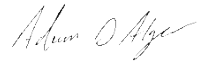


Test Report TR3747A

Equipment Under Test:	Trex Device Communicator
Requirement(s):	FCC: 15.247 ISED: RSS-247
Test Date(s):	11/6/2023-11/29/2023, 7/1/2025-7/3/2025, 7/22/2025
Prepared for:	R. Stahl HMI Systems Attn: Roman Cohnen Adolf-Grimme-Allee 8 Köln, Germany 50829

Report Issued by: Dylan Rosenfeldt, EMC Engineer	
Signature: 	Date: 7/31/2025
Report Reviewed by: Adam Alger, Sr. Manager, EMC Laboratory	
Signature: 	Date: 7/31/2025
Report Constructed by: Dylan Rosenfeldt, EMC Engineer	
Signature: 	Date: 7/31/2025

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Company: R. Stahl HMI Systems	Page 1 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

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Ezurio Test Services in Review

The Ezurio laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:



A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted



Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers



Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

Company: R. Stahl HMI Systems	Page 3 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

1 TEST REPORT SUMMARY

During **11/6/2023-11/29/2023, 7/1/2025-7/3/2025, 7/22/2025** the Equipment Under Test (EUT), **Trex Device Communicator**, as provided by **R. Stahl HMI Systems**, was tested to the following requirements, for the purpose of a product filing:

FCC 15.247 / RSS-247

Requirements	Description	Method	Compliant
FCC: 15.247 (a)(1) ISED: RSS-247 5.1	Channel Separation, Number of Hopping frequencies, Time of Occupancy	ANSI C63.10 7.8.2-7.8.4	Yes
FCC: 2.1049 ISED: RSS-GEN 6.6	Occupied Bandwidth	ANSI C63.10 6.9	Yes
FCC: 15.247 (b)(1) ISED: RSS-247 5.4 (b)	Maximum Conducted Output Power	ANSI C63.10 7.8.5	Yes
FCC: 15.247 (d) ISED: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10 7.8.7	Yes
FCC: 15.247 (d) ISED: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	ANSI C63.10 7.8.8	Yes
FCC: 15.207 ISED: RSS-GEN 8.8	AC Power Line Conducted Emissions	ANSI C63.10 6.2	Yes
2.1055(d) ISED: RSS-GEN 6.11	Frequency Stability	ANSI C63.10 6.8.2	Reported

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	0.5 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

Company: R. Stahl HMI Systems	Page 4 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

2 CLIENT INFORMATION

Company Name	R. Stahl HMI Systems
Contact Person	Roman Cohnen
Address	R. Stahl HMI Systems Adolf-Grimme-Allee 8 Köln, Germany 50829

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	Trex Device Communicator
Model Number	TREX2-00NAW
Serial Number	EMC RF1, EMC RF2
Condition	Good
FCC ID	2AIM6-TREX2
IC ID	21553-TREX2

2.2 Product Description

Touchscreen tablet incorporating Bluetooth Classic, Bluetooth Low Energy, and 2.4GHz WLAN.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Data rates and channels

Bluetooth Classic Datarates: GFSK (1DM5, 1DH5), $\pi/4$ -DQPSK (2DH5), 8DPSK (3DH5). Channels tested: 0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz).

2.6 Antenna Information

Manufacturer	Frequency Range (MHz)	Type	Peak Gain (dBi)
R.Stahl	2400-2483.5	PCB Dipole Antenna	4.03

3 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2
FCC eCFR	-	2023	-	-
RSS-247	3	2023	-	-
RSS-GEN	5	2018	2019	2021
ANSI C63.10	-	2020	-	-

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of $k = 2$.

References
CISPR 16-4-1
CISPR 16-4-2
CISPR 32
ANSI C63.23
A2LA P103
A2LA P103c
ETSI TR 100-028

Measurement Type	Configuration	Uncertainty $\pm$
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

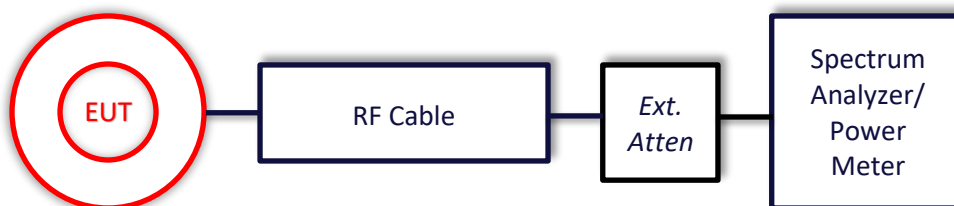
Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 Antenna Port Conducted Emissions – 20dB and 99% Occupied Bandwidth

Operator	Dylan Rosenfeldt	QA	Adam Hauke
Temperature	22.2°C	R.H. %	22.3%
Test Date	11/29/2023	Location	RF conducted Bench
Requirement	FCC: 15.247(a)(1) ICED: RSS-247	Method	ANSI C63.10 6.9.2, 6.9.3

Test Parameters

Frequency	2400 - 2483.5 MHz	Setup	Conducted RF
RBW	27 kHz	VBW	270 kHz
Detector(s)	Peak – Trace/Final	Settings	Trace Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
EE 960197	Meter - Hygro- Thermometer	Control Company	90080-03	180045461	7/21/2023	7/21/2024	Active Calibration

EUT Parameters

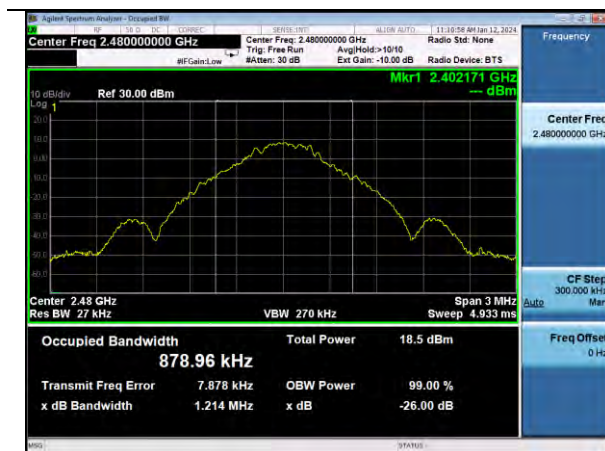
Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	DM5, 1DH5, 2DH5, 3DH5		

Table

Frequency (MHz)	OBW (kHz)	20dB BW (kHz)	Data Rate
2402	880	990	DM5
2441	877	988	DM5
2480	879	988	DM5
2402	851	951	1DH5
2441	854	951	1DH5
2480	853	951	1DH5
2402	1178	1323	2DH5
2441	1180	1323	2DH5
2480	1180	1323	2DH5
2402	1189	1299	3DH5
2441	1189	1299	3DH5
2480	1190	1299	3DH5

99% OBW Plots





Ch 78 | DM5



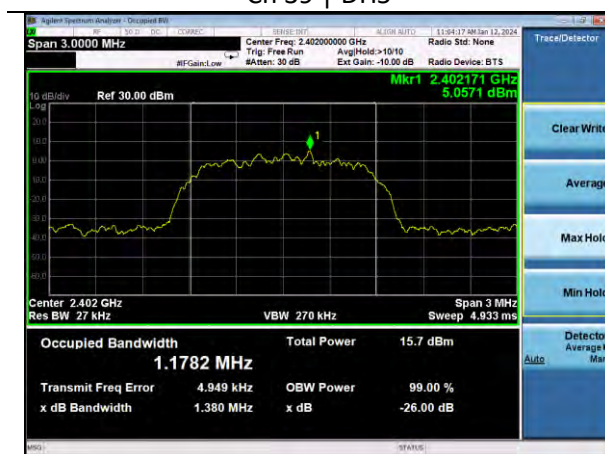
Ch 0 | DH5



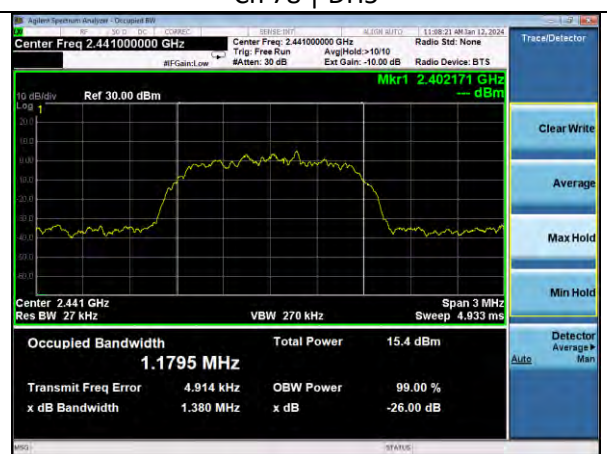
Ch 39 | DH5



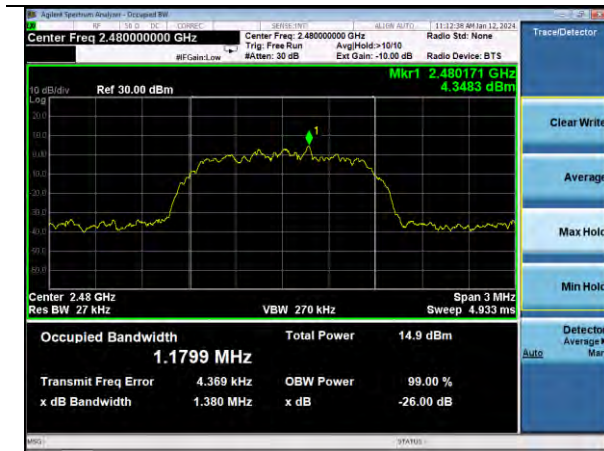
Ch 78 | DH5



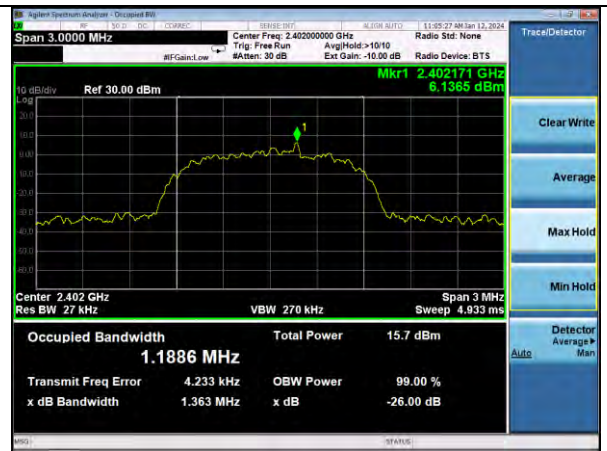
Ch 0 | 2DH5



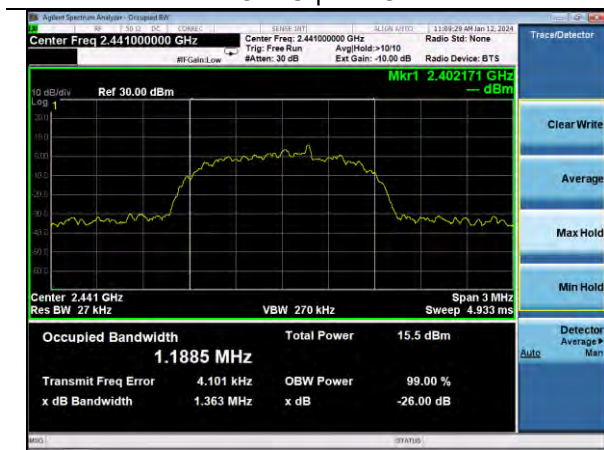
Ch 39 | 2DH5



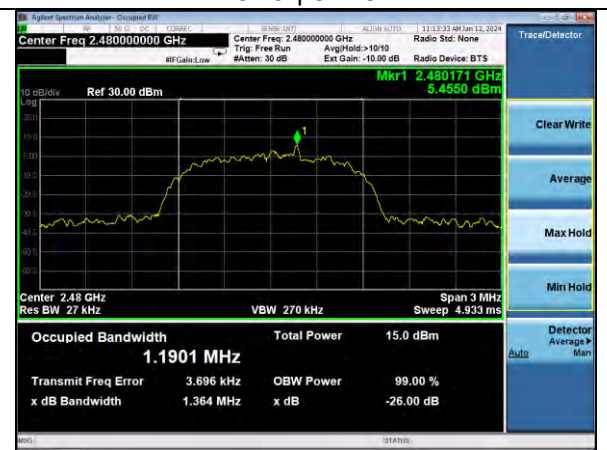
Ch 78 | 2DH5



Ch 0 | 3DH5



Ch 39 | 3DH5

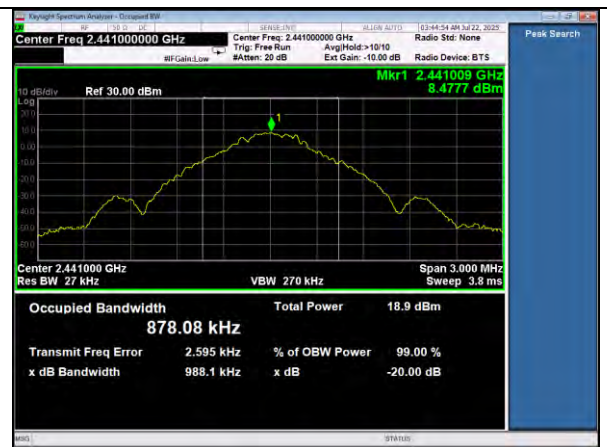


Ch 78 | 3DH5

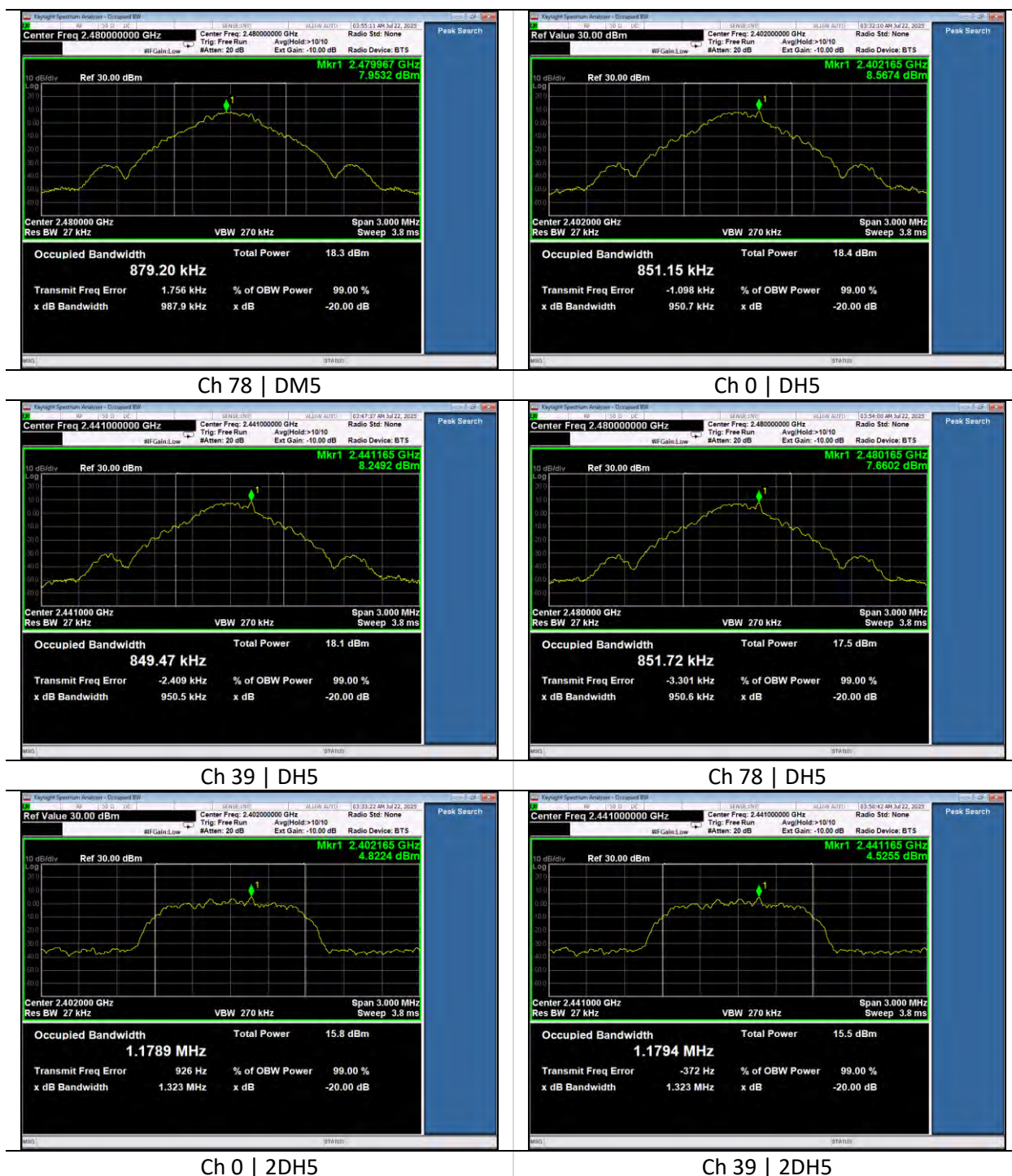
20dB BW Plots

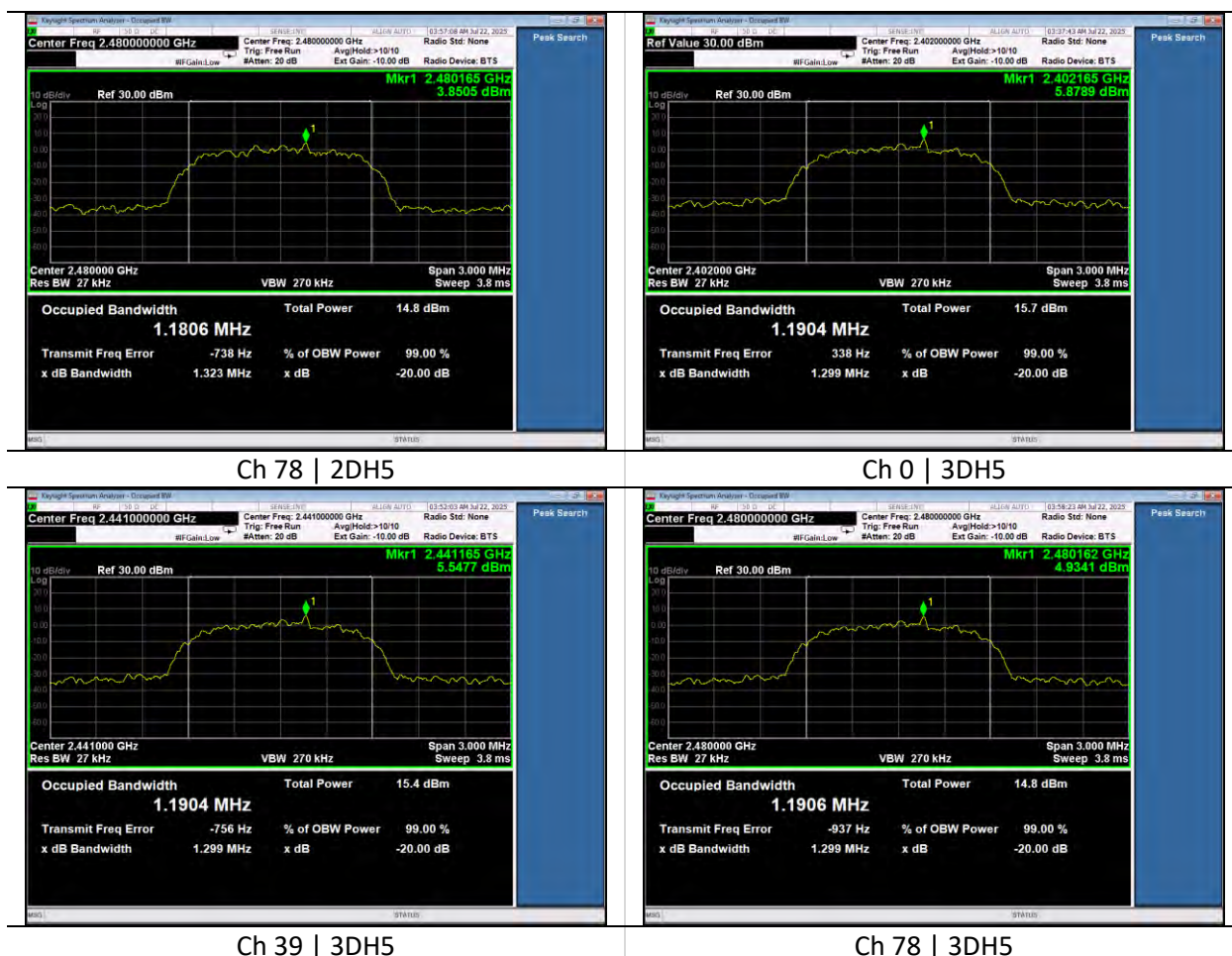


Ch 0 | DM5



Ch 39 | DM5





5.1.2 Antenna Port Conducted Emissions – RF Output Power

Operator	Dylan Rosenfeldt	QA	Adam Hauke
Temperature	22.2°C	R.H. %	22.3%
Test Date	11/29/2023	Location	RF conducted Bench
Requirement	FCC: 15.247(b)(2) ICED: RSS-247 5.4	Method	ANSI C63.10 7.8.5

Limits:

30dBm

Test Parameters

Frequency	2400 - 2483.5 MHz	Setup	Conducted RF
RBW	3 MHz	VBW	50 MHz
Detector(s)	Peak – Trace/Final	Settings	Trace Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
EE 960197	Meter - Hygro- Thermometer	Control Company	90080-03	180045461	7/21/2023	7/21/2024	Active Calibration

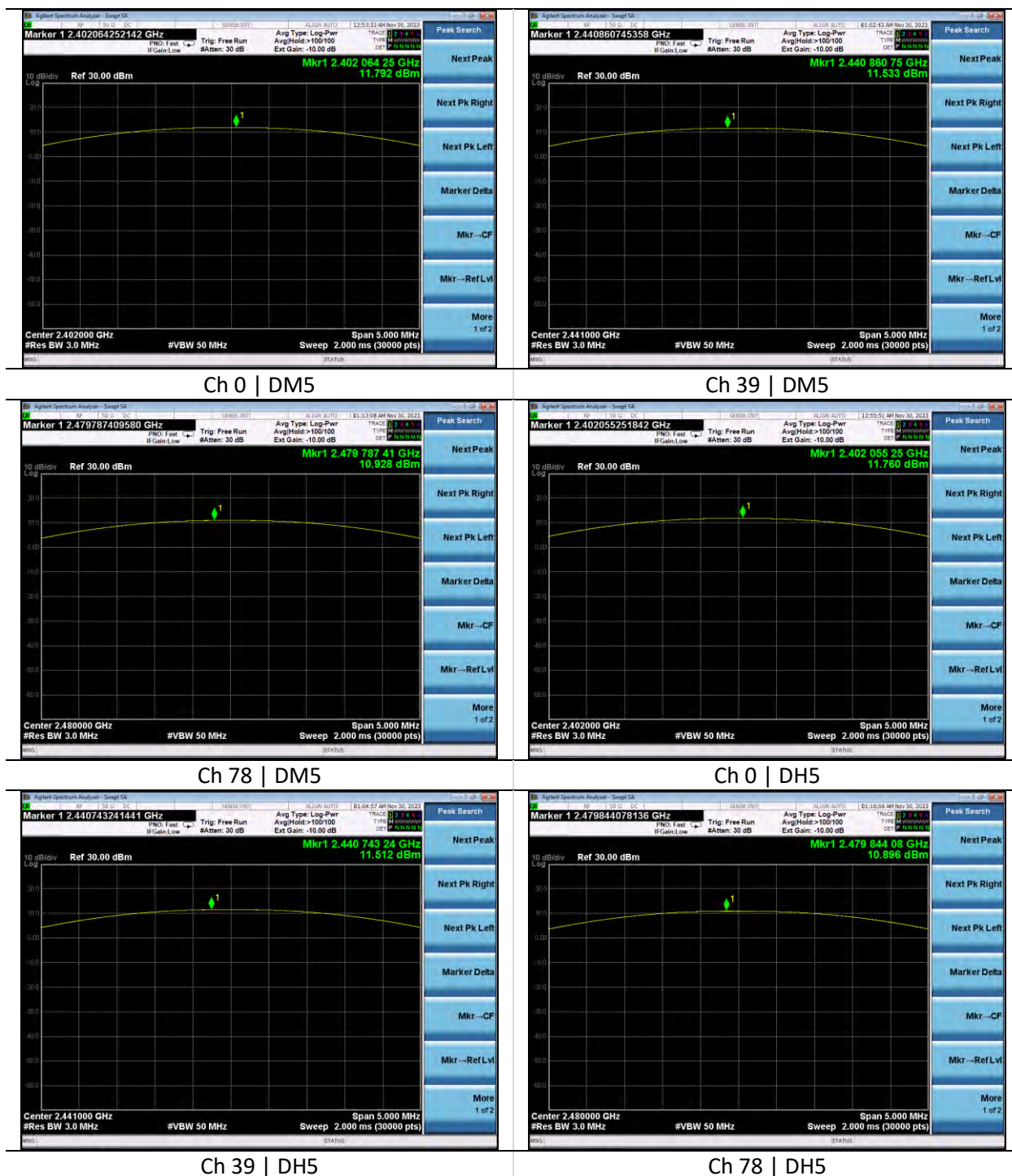
EUT Parameters

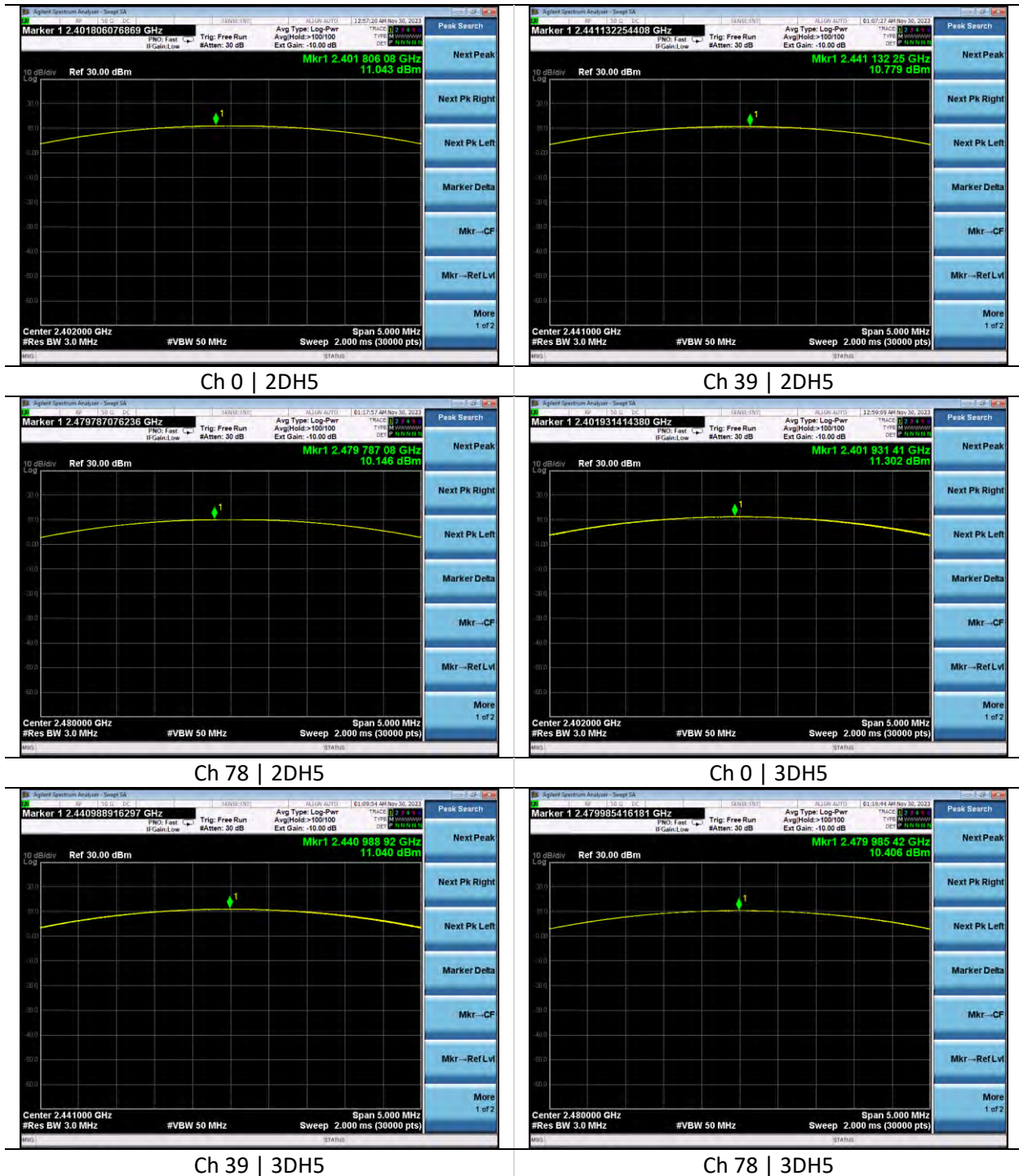
Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	DM5, 1DH5, 2DH5, 3DH5		

Table

Frequency (MHz)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Datarate
2402	11.8	30	18.2	DM5
2441	11.5	30	18.5	DM5
2480	10.9	30	19.1	DM5
2402	11.8	30	18.2	1DH5
2441	11.5	30	18.5	1DH5
2480	10.9	30	19.1	1DH5
2402	11.0	30	19.0	2DH5
2441	10.8	30	19.2	2DH5
2480	10.1	30	19.9	2DH5
2402	11.3	30	18.7	3DH5
2441	11.0	30	19.0	3DH5
2480	10.4	30	19.6	3DH5

Plots





5.1.3 Antenna Port Conducted Emissions – Spurious Emissions

Operator	Dylan Rosenfeldt	QA	Anthony Smith
Temperature	22.7°C	R.H. %	50.8%
Test Date	7/22/2025	Location	RF conducted Bench
Requirement	FCC: 15.247d ICED: RSS-GEN 8.9	Method	ANSI C63.10 7.8.7

Limits:

30dBm

Test Parameters

Frequency	30-25000 MHz	Setup	Conducted RF
RBW	100 kHz	VBW	300 kHz
Detector(s)	Peak – Trace/Final	Settings	Trace Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	6/1/2025	6/1/2026	Active Calibration
EE 960197	Meter - Hygro- Thermometer	Control Company	90080-03	180045461	12/17/2024	12/17/2025	Active Calibration

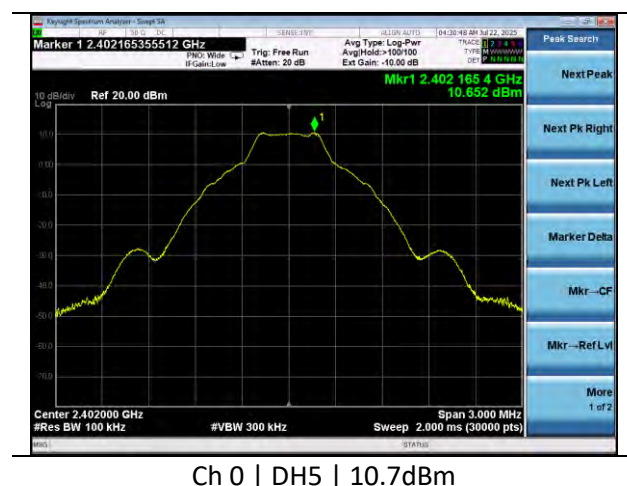
EUT Parameters

Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	DM5, 1DH5, 2DH5, 3DH5		

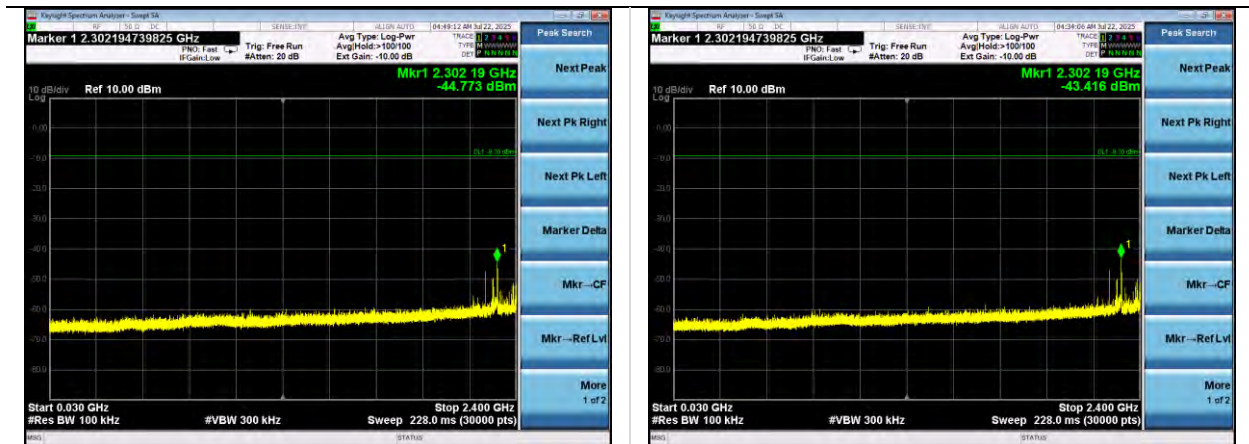
Table

Channel	Mode	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
0	DM5	2303.1	-43.0	-9.3	33.7
0	1DH5	2302.2	-43.0	-9.3	33.7
0	2DH5	2399.8	-46.4	-9.3	37.1
0	3DH5	2399.6	-44.3	-9.3	35.0
39	DM5	2339.6	-42.6	-9.3	33.3
39	1DH5	2337.4	-43.0	-9.3	33.7
78	DM5	2376.1	-42.2	-9.3	32.9
78	DM5	2488.6	-49.3	-9.3	40.0
78	DM5	2583.6	-45.7	-9.3	36.4
78	1DH5	2376.1	-42.4	-9.3	33.1
78	1DH5	2488.6	-49.5	-9.3	40.2
78	1DH5	2586.4	-46.5	-9.3	37.2
78	2DH5	2485.0	-50.4	-9.3	41.1
78	3DH5	2485.0	-50.5	-9.3	41.2
FH	DM5	2399.8	-49.0	-9.3	39.7
FH	DM5	2488.6	-49.5	-9.3	40.2
FH	1DH5	2398.8	-49.3	-9.3	40.0
FH	1DH5	2484.2	-50.8	-9.3	41.5
FH	2DH5	2399.8	-48.5	-9.3	39.2
FH	2DH5	2484.2	-54.7	-9.3	45.4
FH	3DH5	2399.7	-45.6	-9.3	36.3

Reference Level Plot

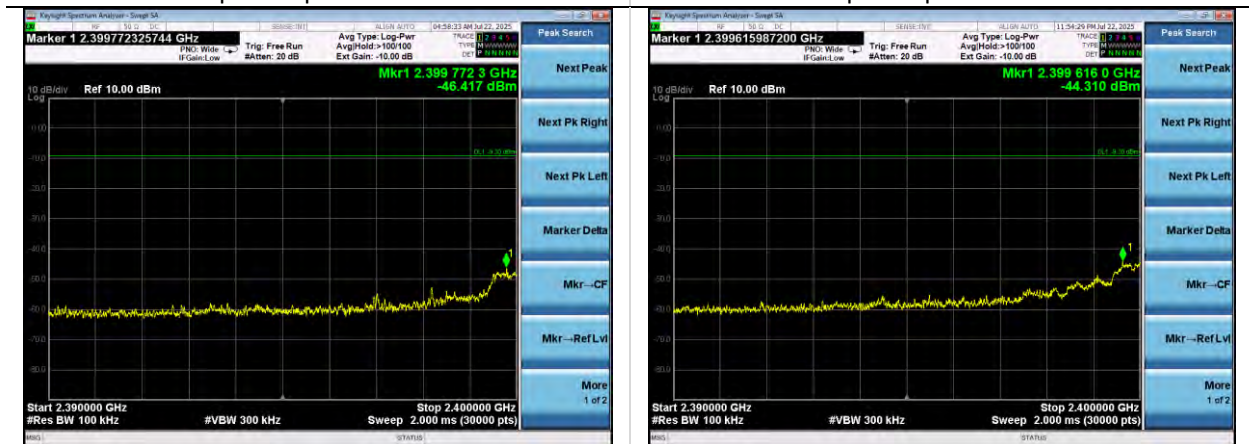


Worst Case Plots



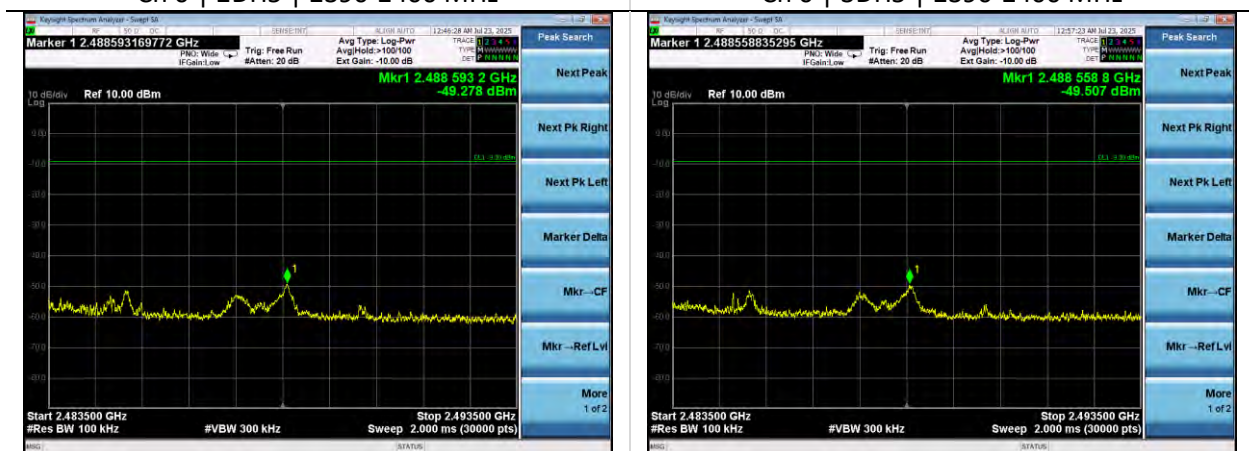
Ch 0 | DM5 | 30-2400 MHz

Ch 0 | DH5 | 30-2400 MHz



Ch 0 | 2DH5 | 2390-2400 MHz

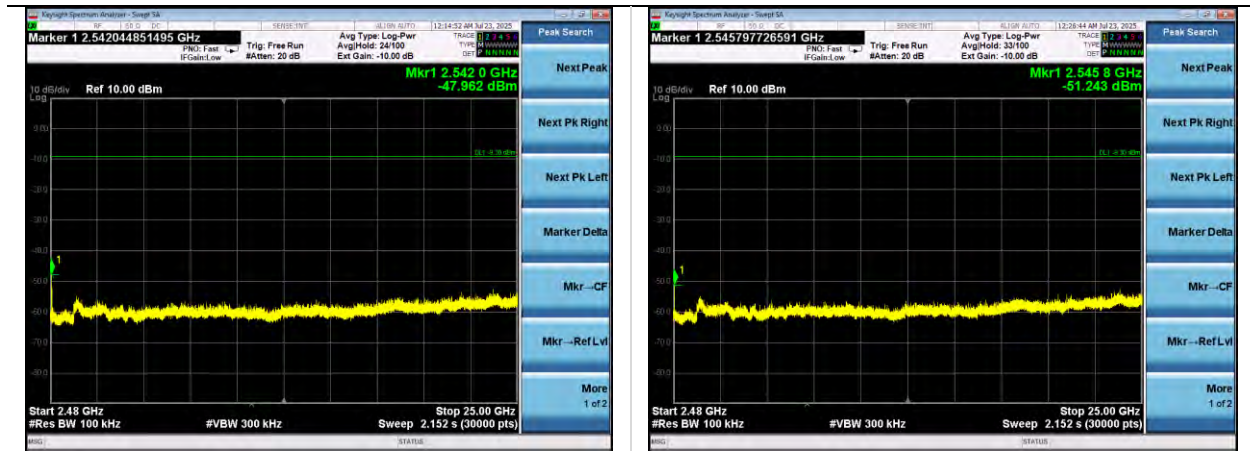
Ch 0 | 3DH5 | 2390-2400 MHz



Ch 78 | DM5 | 2483.5-2493.5 MHz

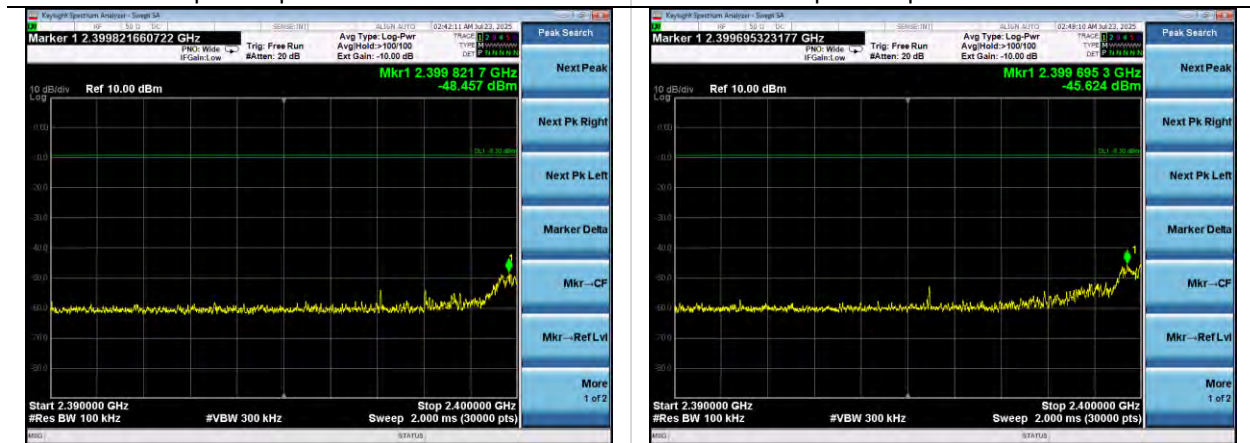
Ch 78 | DH5 | 2483.5-2493.5 MHz

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Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2



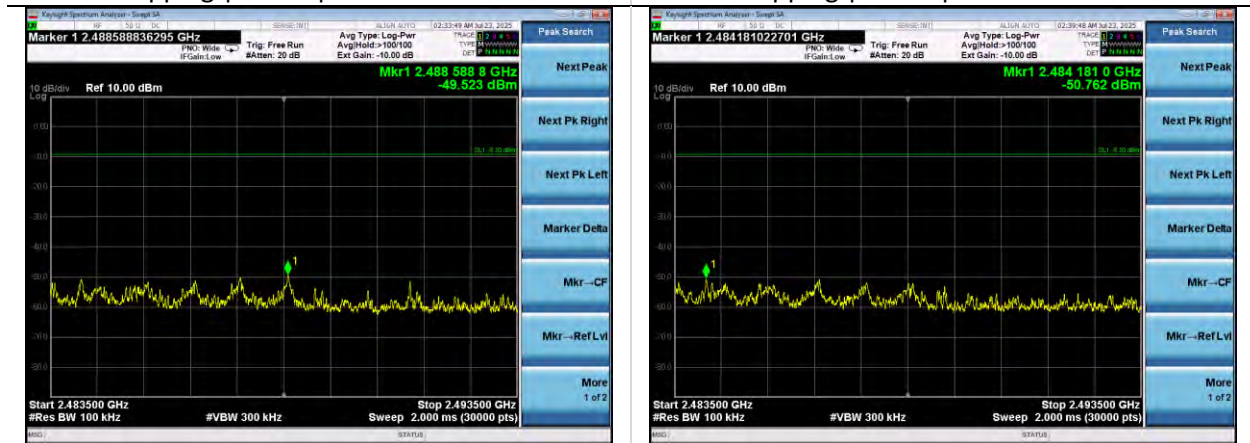
Ch 39 | DM5 | 2483.5-25000 MHz

Ch 39 | 3DH5 | 2483.5-25000 MHz



Hopping | 2DH5 | 2390-2400 MHz

Hopping | 3DH5 | 2390-2400 MHz



Hopping | DM5 | 2483.5-2493.5 MHz

Hopping | DH5 | 2483.5-2493.5 MHz

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Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

5.1.4 Antenna Port Conducted Emissions – Carrier Separation, Number of Channels, Time of Occupancy

Operator	Dylan Rosenfeldt	QA	Anthony Smith
Temperature	22.2°C, 22.7°C	R.H. %	22.3%, 50.8%
Test Date	11/29/2023, 7/22/2025	Location	RF conducted Bench
Requirement	FCC: 15.247(a)(i) ICED: RSS-247 5.1	Method	ANSI C63.10 7.8.2, 7.8.3, 7.8.4

Limits:

Carrier separation: At least 2/3 of 20dB BW

Number of Channels: At Least 15 channels

Time of Occupancy: no greater than 0.4s in a period of 0.4s multiplied by the number of channels

Test Parameters

Frequency	2400-2483.5 MHz	Setup	Conducted RF
RBW	100 kHz, 200 kHz	VBW	1 MHz, 2 MHz
Detector(s)	Peak – Trace/Final	Settings	Trace Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration
EE 960197	Meter - Hygro- Thermometer	Control Company	90080-03	180045461	7/21/2023	7/21/2024	Active Calibration

EUT Parameters

Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	1DH5		

Channel Separation Table

Frequency (MHz)	Channel Separation (kHz)	Limit (2/3 20 dB BW) (kHz)	Margin (kHz)	Data Rate
2402.5	1000	882	118	2DH5

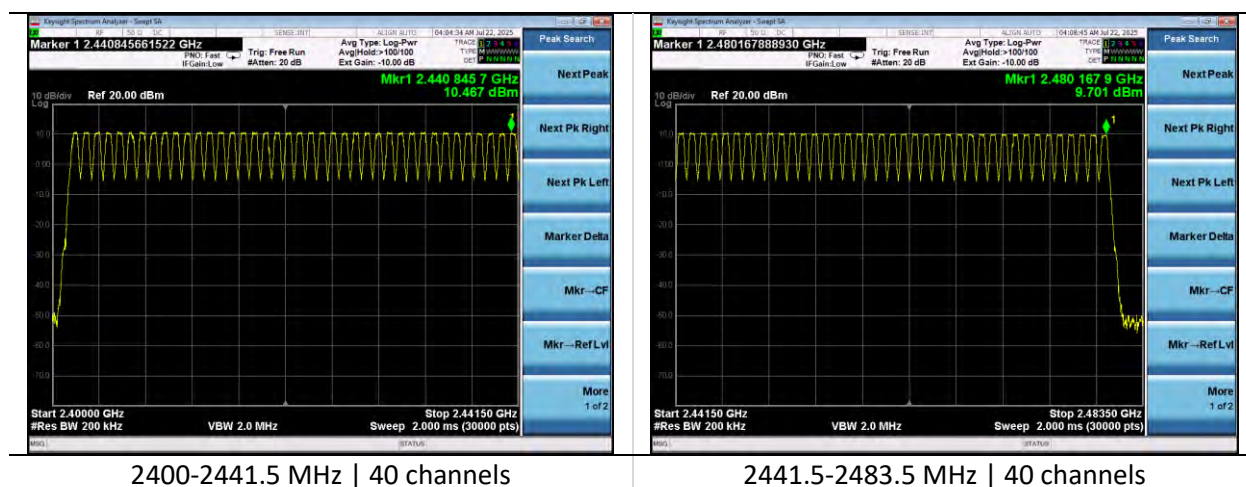
Carrier Frequency Plots



Carrier Frequency Separation

Company: R. Stahl HMI Systems	Page 25 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

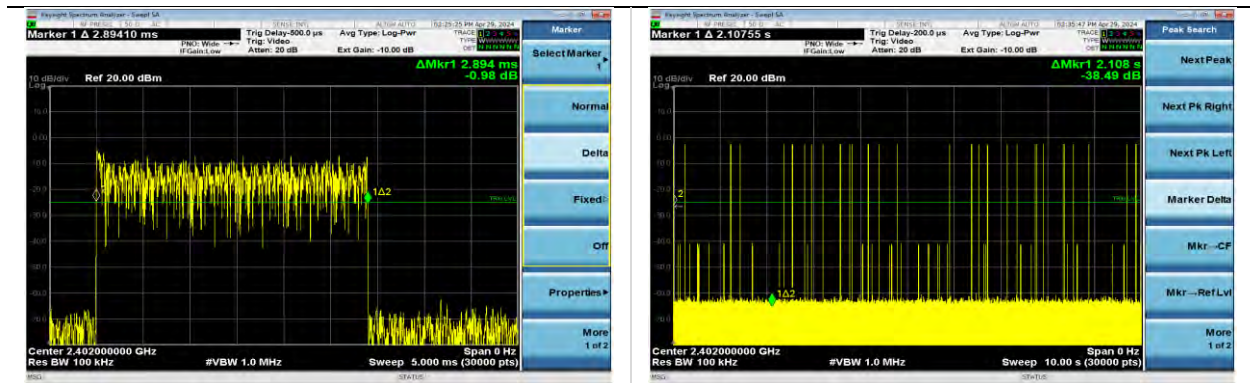
Number of Hopping Channels used



Channel Occupancy Table

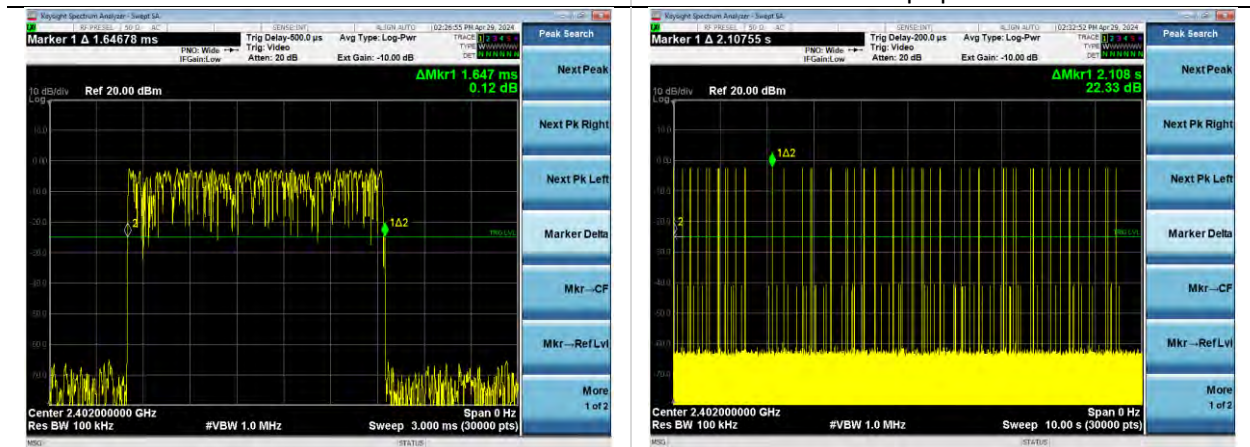
Frequency (MHz)	Dwell Time (ms)	Average number of transmissions per 31.6s	Channel Occupancy Time (ms)	Limit (ms)	Margin (ms)	Datarate
2402	2.894	116.92	0.338	0.400	0.062	1DH5
2402	1.647	195.9	0.323	0.400	0.077	1DH3
2402	0.3906	320	0.125	0.400	0.275	1DH1

Plots



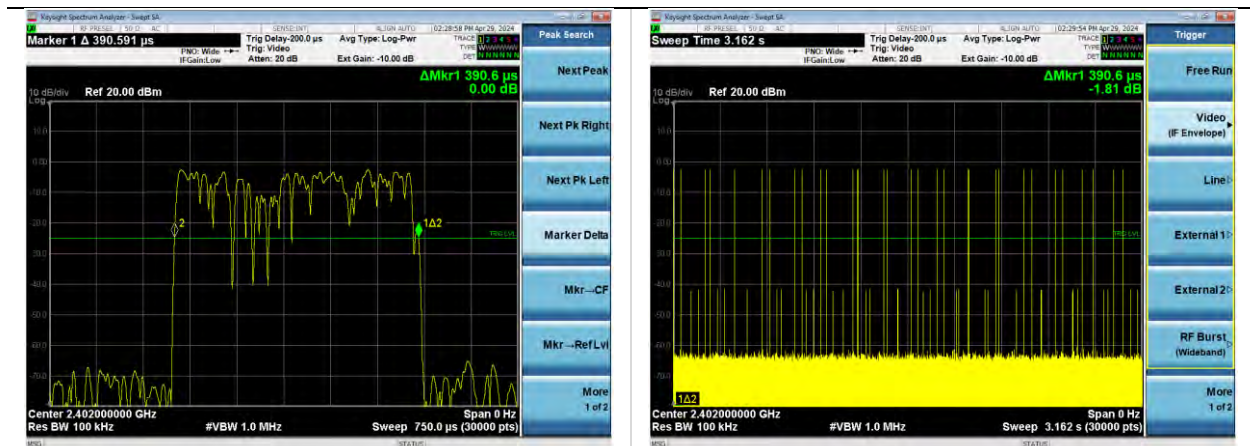
1DH5 Dwell Time

1DH5 37 hops per 10 seconds



1DH3 Dwell time

1DH3 62 hops per 10 seconds



1DH1 Dwell time

1DH1 32 hops per 3.16 seconds

Company: R. Stahl HMI Systems	Page 27 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

5.1.5 Frequency Stability

Operator	Dylan Rosenfeldt	QA	Adam Hauke
Temperature	22.2°C	R.H. %	22.3%
Test Date	11/29/2023	Location	RF conducted Bench
Requirement	FCC: 2.1055(d) ISED: RSS-GEN 6.11	Method	ANSI C63.10 6.8.2

Test Parameters

Frequency	2402-2480 MHz	Voltage	102VAC, 120VAC, 138VAC 60Hz
Detector(s)	Peak	Settings	Max Hold
Notes	Tested on AC adapter		

Table

Channel	Voltage (V _{rms} 60Hz)	Center Frequency (Hz)
0	102	2402000761
	120	2401999679
	138	2402000600
39	102	2441000455
	120	2440999922
	138	2440999648
78	102	2479998874
	120	2479997793
	138	2479999852

5.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBμV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBμV/m) Margin (dB) = Limit (dBμV/m) - Corrected Reading (dBμV/m) Example at 4000 MHz: Reading = 40 dBμV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBμV/m Average Limit = 20 log (500) = 54 dBμV/m Margin = 54 dBμV/m - 50.8 dBμV/m = 3.2 dB

Block Diagram



5.2.1 Radiated Emissions

Operator	Dylan Rosenfeldt	QA	Anthony Smith
Temperature	20-25°C	R.H. %	30-60%
Test Date	11/6/2023-11/17/2023, 6/30/2025	Location	Chamber 3
Requirement	FCC: 15.247(d) ISED: RSS-GEN 8.10	Method	ANSI C63.10 11.12

15.209 Limits:

Frequency (MHz)	Quasi-Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-25000	-	54.0	74.0

Test Parameters

Frequency	30-25000 MHz	Distance	3m
Detector(s)	Peak, Trace/Final Quasi-Peak, Final	Table height	80 cm (<1GHz) 150 cm (>1GHz)
RBW	120kHz (<1GHz) 1MHz (>1GHz)	VBW	1.2MHz (<1GHz) 3MHz (>1GHz)
Notes	The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125 ms. DH5 Packet permit maximum $1600/79/6 = 3.37$ hops per second in each channel.		
Example Calculations	Reduced VBW averaging used for band edge emissions Avg VBW = 1/on-time Calculated Peak Average used for harmonics Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from the formula for DH5 packet type which has worst duty factor.		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	2/21/2025	2/21/2026	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/24/2025	1/24/2026	Active Verification
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/3/2025	4/3/2026	Active Calibration
AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	11/19/2024	11/19/2025	Active Calibration
AA 960220	Cable	A.H. Systems, Inc.	SAC-26G-6	552	1/28/2025	1/28/2026	Active Verification
AA 960209	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	037101808	11/19/2024	11/19/2025	Active Calibration
AA 960154	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-02	4/3/2025	4/3/2026	Active Calibration
AA 960174	Antenna - Small Horn	ETS Lindgren	3116C-PA	00206880	12/2/2024	12/2/2025	Active Calibration
AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	12/9/2024	12/9/2025	Active Calibration
AA 960163	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	500	12/11/2024	12/11/2025	Active Calibration

EUT Parameters

Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	DM5, 1DH5, 2DH5, 3DH5		

Band Edge Emissions Ch 0

Frequency (MHz)	EUT orientation	Polarity	Peak Reading (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)	Average Margin (dB)	Peak Margin (dB)	Mode
2499.2	Y	H	51.0	54.0	74.0	3.0	23.0	DM5 ch 0
2378.0	Y	H	51.7	54.0	74.0	2.3	22.3	DM5 ch 0
2371.9	Y	H	51.5	54.0	74.0	2.5	22.5	DM5 FH
2486.6	Y	H	51.4	54.0	74.0	2.6	22.6	DM5 FH
2499.9	Y	H	51.6	54.0	74.0	2.4	22.4	1DH5 ch 0
2378.2	Y	H	51.6	54.0	74.0	2.4	22.4	1DH5 ch 0
2355.3	Y	H	51.3	54.0	74.0	2.7	22.7	1DH5 FH
2483.5	Y	H	51.4	54.0	74.0	2.6	22.6	1DH5 FH
2386.4	Y	H	51.3	54.0	74.0	2.7	22.7	2DH5 ch 0
2487.0	Y	H	50.9	54.0	74.0	3.1	23.1	2DH5 ch 0
2485.4	Y	H	51.8	54.0	74.0	2.2	22.2	2DH5 FH
2380.5	Y	H	51.2	54.0	74.0	2.8	22.8	2DH5 FH
2389.2	Y	H	50.9	54.0	74.0	3.1	23.1	3DH5 ch 0
2484.3	Y	H	51.5	54.0	74.0	2.5	22.5	3DH5 ch 0
2485.9	Y	H	51.4	54.0	74.0	2.6	22.6	3DH5 FH
2366.2	Y	H	51.5	54.0	74.0	2.5	22.5	3DH5 FH

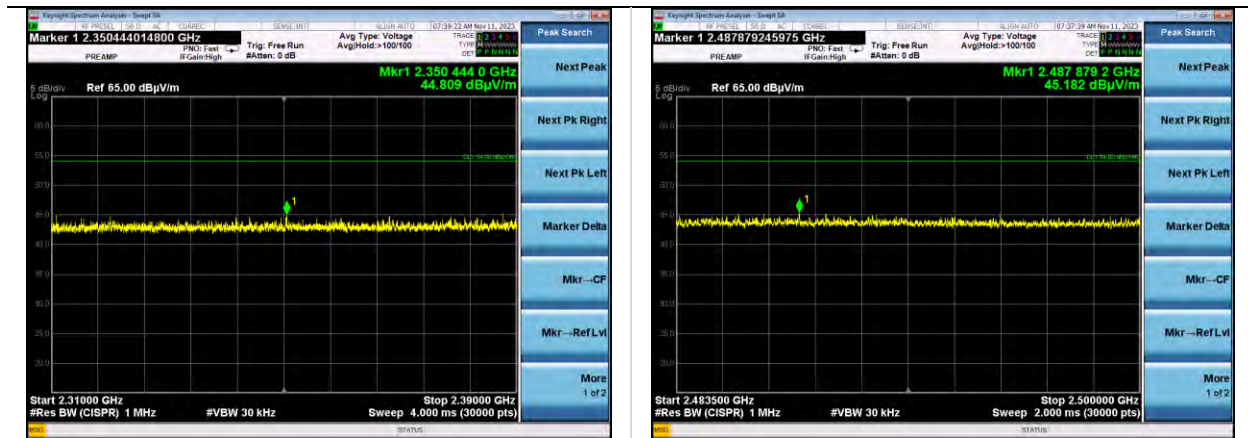
Note: Peak measurement complies with average limit

Band Edge Emissions Ch 78

Frequency (MHz)	EUT orientation	Polarity	Peak Reading (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)	Average Margin (dB)	Peak Margin (dB)	Mode
2488.4	Y	H	51.9	54.0	74.0	2.1	22.1	DM5 ch 78
2373.9	Y	H	52.4	54.0	74.0	1.6	21.6	DM5 ch 78
2363.4	Y	H	51.2	54.0	74.0	2.8	22.8	DM5 FH
2485.4	Y	H	52.1	54.0	74.0	1.9	21.9	DM5 FH
2488.6	Y	H	52.9	54.0	74.0	1.1	21.1	1DH5 ch 78
2376.0	Y	H	53.5	54.0	74.0	0.5	20.5	1DH5 ch 78
2491.1	Y	H	51.4	54.0	74.0	2.6	22.6	1DH5 FH
2389.2	Y	H	50.9	54.0	74.0	3.1	23.1	1DH5 FH
2378.5	Y	H	51.4	54.0	74.0	2.6	22.6	2DH5 ch 78
2483.6	Y	H	53.0	54.0	74.0	1.0	21.0	2DH5 ch 78
2483.5	Y	H	51.9	54.0	74.0	2.1	22.1	2DH5 FH
2387.1	Y	H	51.6	54.0	74.0	2.4	22.4	2DH5 FH
2372.4	Y	H	51.6	54.0	74.0	2.4	22.4	3DH5 ch 78
2483.5	Y	H	52.1	54.0	74.0	1.9	21.9	3DH5 ch 78
2483.5	Y	H	52.2	54.0	74.0	1.8	21.8	3DH5 FH
2381.4	Y	H	51.4	54.0	74.0	2.6	22.6	3DH5 FH

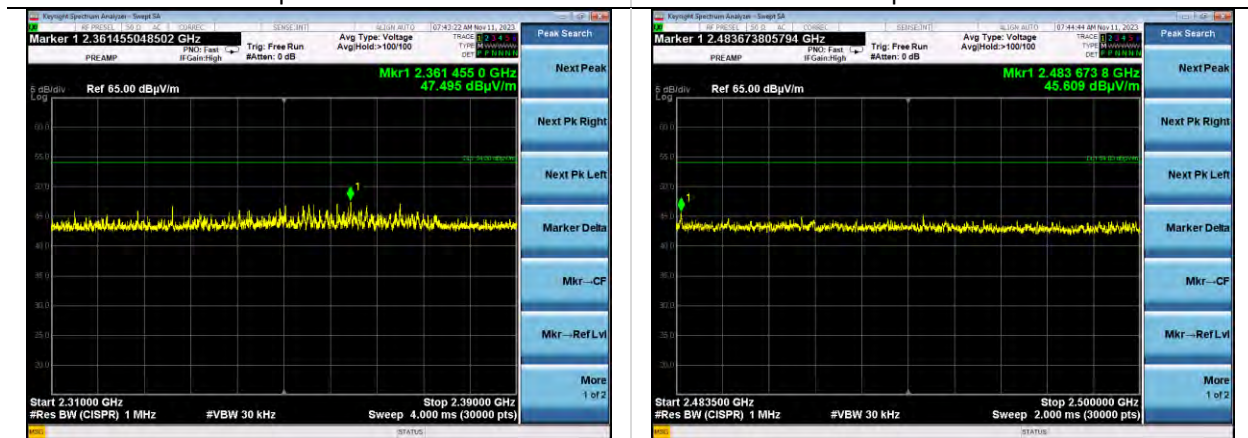
Note: Peak measurement complies with average limit

Plots



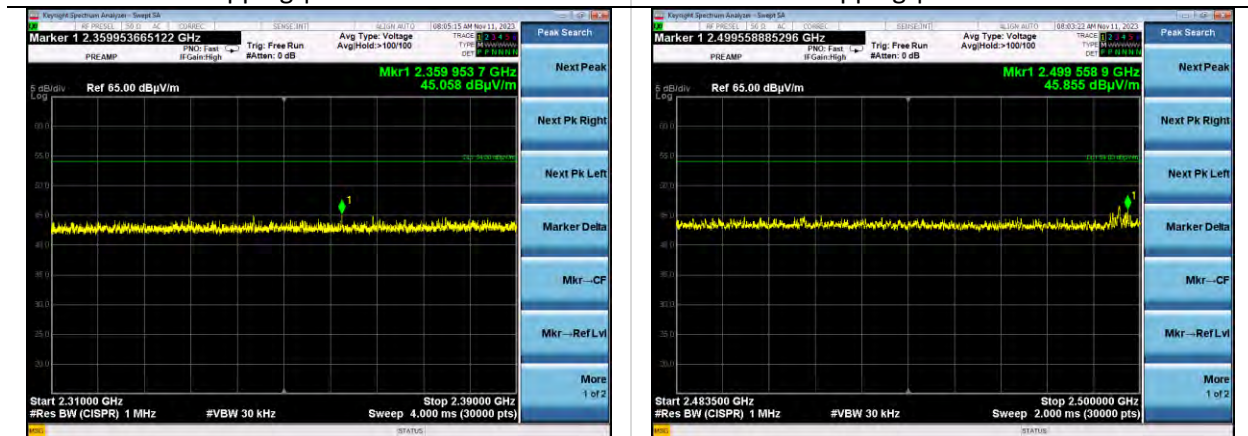
DM5 ch 0 | 2310-2390 MHz

DM5 ch 0 | 2483.5-2500 MHz



DM5 Hopping | 2310-2390 MHz

DM5 Hopping | 2483.5-2500 MHz

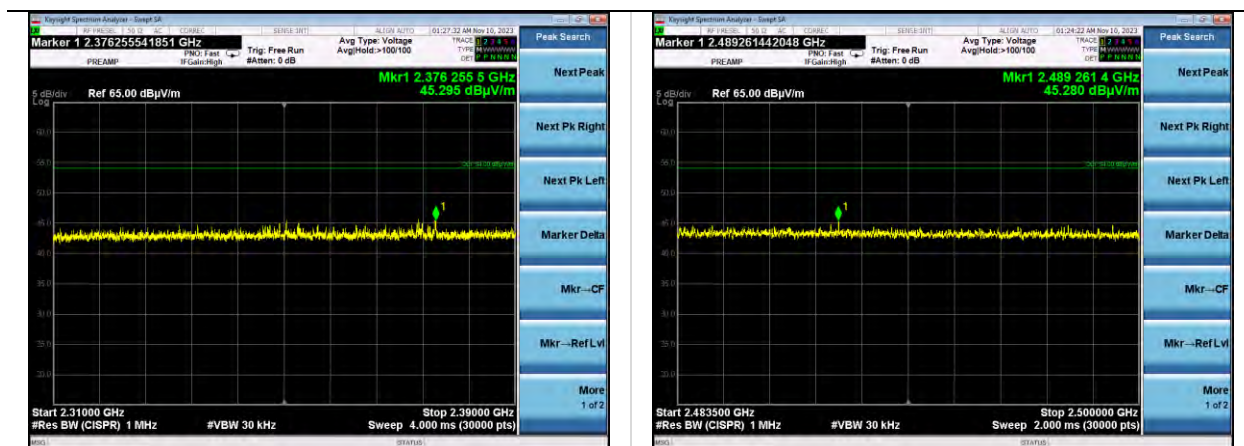


1DH5 ch 0 | 2310-2390 MHz

1DH5 ch 0 | 2483.5-2500 MHz

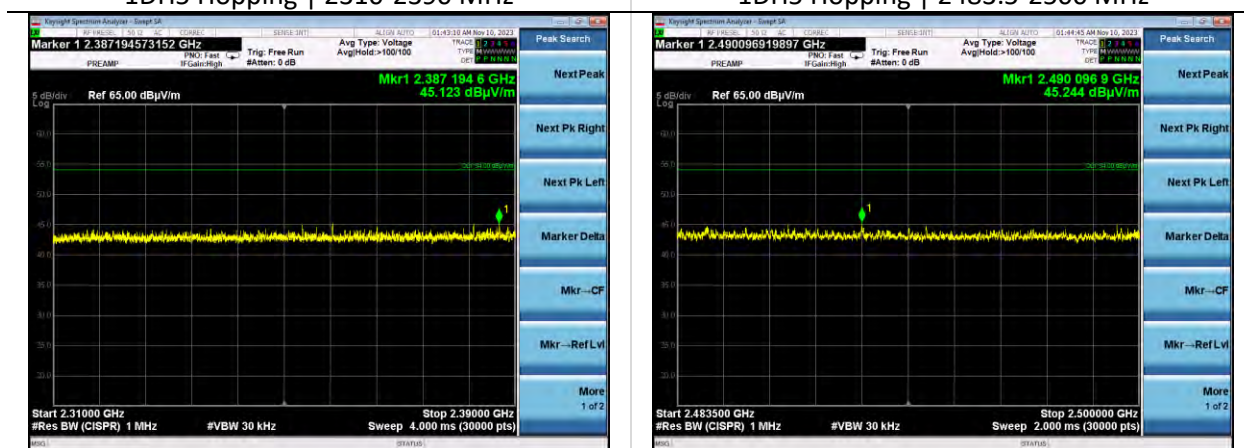
Screen captures at 30kHz VBW, Measurements taken with 3MHz VBW

Company: R. Stahl HMI Systems	Page 33 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2



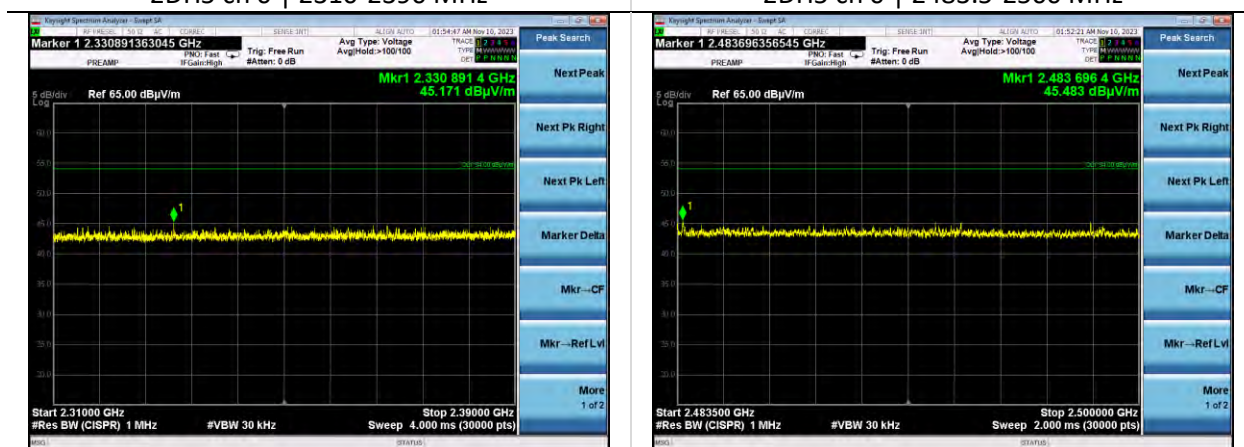
1DH5 Hopping | 2310-2390 MHz

1DH5 Hopping | 2483.5-2500 MHz



2DH5 ch 0 | 2310-2390 MHz

2DH5 ch 0 | 2483.5-2500 MHz

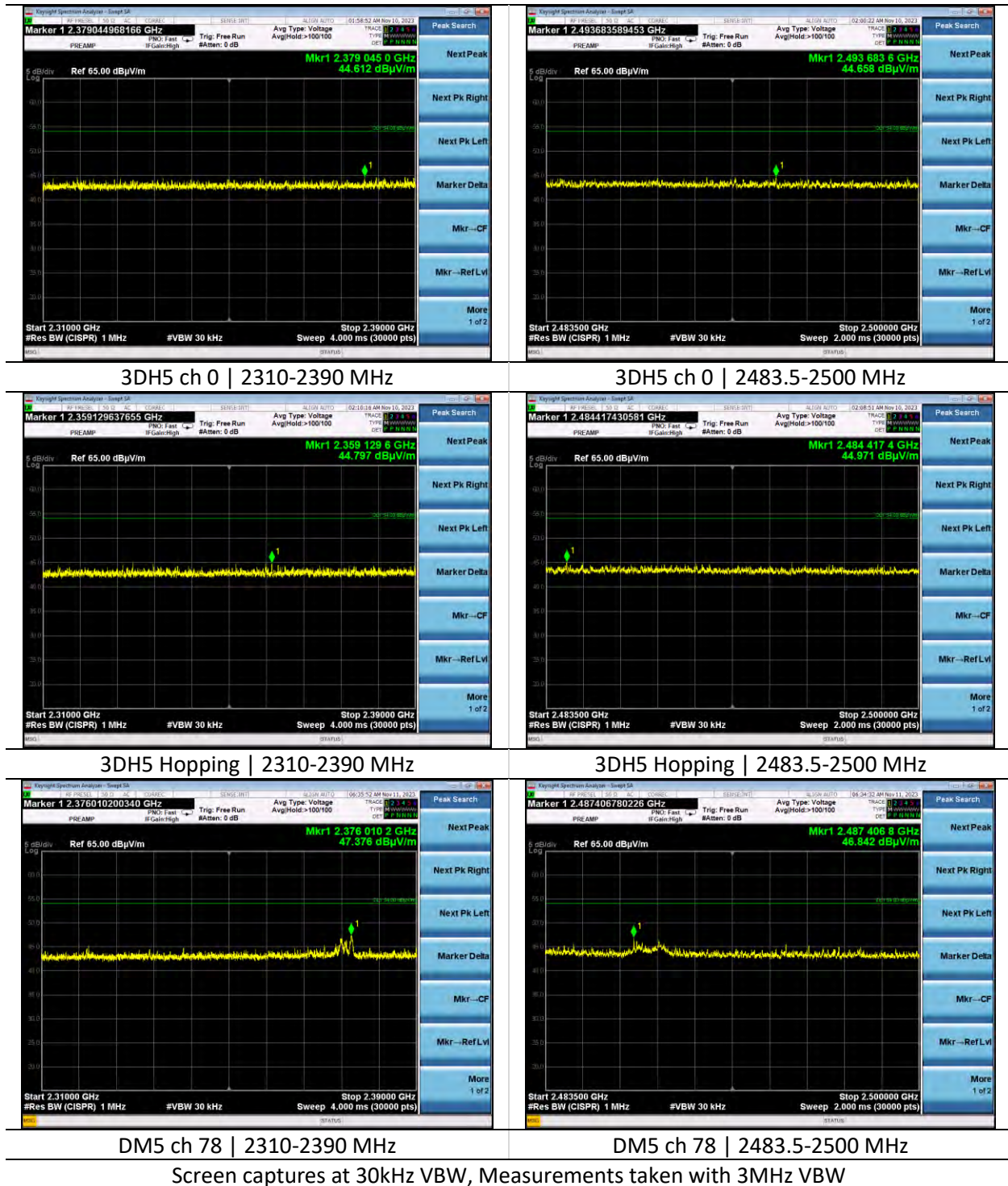


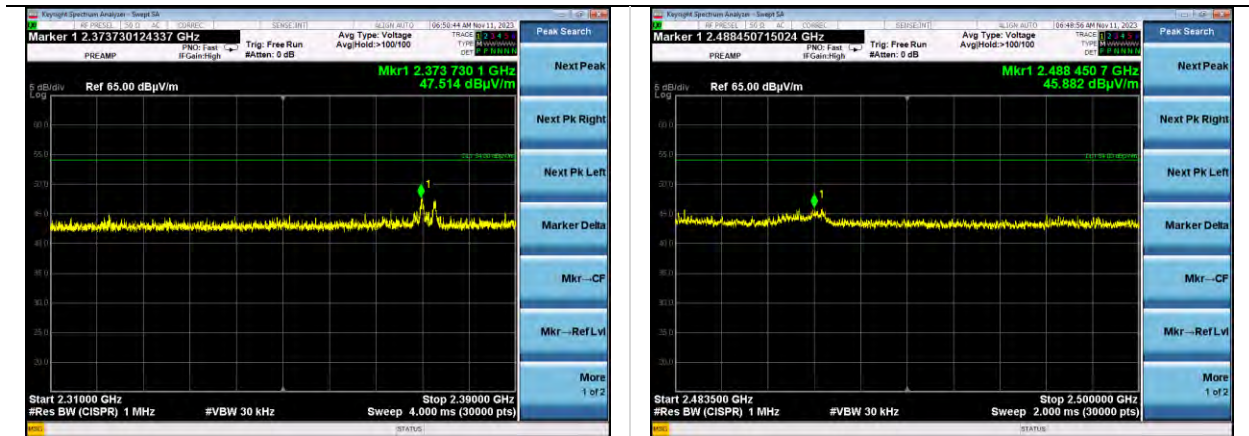
2DH5 Hopping | 2310-2390 MHz

2DH5 Hopping | 2483.5-2500 MHz

Screen captures at 30kHz VBW, Measurements taken with 3MHz VBW

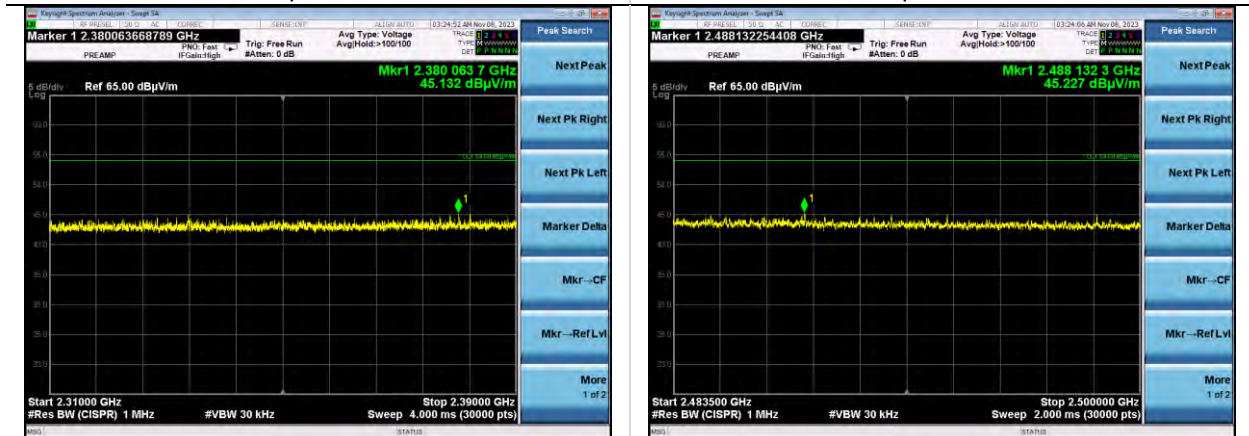
Company: R. Stahl HMI Systems	Page 34 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2





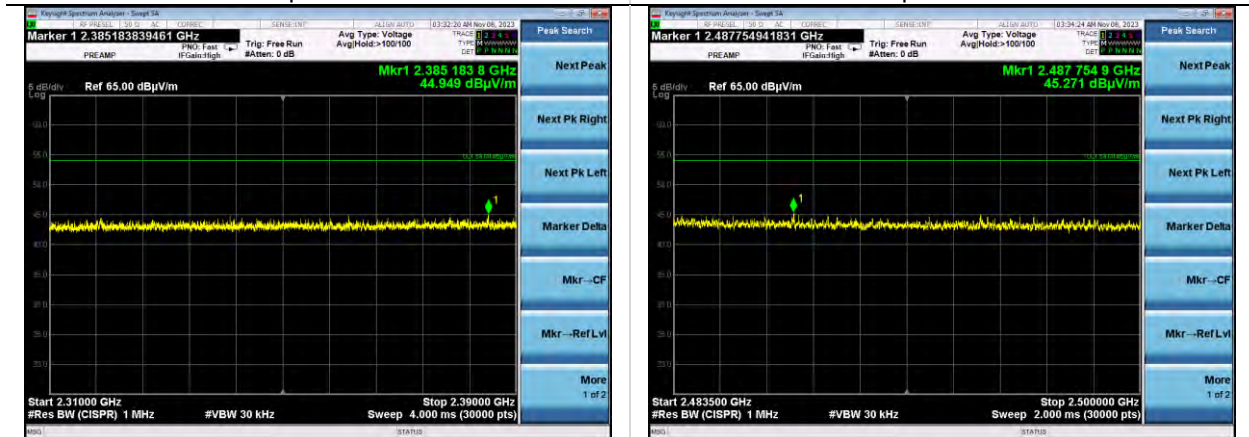
1DH5 ch 78 | 2310-2390 MHz

1DH5 ch 78 | 2483.5-2500 MHz



2DH5 ch 78 | 2310-2390 MHz

2DH5 ch 78 | 2483.5-2500 MHz



3DH5 ch 78 | 2310-2390 MHz

3DH5 ch 78 | 2483.5-2500 MHz

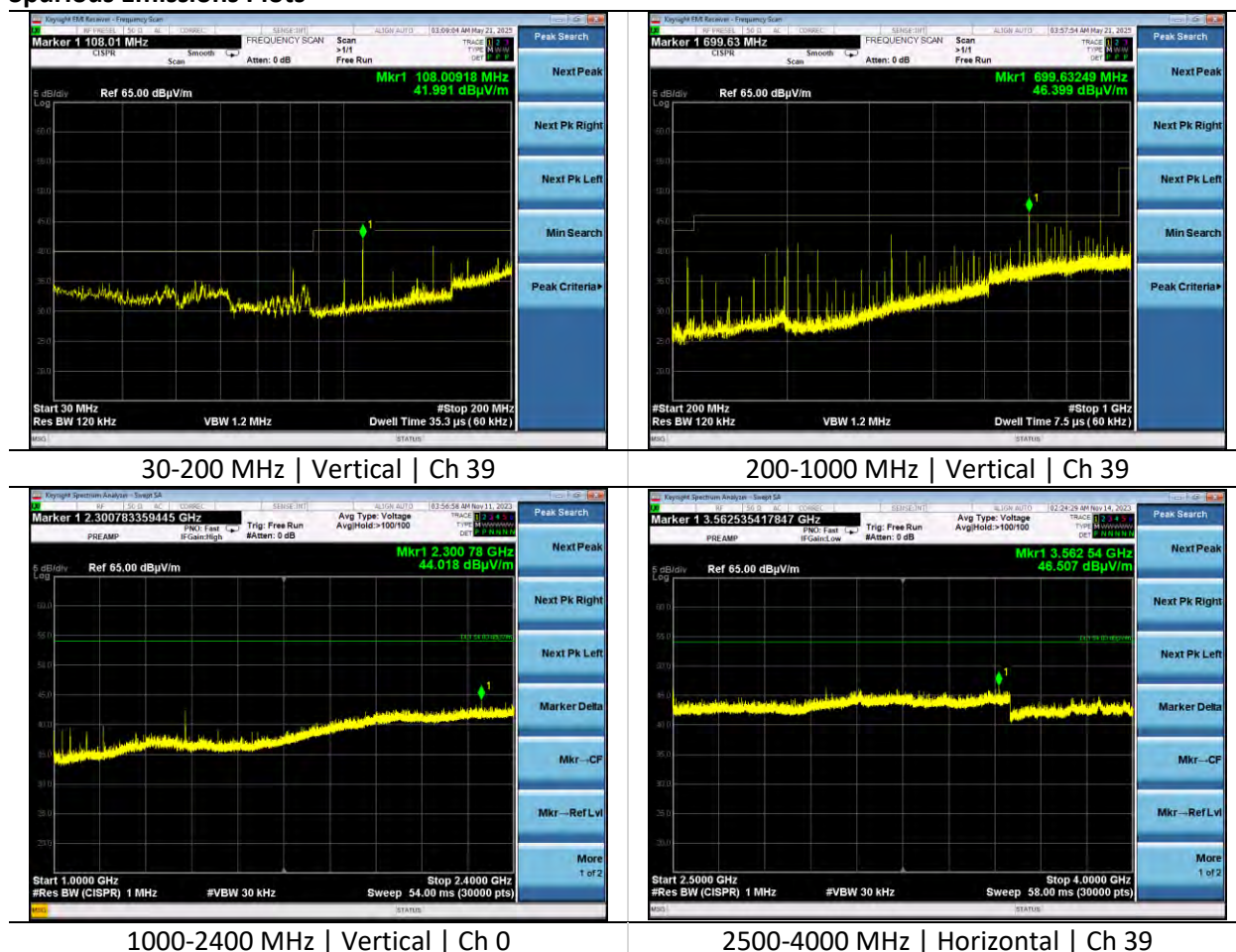
Screen captures at 30kHz VBW, Measurements taken with 3MHz VBW

Company: R. Stahl HMI Systems	Page 36 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

Spurious Emissions

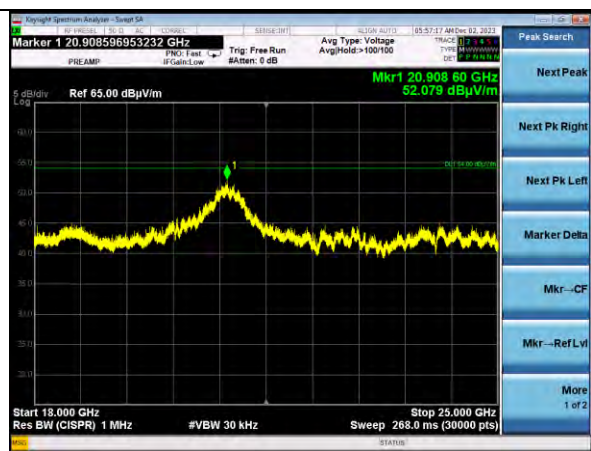
Frequency (MHz)	EUT orientation	Antenna Polarity	Calculated Average (dBμV/m)	Peak Reading (dBμV/m)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)	Average Margin (dB)	Peak Margin (dB)	Channel
4804.0	Y	H	23.5	53.6	54.0	74.0	30.5	20.4	0
4882.1	Y	H	18.9	49.0	54.0	74.0	35.1	25.0	39
4960.1	Y	H	17.9	48.0	54.0	74.0	36.1	26.0	78
4960.1	Y	V	18.4	48.5	54.0	74.0	35.6	25.5	78
4882.0	Y	V	21.2	51.3	54.0	74.0	32.8	22.7	39
4804.0	Y	V	25.4	55.5	54.0	74.0	28.6	18.5	0
4804.0	Z	V	24.3	54.4	54.0	74.0	29.7	19.6	0
4804.0	Z	H	26.9	57.0	54.0	74.0	27.1	17.0	0
4882.0	Z	H	22.7	52.8	54.0	74.0	31.3	21.2	39
4882.0	X	H	20.7	50.8	54.0	74.0	33.3	23.2	39
4882.1	X	V	23.0	53.1	54.0	74.0	31.0	20.9	39
4804.0	X	H	24.2	54.3	54.0	74.0	29.8	19.7	0

Spurious Emissions Plots





4-18 GHz | X | Vertical | Ch 0



All Orientations and polarities | scan at ~20cm |
Ch 39

Company: R. Stahl HMI Systems	Page 38 of 45	Name: Trex Device Communicator
Report: TR3747A		Model: TREX2-00NAW
Quote: NBO-04-2023-006145		Serial: EMC RF1, EMC RF2

5.2.2 Spurious Radiated Emissions – Spot Checks

Operator	Dylan Rosenfeldt	QA	Anthony Smith
Temperature	19.7°C	R.H. %	70.1%
Test Date	7/3/2025	Location	Chamber 3
Requirement	FCC: 15.247(d) ISED: RSS-GEN 8.10	Method	ANSI C63.10 6.6

15.209 Limits:

Frequency (MHz)	Quasi-Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-25000	-	54.0	74.0

Test Parameters

Frequency	30-25000 MHz	Distance	3m
Detector(s)	Peak, Trace/Final Quasi-Peak, Final	Table height	80 cm (<1GHz) 150 cm (>1GHz)
RBW	120kHz (<1GHz) 1MHz (>1GHz)	VBW	1.2MHz (<1GHz) 3MHz (>1GHz)
Notes	The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125 ms. DH5 Packet permit maximum $1600/79/6 = 3.37$ hops per second in each channel.		
Example Calculations	Reduced VBW averaging used for band edge emissions Avg VBW = 1/on-time Calculated Peak Average used for harmonics Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from the formula for DH5 packet type which has worst duty factor.		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	2/21/2025	2/21/2026	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/24/2025	1/24/2026	Active Verification
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/3/2025	4/3/2026	Active Calibration
AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	11/19/2024	11/19/2025	Active Calibration
AA 960220	Cable	A.H. Systems, Inc.	SAC-26G-6	552	1/28/2025	1/28/2026	Active Verification
AA 960209	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	037101808	11/19/2024	11/19/2025	Active Calibration
AA 960154	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-02	4/3/2025	4/3/2026	Active Calibration
AA 960174	Antenna - Small Horn	ETS Lindgren	3116C-PA	00206880	12/2/2024	12/2/2025	Active Calibration
AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	12/9/2024	12/9/2025	Active Calibration
AA 960163	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	500	12/11/2024	12/11/2025	Active Calibration

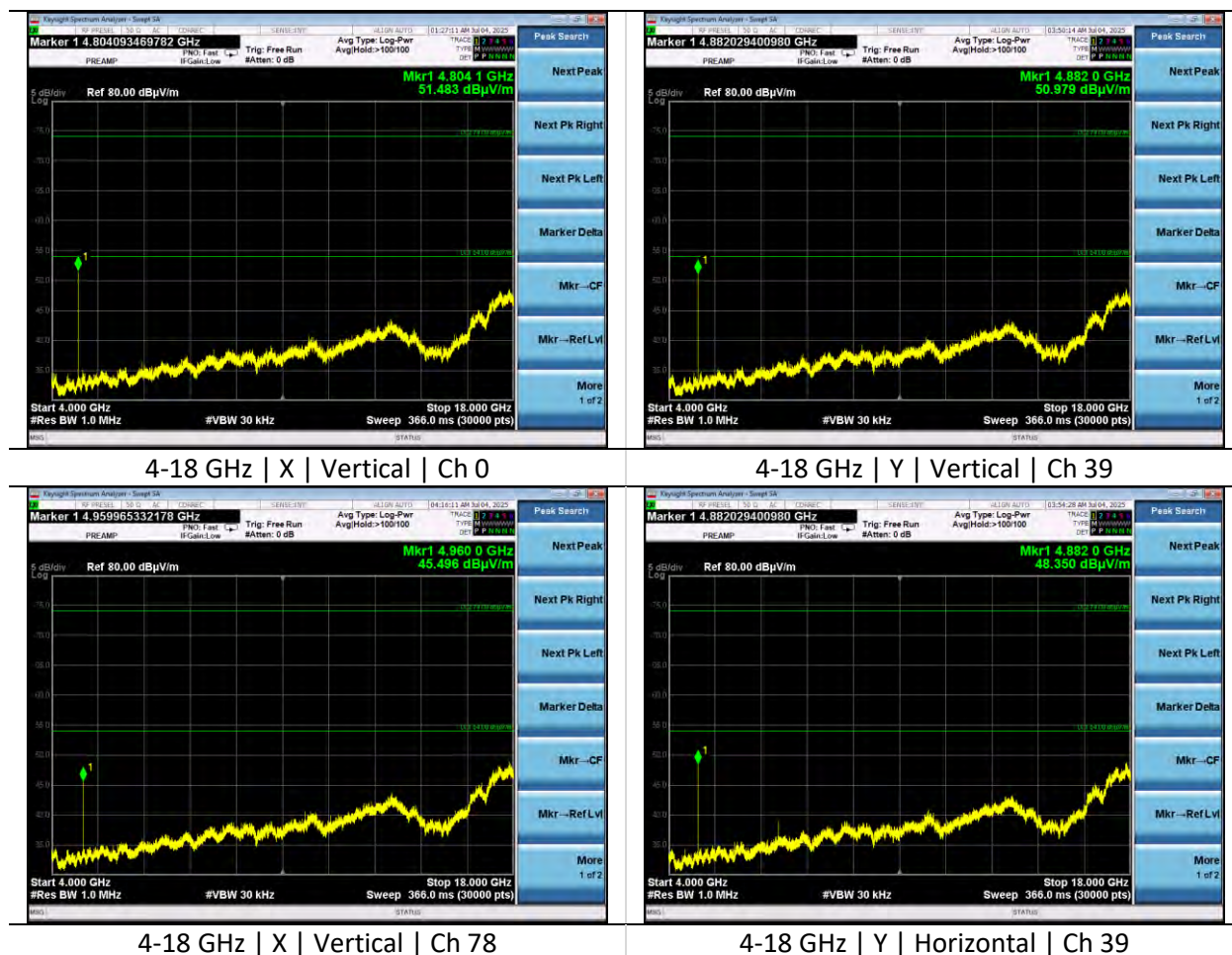
EUT Parameters

Input Power	15V Battery	Mode	Bluetooth TX
Frequency	2402MHz, 2441MHz, 2480MHz	Channel	0 (2402MHz), 39 (2441MHz), 78 (2480MHz)
Data Rates	DM5, 1DH5, 2DH5, 3DH5		

Spurious Emissions

Frequency (MHz)	EUT orientation	Antenna Polarity	Calculated Average (dBμV/m)	Peak Reading (dBμV/m)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)	Average Margin (dB)	Peak Margin (dB)	Channel
4803.7	X	H	21.3	51.4	54.0	74.0	32.7	22.6	0
4803.8	X	V	18.0	55.1	54.0	74.0	36.0	18.9	0
4804.3	Y	V	25.0	57.2	54.0	74.0	29.0	16.8	0
4803.7	Y	H	22.6	54.7	54.0	74.0	31.4	19.3	0
4804.4	Z	H	27.1	56.2	54.0	74.0	26.9	17.8	0
4804.4	Z	V	24.6	53.6	54.0	74.0	29.4	20.4	0
4882.2	Y	V	26.1	53.5	54.0	74.0	27.9	20.5	39
4882.2	Y	H	23.5	51.6	54.0	74.0	30.5	22.4	39
4881.6	X	V	23.4	50.9	54.0	74.0	30.6	23.1	39
4882.2	Z	H	21.5	53.6	54.0	74.0	32.5	20.4	39
4960.2	Y	V	20.8	49.7	54.0	74.0	33.2	24.3	78

Spurious Emissions Plots

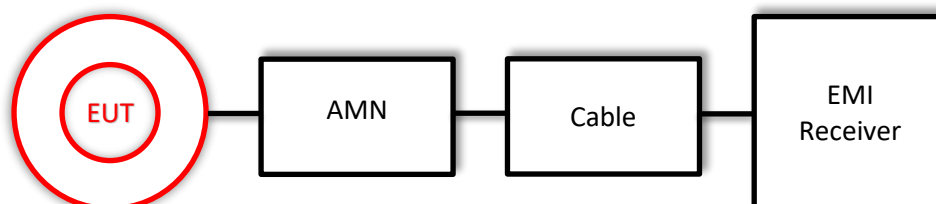


5.3 AC Mains Conducted Emissions

Description of Measurement	A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains. The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values. Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)
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Example Calculations	$\text{Measurement (dB}\mu\text{V)} + \text{Cable factor (dB)} + \text{Other (dB)} = \text{Corrected Reading (dB}\mu\text{V)}$ $\text{Margin (dB)} = \text{Limit (dB}\mu\text{V)} - \text{Corrected Reading (dB}\mu\text{V)}$
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Block Diagram



5.3.1 AC Mains Conducted Emissions

Operator	Dylan Rosenfeldt	QA	Adam Alger
Temperature	22.1°C	R.H. %	27.6%
Test Date	12/14/2023	Location	AC Conducted Emissions Bench
Requirement	FCC: 15.207 ISED: RSS-GEN 8.8	Method	ANSI C63.10 6.2

15.207 Limits:

Frequency (MHz)	Quasi-Peak (dBμV)	Average (dBμV)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

*Decreases with the logarithm of the frequency

Test Parameters

Frequency	0.150-30 MHz	Distance	40cm from VCP >80cm from LISN
Detector(s)	Peak – Trace Quasi-Peak – Final Average – Final	Table height	80cm
RBW	9kHz	VBW	62kHz

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
EE 960088	Analyzer - EMI Receiver	Agilent	N9038A	MY51210138	12/10/2024	12/10/2025	Active Calibration
EE 960162	LISN	COM-POWER	LI-215A	191969	3/31/2025	3/31/2026	Active Calibration
EE 960197	Meter - Hygro-Thermometer	Control Company	90080-03	180045461	12/17/2024	12/17/2025	Active Calibration
LSC-211	Cable	Micro-Coax	UFB311A-0-1440-70U70U	64639 224071-002	1/29/2025	1/29/2026	Active Verification

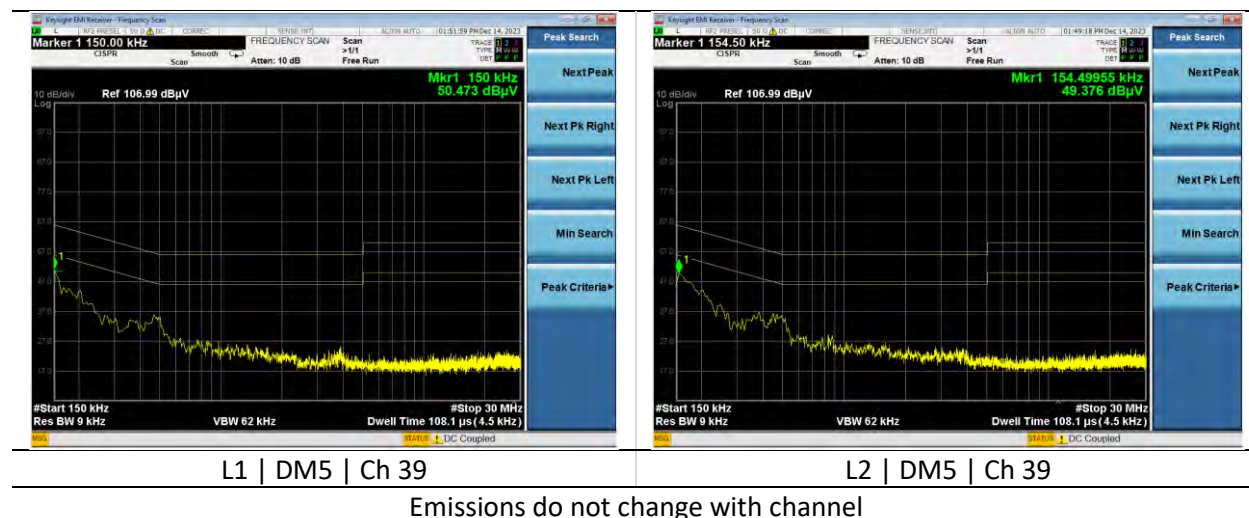
EUT Parameters

Input Power	15VDC battery charged on 120VAC adapter	Mode	Bluetooth Transmitting
EUT	Plugged in, charging		

Table

Line	Frequency (MHz)	Peak Reading (dBμV)	Quasi-Peak Reading (dBμV)	Average Reading (dBμV)	Quasi-Peak Limit (dBμV)	Average Limit (dBμV)	Quasi-Peak Margin (dB)	Average Margin (dB)
1	0.150	55.3	50.8	39.3	66.0	56.0	15.2	16.7
1	0.505	36.9	33.3	22.1	56.0	46.0	22.7	23.9
1	3.883	26.9	22.0	11.9	56.0	46.0	34.0	34.1
2	0.150	53.2	48.9	36.2	66.0	56.0	17.1	19.8
2	0.504	36.3	33.8	29.4	56.0	46.0	22.2	16.6
2	0.843	30.9	27.3	21.6	56.0	46.0	28.7	24.4

Plots



6 REVISION HISTORY

Version	Date	Notes	Person
0	7/30/2025	Initial Draft	Dylan Rosenfeldt
1	7/31/2025	Updated Draft	Dylan Rosenfeldt
2	7/31/2025	Final Draft	Dylan Rosenfeldt
3	8/6/2025	Updated Model Name	Dylan Rosenfeldt

END OF REPORT