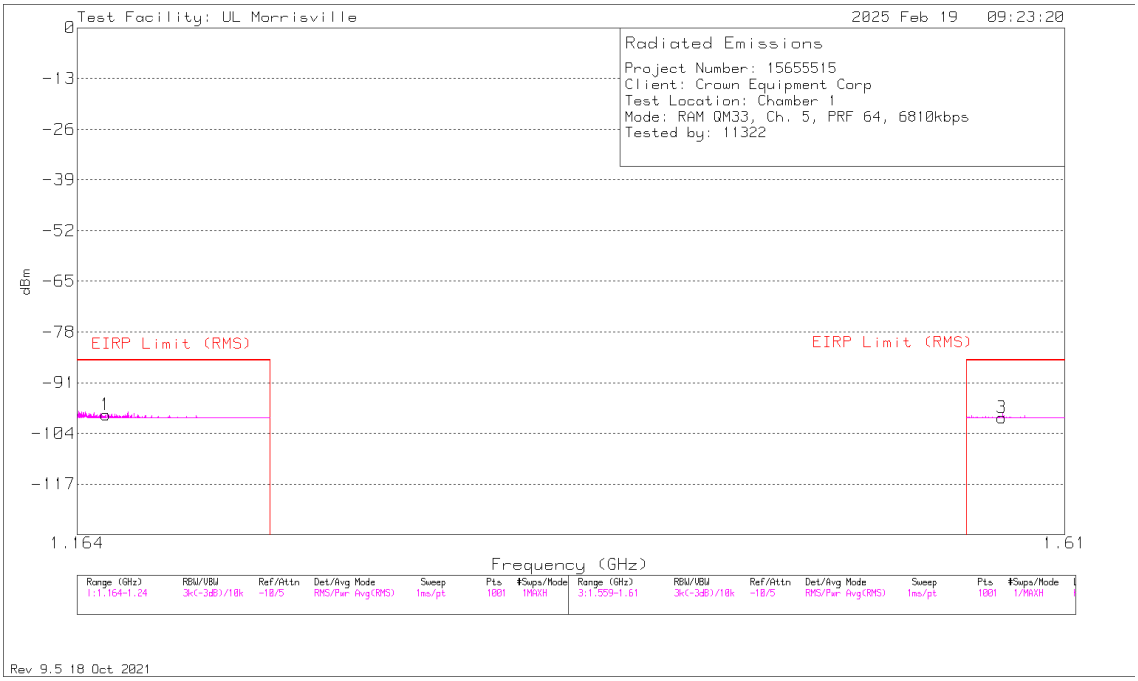

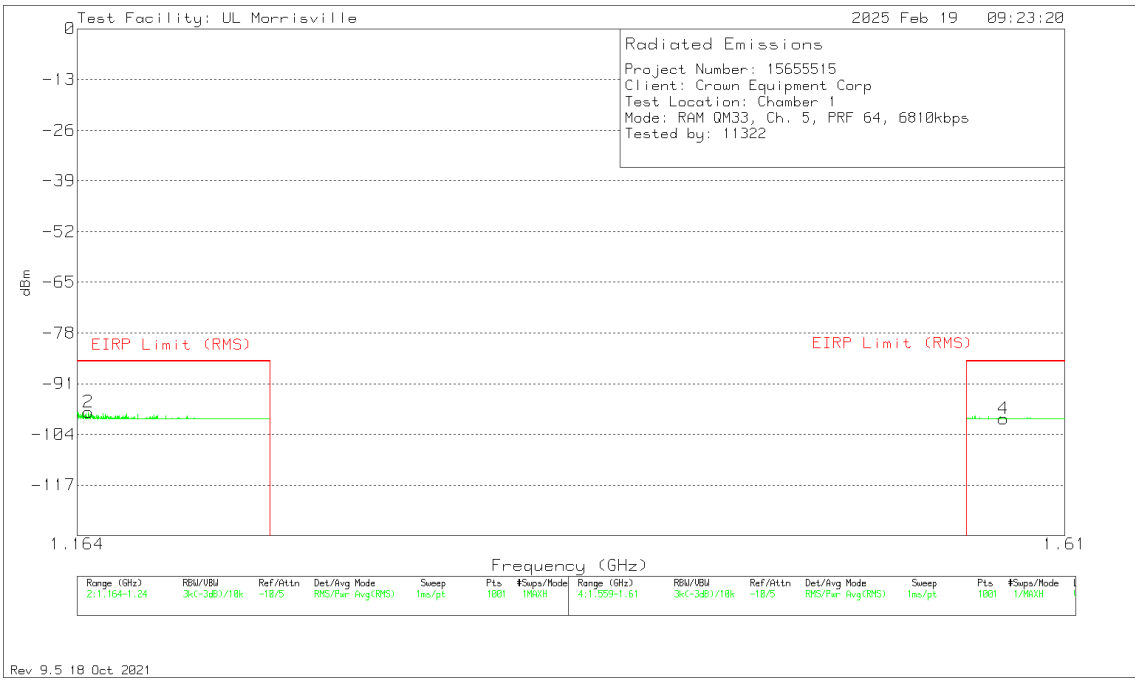

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	DCF (dB)	Corrected Reading dBm	EIRP Limit (RMS)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.17502	-80.33	RMS	28.4	-49.6	11.8	-9.5	-99.23	-85.3	-13.93	176	101	H
2	1.16833	-79.47	RMS	28.4	-49.5	11.8	-9.5	-98.27	-85.3	-12.97	141	200	V
3	1.57708	-81.09	RMS	28	-49.2	11.8	-9.5	-99.99	-85.3	-14.69	22	101	H
4	1.578	-81.09	RMS	28	-49.2	11.8	-9.5	-99.99	-85.3	-14.69	22	101	V

RMS - RMS detection

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Marker	Frequency (GHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Conversion factor (dB)	DCF (dB)	Corrected Reading dBm	EIRP Limit (RMS)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	1.16917	-80.21	RMS	28.4	-49.6	11.8	-9.5	-99.11	-85.3	-13.81	141	200	V
1	1.17092	-79.79	RMS	28.4	-49.6	11.8	-9.5	-98.69	-85.3	-13.39	75	200	H
4	1.56369	-79.66	RMS	28	-49.4	11.8	-9.5	-98.76	-85.3	-13.46	97	200	V
3	1.56568	-80.62	RMS	28	-49.5	11.8	-9.5	-99.82	-85.3	-14.52	22	101	H

RMS - RMS detection

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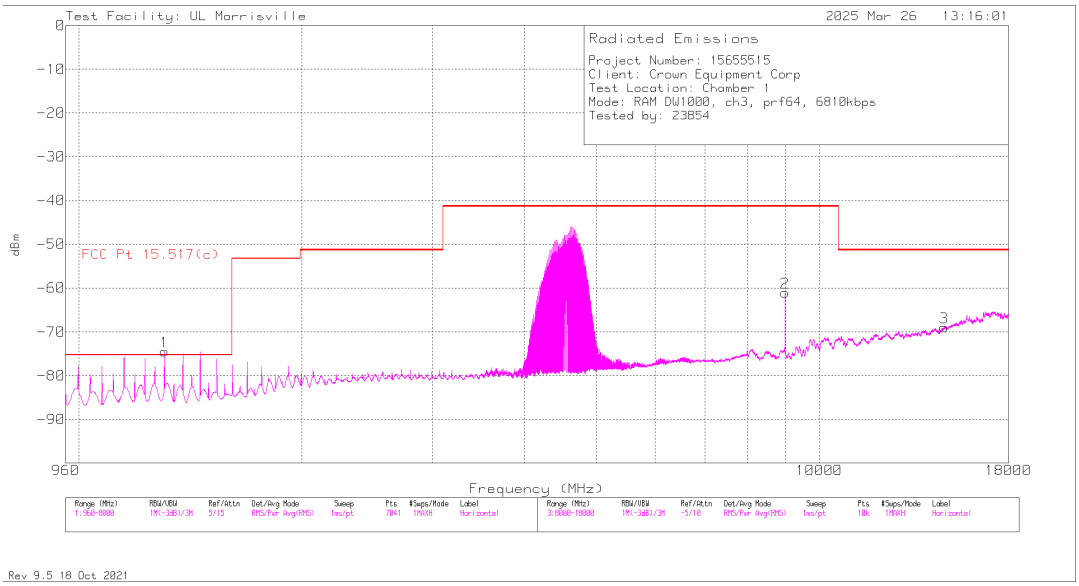
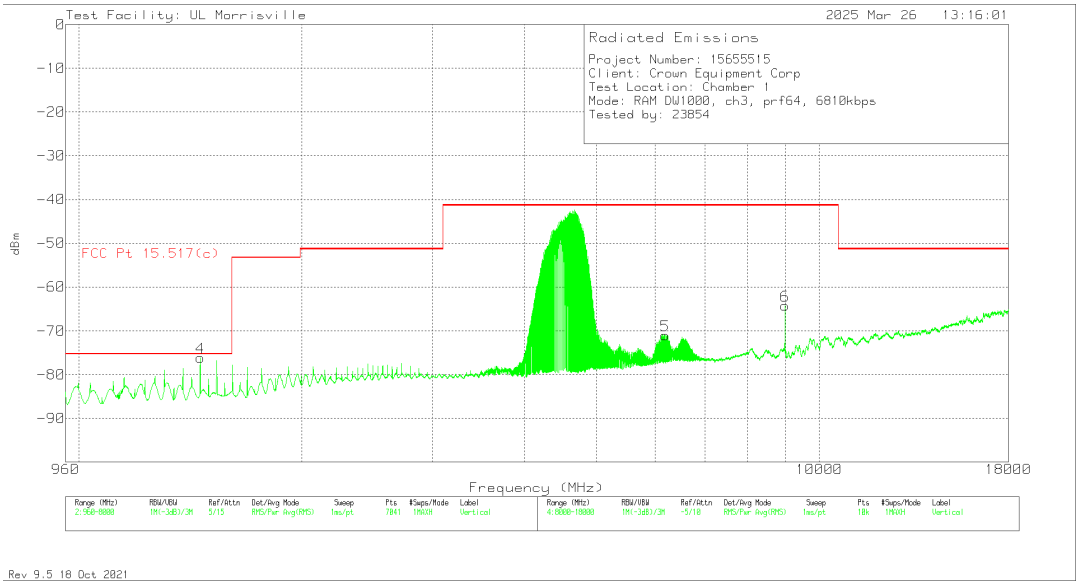
8.5.2. RADIATED EMISSIONS 960 MHz – 18 GHz





Marker	Frequency (MHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	FCC Pt 15.517(c)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity	Notes
1	1305.5035	-49.3	RMS	29.1	-53.2	-73.4	**-75.3**	**1.9**	337	163	H	1
	1305.5035	-49.96	RMS	29.1	-53.2	-74.06	**-75.3**	**1.24**	337	163	H	2
4	1459.2158	-51.19	RMS	28.4	-53.1	-75.89	-75.3	-.59	348	166	V	-
5	6188	-57.22	RMS	35.4	-49.2	-71.02	-41.3	-29.72	308	155	V	-
2	8.985	-49.82	RMS	35.8	-47	-61.02	-41.3	-19.72	360	155	H	-
3	14.737	-63.89	RMS	39.5	-44.6	-68.99	-51.3	-17.69	338	155	H	-
6	8.986	-53.04	RMS	35.8	-47	-64.24	-41.3	-22.94	22	155	V	-

RMS - RMS detection
Notes: 1 – Radio ON re-measurement
2 – Radio OFF re-measurement
Offending emissions were determined to be not radio-related

DW1000 Transceiver, Channel 3

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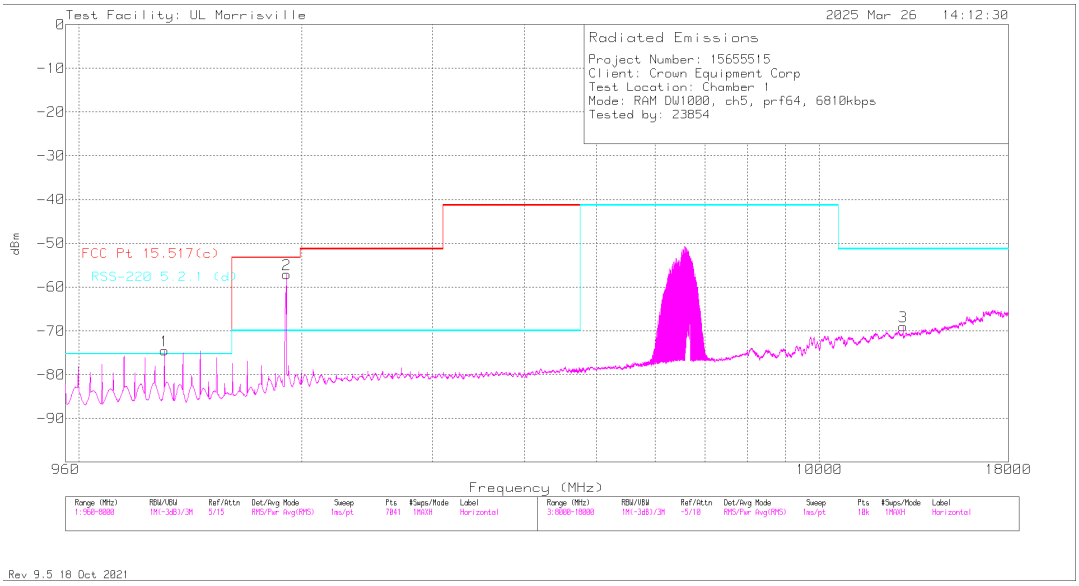

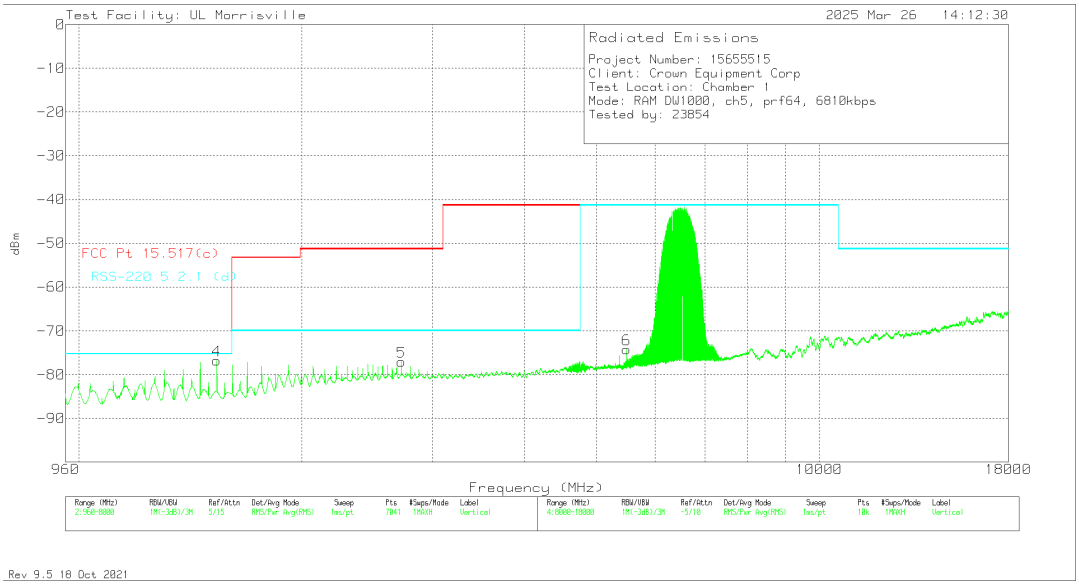

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	FCC Pt 15.517(c)	Margin (dB)	RSS-220 5.2.1 (d)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity	Notes
1	1305.6274	-49.33	RMS	29.1	-53.2	-73.43	-75.3	1.87	-75.3	1.87	320	165	H	1
	1305.6274	-49.23	RMS	29.1	-53.2	-73.33	-75.3	1.97	-75.3	1.97	320	165	H	2
2	1907.6563	-60.38	RMS	31.3	-53.3	-82.38	-53.3	-29.08	-70	-12.38	139	239	H	3
4	1536.008	-50.16	RMS	28.1	-52.9	-74.96	-75.3	.34	-75.3	.34	360	153	V	1
	1536.008	-49.3	RMS	28.1	-52.9	-74.1	-75.3	1.2	-75.3	1.2	360	153	V	2
5	2726	-57.19	RMS	32.6	-52.5	-77.09	-51.3	-25.79	-70	-7.09	330	155	V	-
6	5492	-59	RMS	34.4	-49.6	-74.2	-41.3	-32.9	-41.3	-32.9	66	155	V	-
3	12.98	-61.99	RMS	38.8	-45.8	-68.99	-51.3	-17.69	-51.3	-17.69	52	155	H	-

RMS - RMS detection

Notes: 1 – Radio ON re-measurement
2 – Radio OFF re-measurement
3 – Emissions from Prescan was determined to be a transient

Offending emissions were determined to be not radio-related

DW1000 Transceiver, Channel 5

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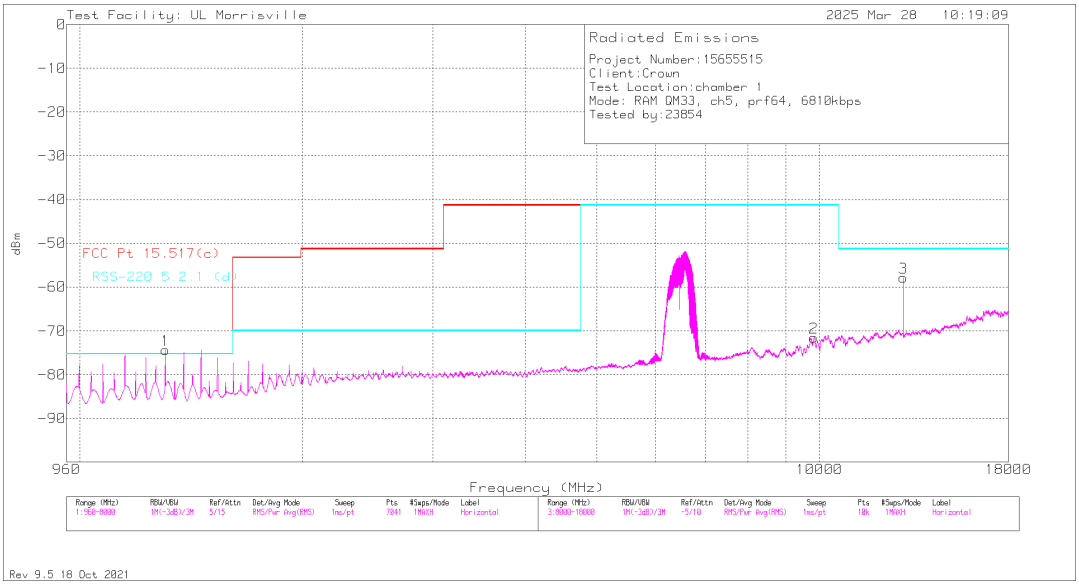

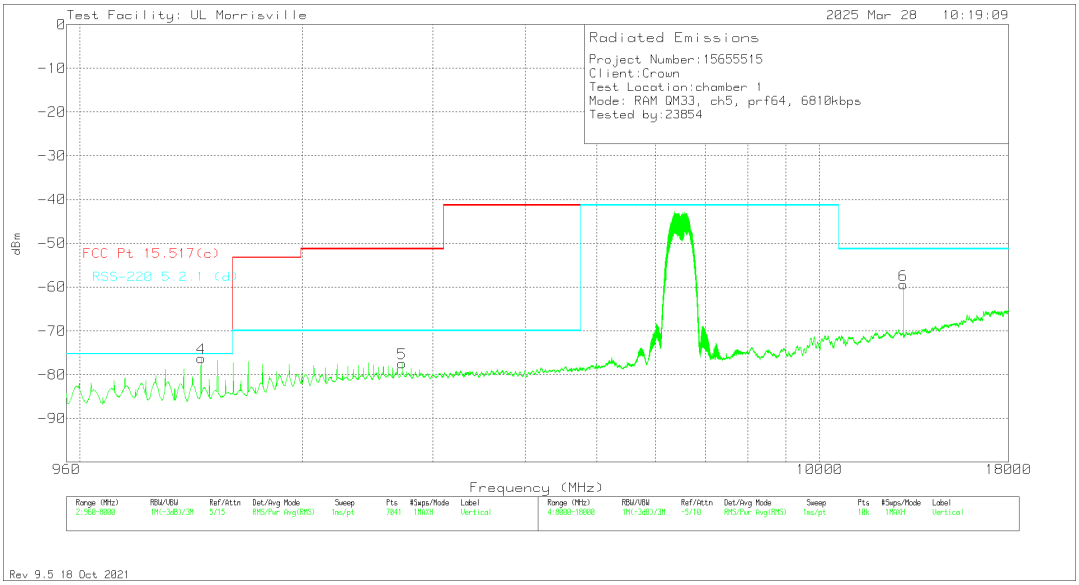

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	FCC Pt 15.517(c)	Margin (dB)	RSS-220 5.2.1 (d)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity	Notes
1	1305.7393	-49.92	RMS	29.1	-53.2	-74.02	-75.3	1.28	-75.3	1.28	326	164	H	1
	1305.7393	-49.75	RMS	29.1	-53.2	-73.85	-75.3	1.45	-75.3	1.45	326	164	H	2
4	1459.0879	-50.39	RMS	28.4	-53.1	-75.09	-75.3	.21	-75.3	.21	351	168	V	1
	1459.0879	-50.23	RMS	28.4	-53.1	-74.93	-75.3	.37	-75.3	.37	351	168	V	2
5	2726	-57.55	RMS	32.6	-52.5	-77.45	-51.3	-26.15	-70	-7.45	330	155	V	-
2	9.8275	-62.09	RMS	37.3	-46.7	-71.49	-41.3	-30.19	-41.3	-30.19	338	155	H	-
3	12.97927	-48.2	RMS	38.8	-45.8	-55.2	-51.3	-3.9	-51.3	-3.9	345	156	H	-
6	12.97916	-51.3	RMS	38.8	-45.8	-58.3	-51.3	-7	-51.3	-7	332	161	V	-

RMS - RMS detection

Notes: 1 – Radio ON re-measurements
2 – Radio OFF re-measurements

Offending emissions were determined to be not radio-related

QM33 Transceiver, Channel 5

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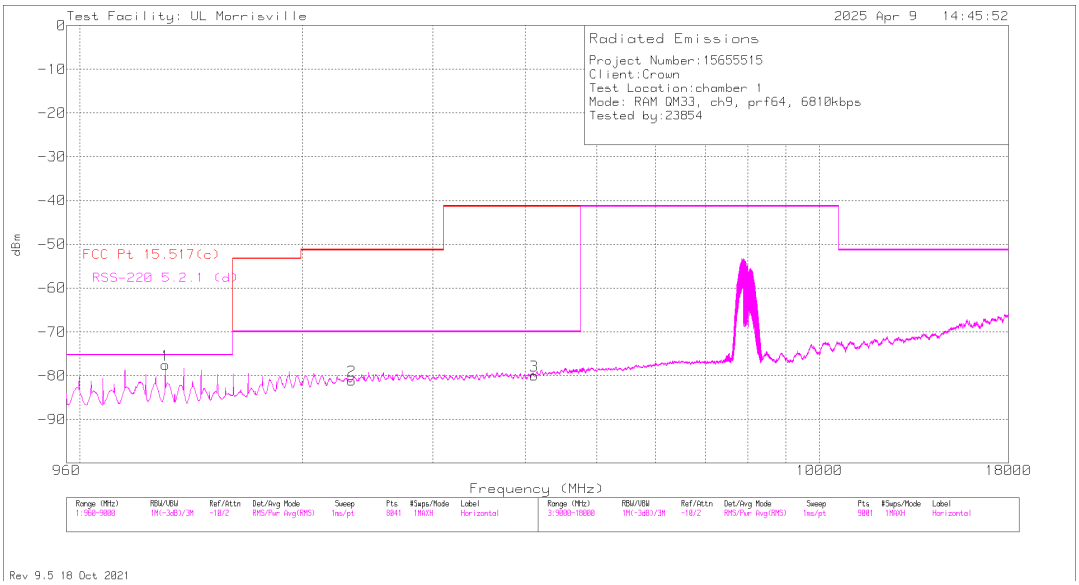

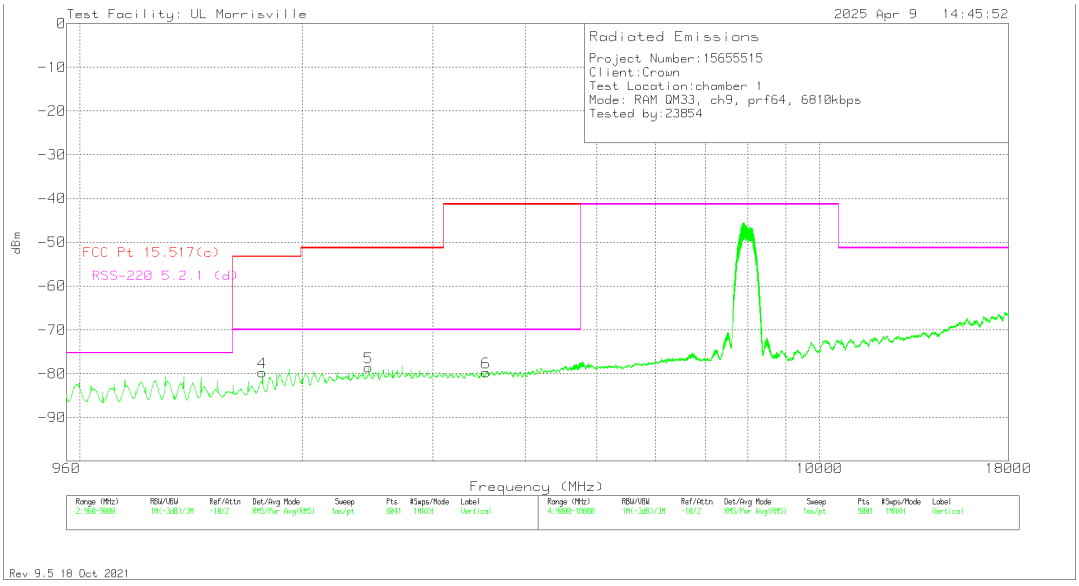

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	135143 (dB/m)	Gain/Loss (dB)	Corrected Reading dBm	FCC Pt 15.517(c)	Margin (dB)	RSS-220 5.2.1 (d)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1305.52431	-53.96	RMS	29.1	-53.2	-78.06	-75.3	-2.76	-75.3	-2.76	271	200	H
2	2332	-59.42	RMS	31.7	-53.4	-81.12	-51.3	-29.82	-70	-11.12	317	200	H
3	4116	-62.07	RMS	33.3	-51.2	-79.97	-41.3	-38.67	-70	-9.97	294	200	H
4	1766	-56.35	RMS	29.7	-53.1	-79.75	-53.3	-26.45	-70	-9.75	31	200	V
5	2457	-57.42	RMS	32.1	-53.2	-78.52	-51.3	-27.22	-70	-8.52	330	101	V
6	3541	-62.47	RMS	32.9	-50.1	-79.67	-41.3	-38.37	-70	-9.67	339	200	V

RMS - RMS detection

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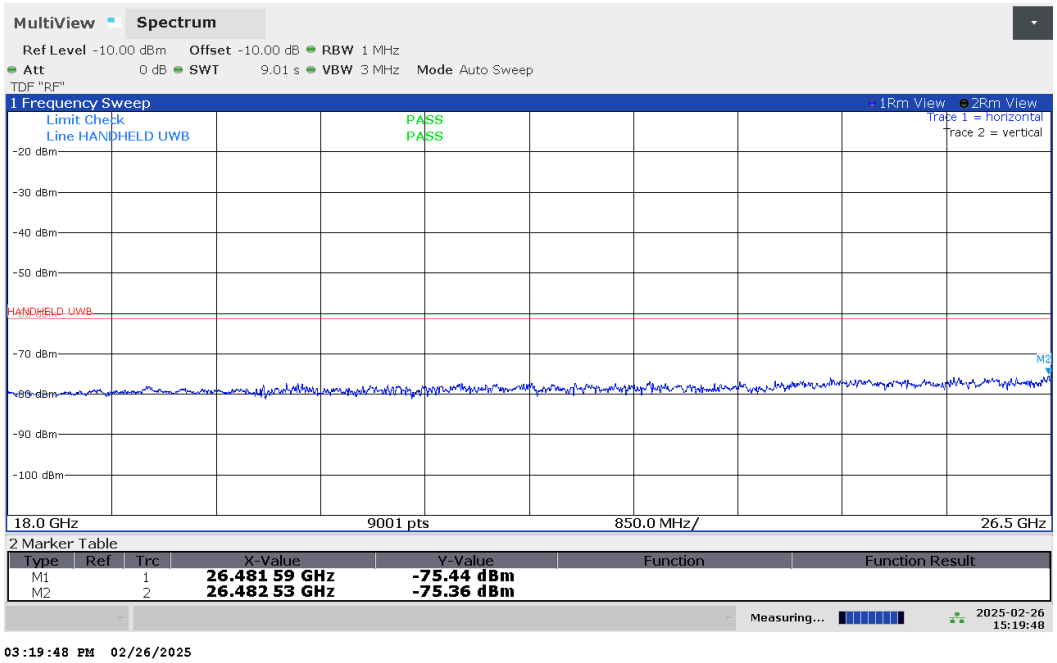
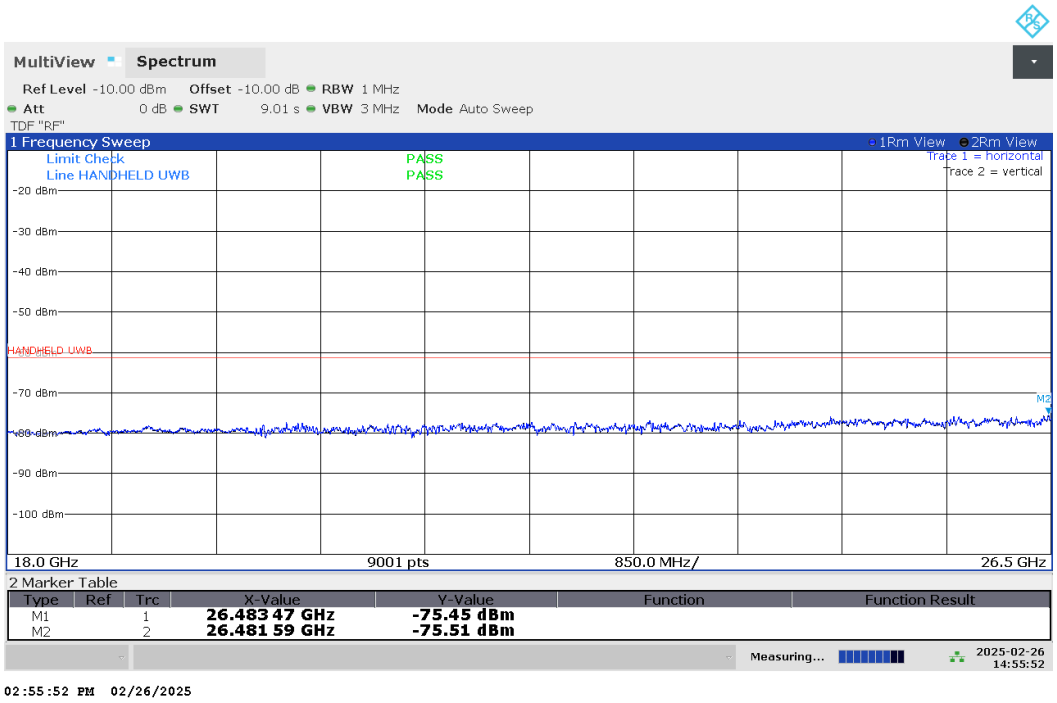
8.5.3. RADIATED EMISSIONS 18 – 26.5 GHz



DW1000 Transceiver, Channel 3



DW1000 Transceiver, Channel 5

Note: A more stringent limit was displayed on the plot, which the EUT is also compliant with

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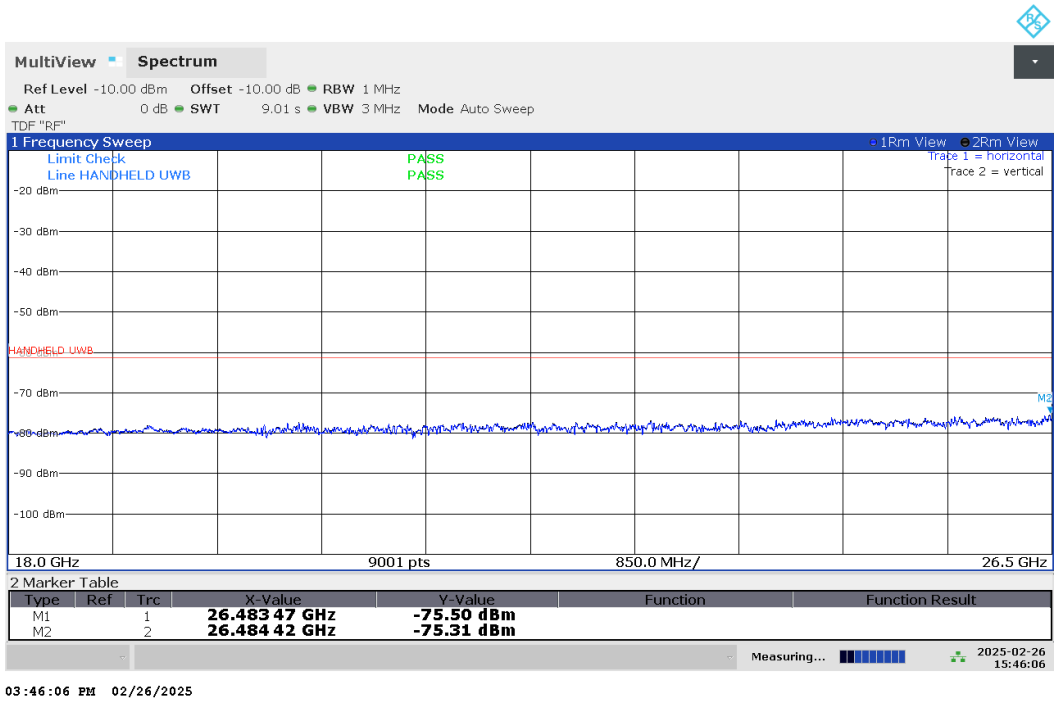
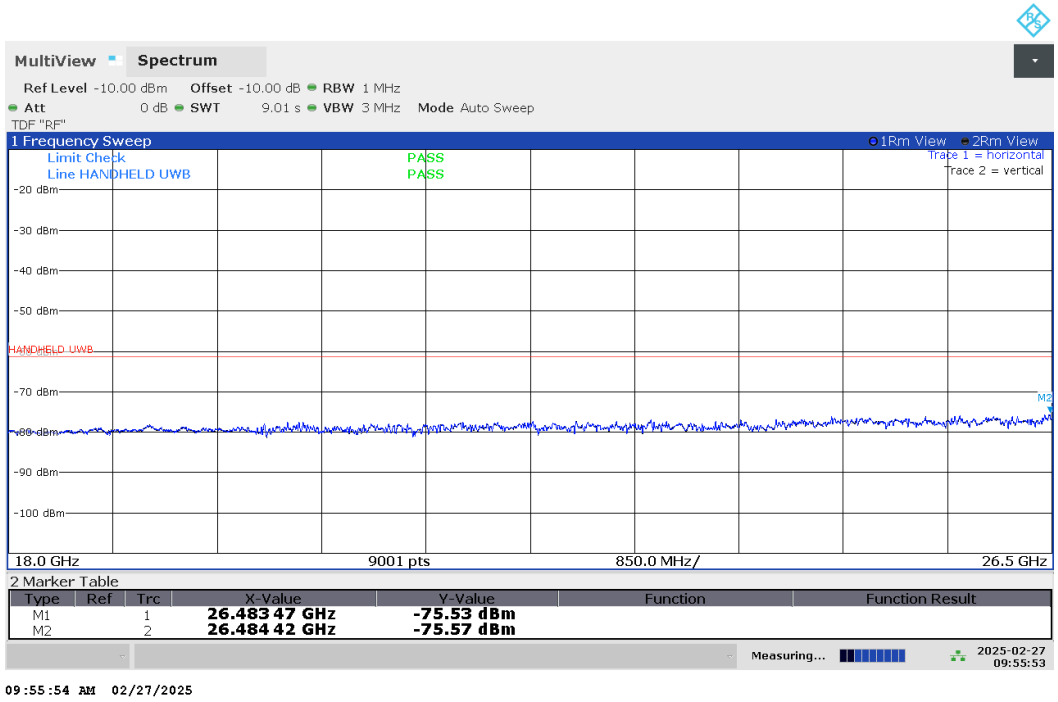


QM33 Transceiver, Channel 5



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Note: A more stringent limit was displayed on the plot, which the EUT is also compliant with

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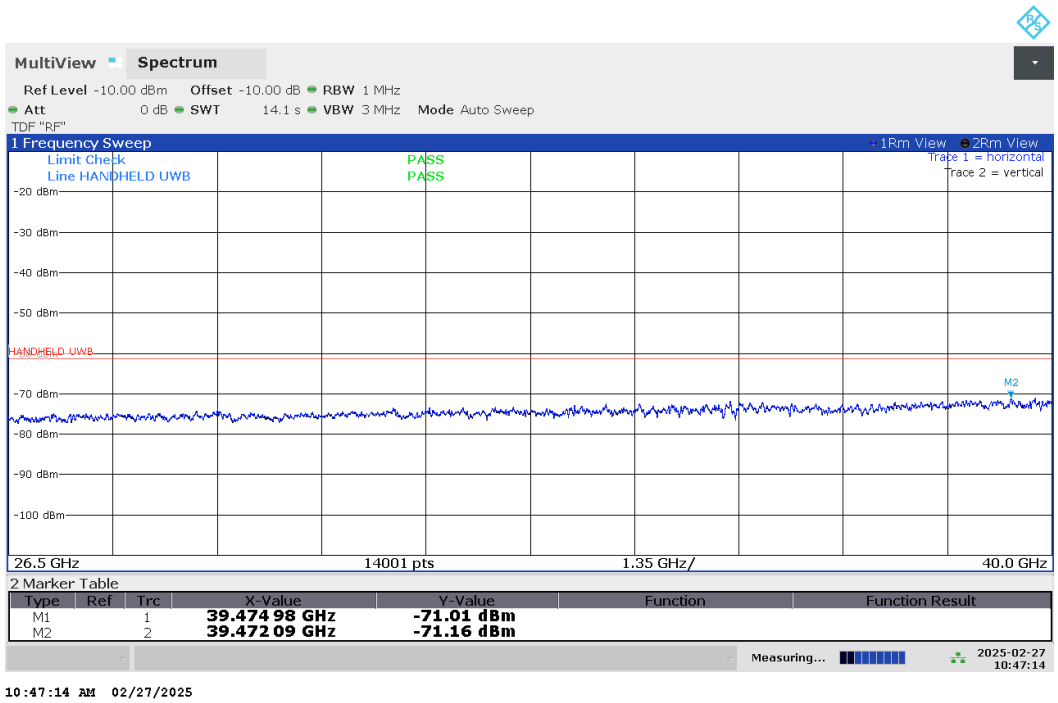
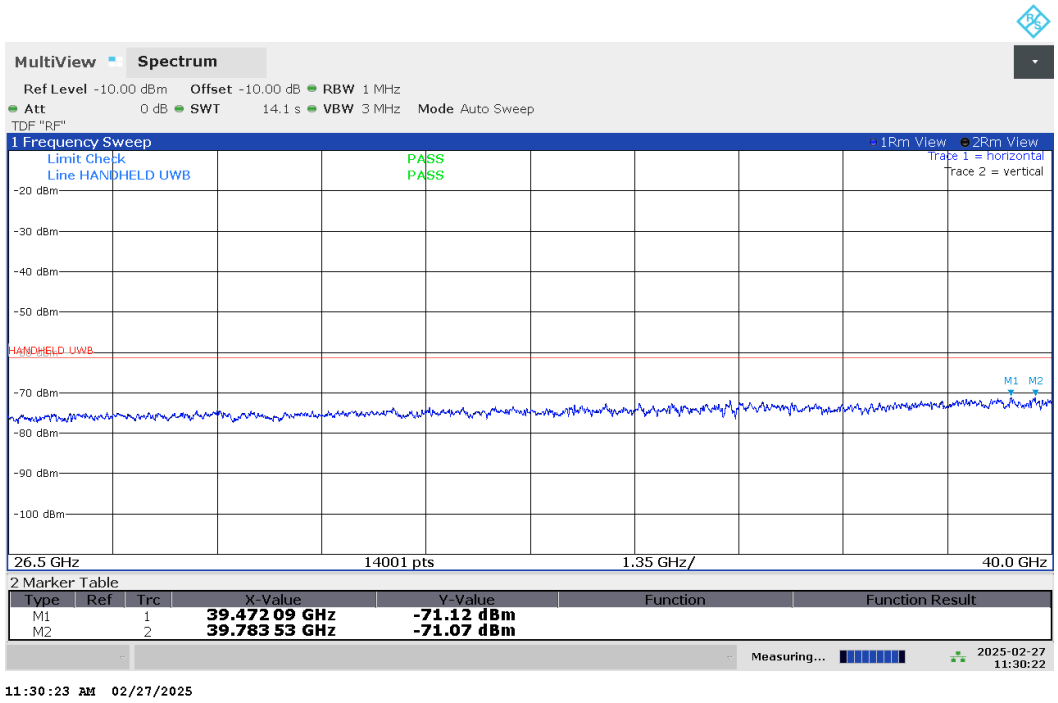
8.5.4. RADIATED EMISSIONS 26.5 – 40 GHz



DW1000 Transceiver, Channel 3



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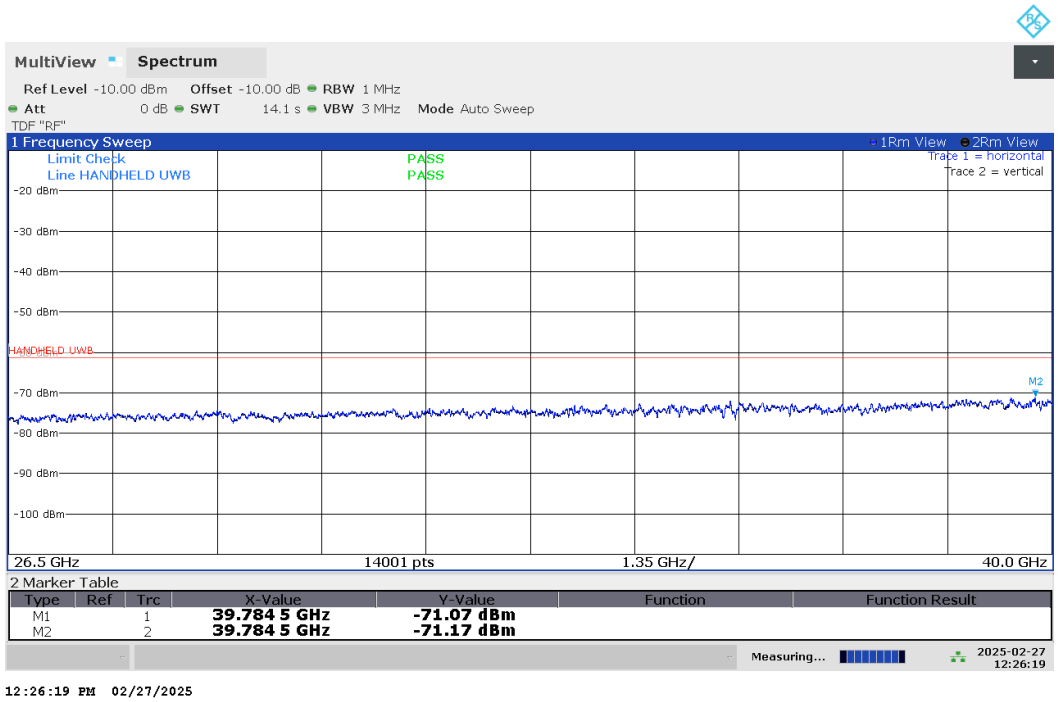

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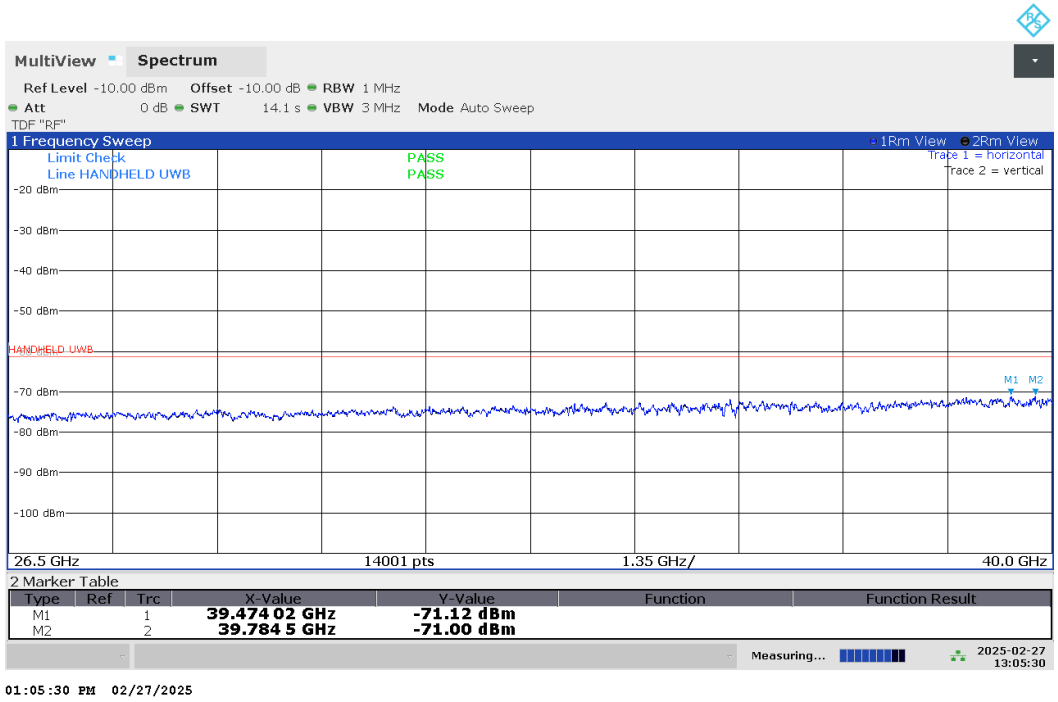

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9. SETUP PHOTOS

Refer to R15655515-EP1 for setup photos.

END OF TEST REPORT

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