Raute Corporation

TEST REPORT FOR

Veneer measurement system
Model: MVA3

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.256

Report No.: 106587-20

Date of issue: July 25, 2023

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust-based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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REPORT PREPARED BY:

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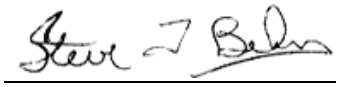
Dean Nelson - Raute Corporation
Karen Whipkey - F-Squared Laboratories
Customer Reference Number: 6105

Project Number: 106587

DATE OF EQUIPMENT RECEIPT: September 16, 2022
DATE(S) OF TESTING: September 16 and November 16, 2022 and June 20 and 21, 2023

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable, and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 North Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.256

Test Procedure	Description	Modifications	Results
15.215(c)	Occupied Bandwidth (-20dBc)	Mod. #1	Pass
15.256(f)(1), (2)	Fundamental Emission Bandwidth	NA	Pass**
15.256(g)(3)	Fundamental Emission (peak, ave)	NA	Pass**
15.256(h)	Unwanted Emission	Mod. #1	Pass
15.256(h)(i)(A)	Antenna Beamwidth	Mod. #1	Pass
15.256(j)	Antenna Side Lobe Gain	Mod. #1	Pass
15.207	AC Conducted Emissions	Mod. #1	Pass
15.215(c)	Frequency Stability	Mod. #1	Pass

NA = Not Applicable

** = Emission profile verified with modified unit Configuration 6; no variation was detected.

ISO/IEC 17025 Decision Rule
The equipment sample utilized for testing is selected by the manufacturer. The declaration of pass or fail herein is a binary statement for simple acceptance rule (ILAC G8) based upon assessment to the specification(s) listed above, without consideration of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
Modification #1: To comply with below 1GHz radiated emission limit, the PCB section is enclosed in metal enclosure, changed routing of RF cable, grounded SMA connector, and separated GND from the shield. (Configuration 6)

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 4

Equipment Tested:

Device	Manufacturer	Model #	S/N
Veneer measurement system	Raute Corporation	MVA3	004

Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Mean Well	MDR-60-24	TC1A061656

Configuration 6

Equipment Tested:

Device	Manufacturer	Model #	S/N
Veneer measurement system	Raute Corporation	MVA3	005

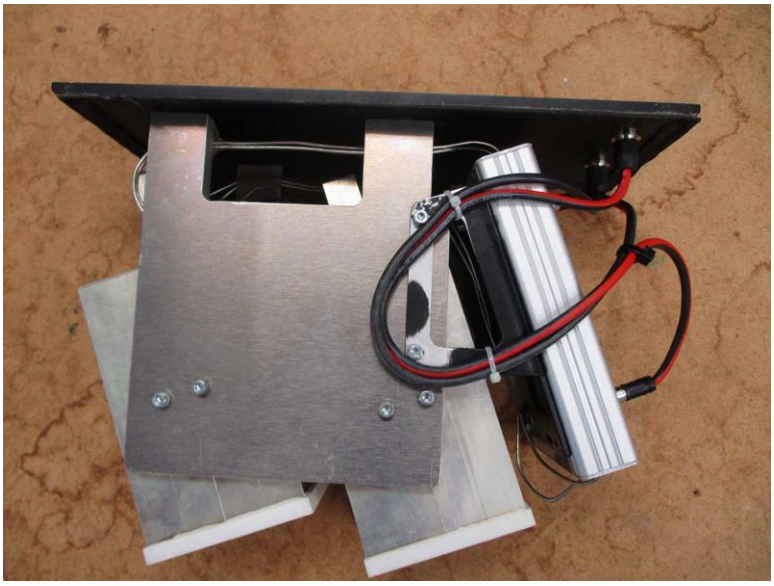
Support Equipment:

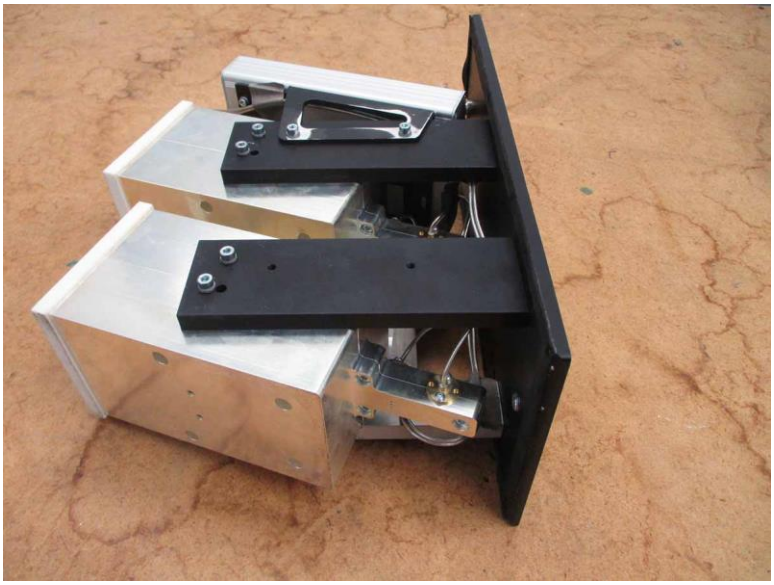
Device	Manufacturer	Model #	S/N
Power Supply	Phoenix Contact	Quint4	NA
EtherCat	Beckhoff	EK1100	NA
2 port EthrCat P Junction	Beckhoff	EK1322	NA

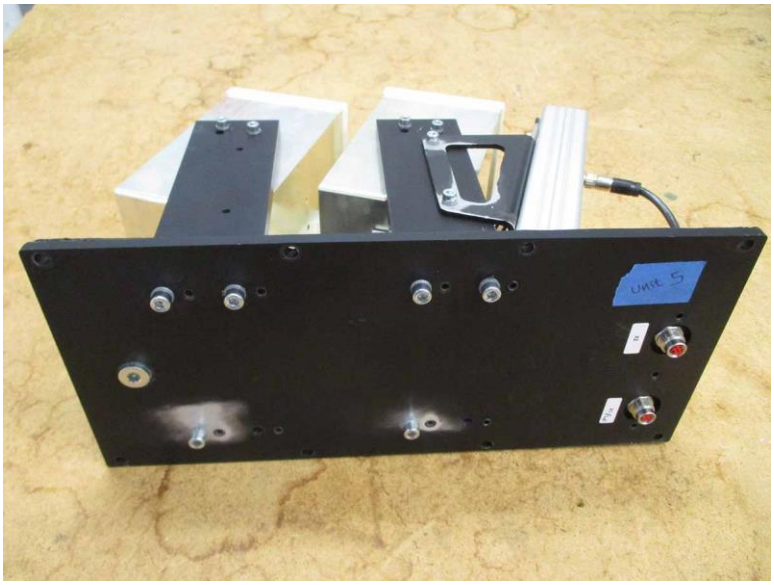
General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Modulation Type(s):	FMCW
Maximum Duty Cycle:	98%
Antenna Type(s) and Gain:	Integrated Horn
Antenna Connection Type:	Integral
Nominal Input Voltage:	24V DC
Firmware / Software used for Test:	Test mode V1.56 Test mode V1.56 CW
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

EUT and Accessory Photo(s)



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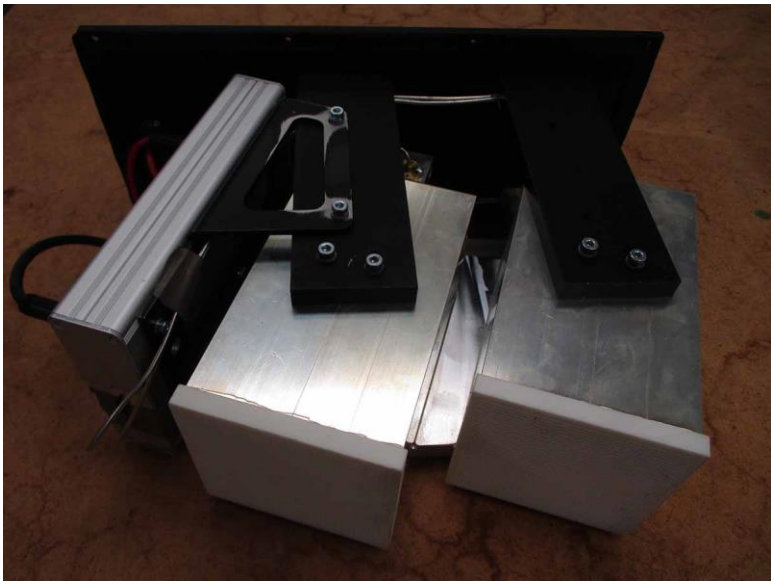
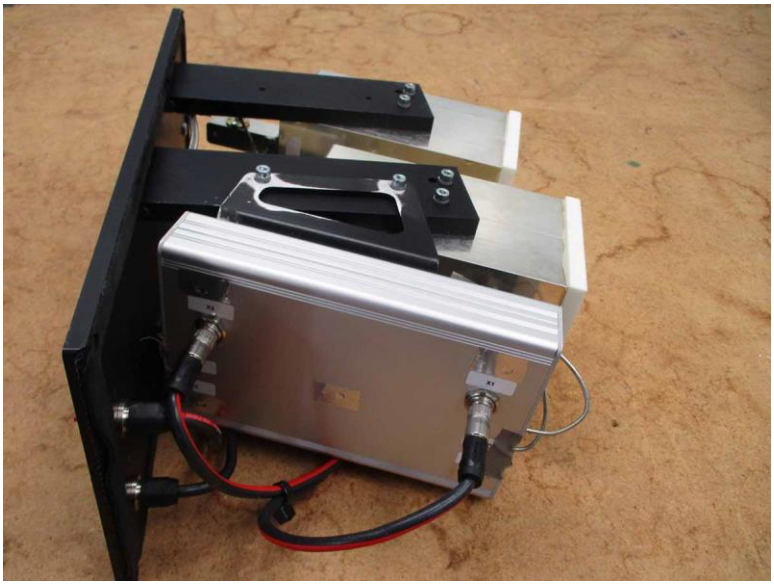
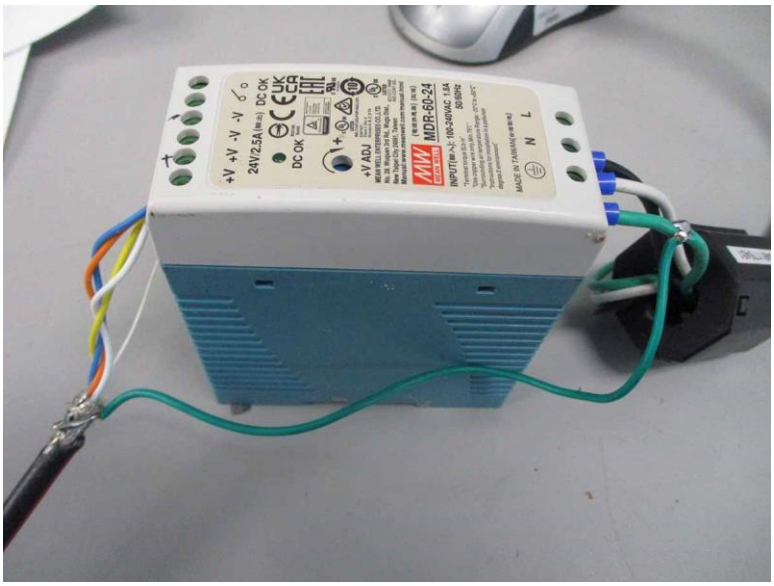


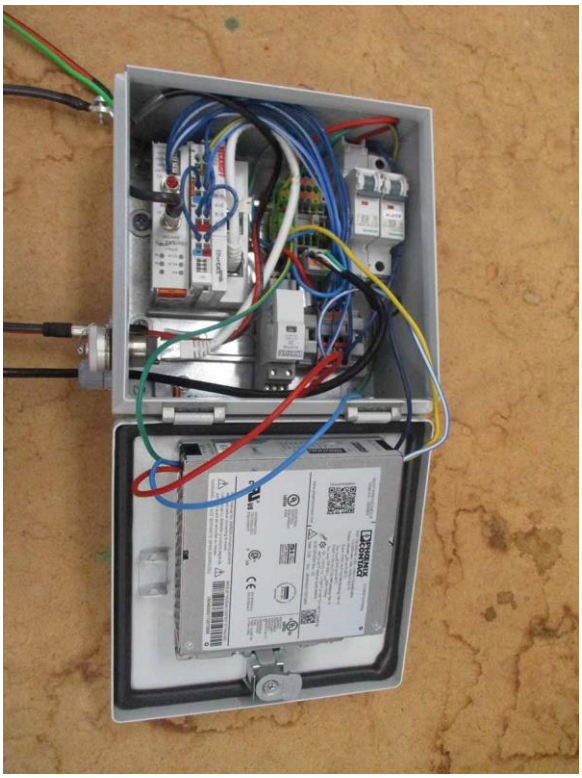


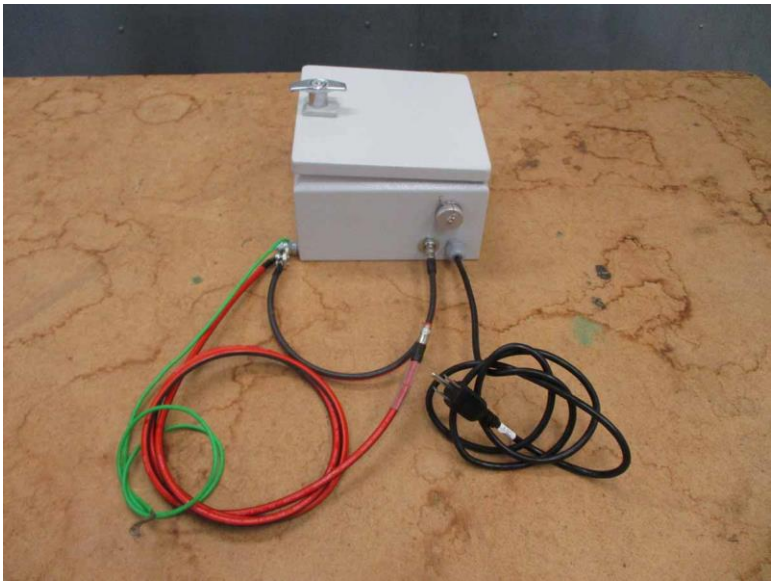
Support Equipment Photo(s)

Configuration 4

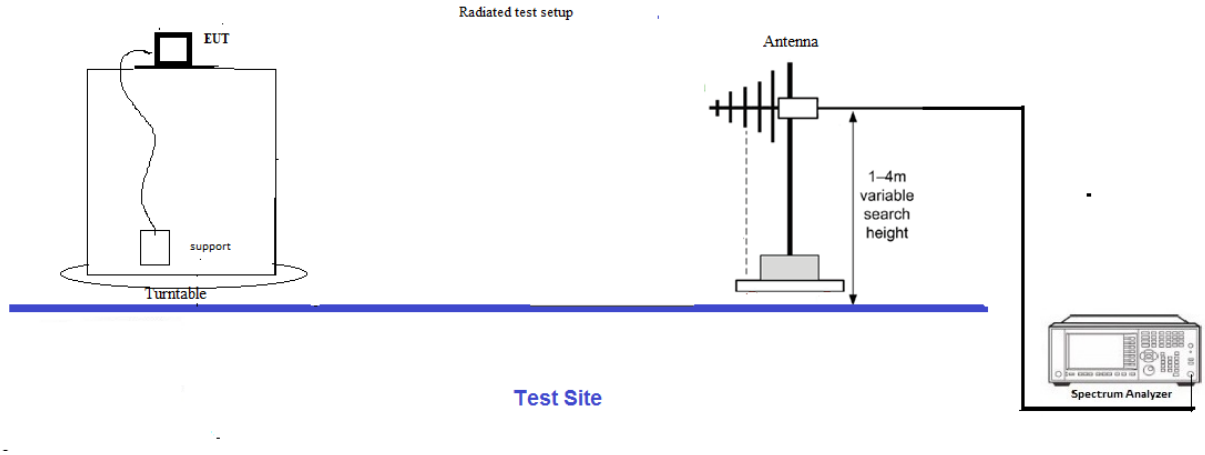


Configuration 6





Block Diagram of Test Setup(s)



FCC Part 15 Subpart C

15.215(c) Occupied Bandwidth (-20dBc)

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013)	Test Date(s):	6/20/2023
Configuration:	6		
Declaration:	**Modification #1 was in place during testing.**		

Environmental Conditions			
Temperature (ºC)	23	Relative Humidity (%):	60

Test Equipment

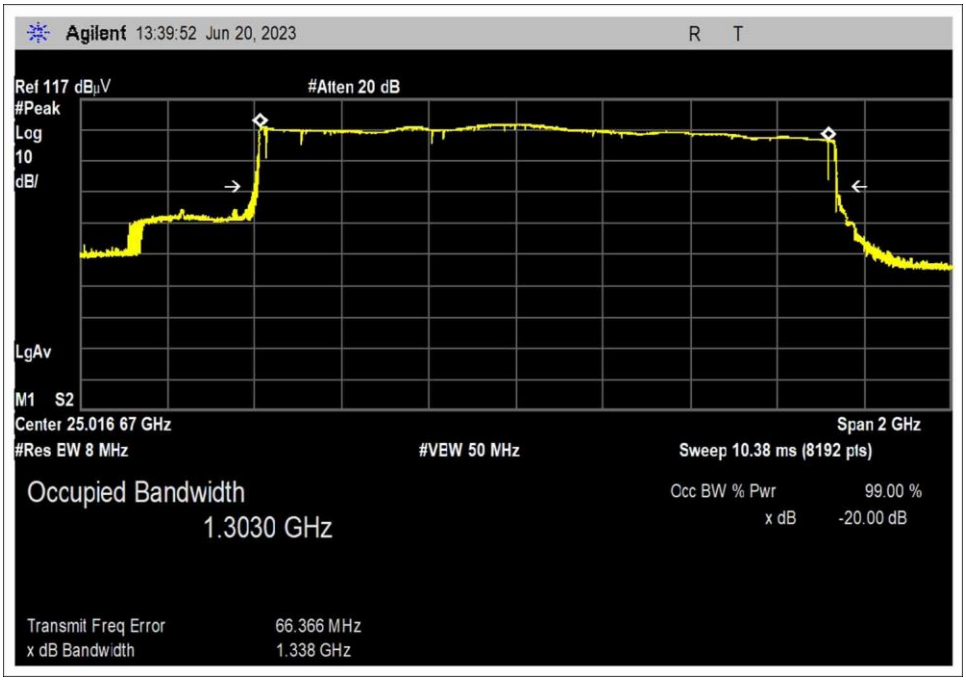
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
01413	Horn Antenna	HP	84125-80008	10/3/2022	10/3/2024
07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

Test Data Summary

Frequency (GHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
25. 122 267	1	FMCW	1 338 000	None	NA

Due to limitation of the test equipment, the occupied BW was not measured at RBW of >1% of the occupied BW.

Plot(s)


Agilent 13:39:52 Jun 20, 2023
R T
Ref 117 dBµV
#Atten 20 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 25.016 67 GHz
Span 2 GHz
#Res EW 8 MHz
#VEW 50 MHz
Sweep 10.38 ms (8192 pts)
Occupied Bandwidth
1.3030 GHz
Ccc BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error 66.366 MHz
x dB Bandwidth 1.338 GHz

Test Setup Photo(s)

1.5m; View 1

1.5m; View 2

Above 1GHz; View 1

Above 1GHz; View 2

15.256(f)(1), (2) Fundamental Emission Bandwidth

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013) KDB 890966 D01 Meas Level Probing Radar V01r01	Test Date(s):	9/16/2022
Configuration:	4 & 6 (6/21/23 for verification purpose)		

Environmental Conditions			
Temperature (ºC)	25	Relative Humidity (%):	68

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
01413	Horn Antenna	HP	84125-80008	10/3/2022	10/3/2024
07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

Test Data Summary					
Frequency L (MHz) -10dB	**Frequency H (MHz) -10dB**	**Modulation**	**Measured (MHz)**	**Limit (MHz)**	**Results**
24 463.221	25 781.313	FMCW	1 318.092	>50	Pass

*15.256(f)(1) The **minimum** fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.*

Test Data Summary					
Frequency (GHz)	**Antenna Port**	**Modulation**	**Measured (GHz) FL / FH**	**Limit (GHz) FL/FH**	**Results**
25. 122 267	1	FMCW	24. 463221/ 25. 781313	24.05-29.00	Pass

*15.256(f)(2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, **24.05-29.00 GHz**, and 75-85 GHz bands under all conditions of operation.*

Frequency Stability

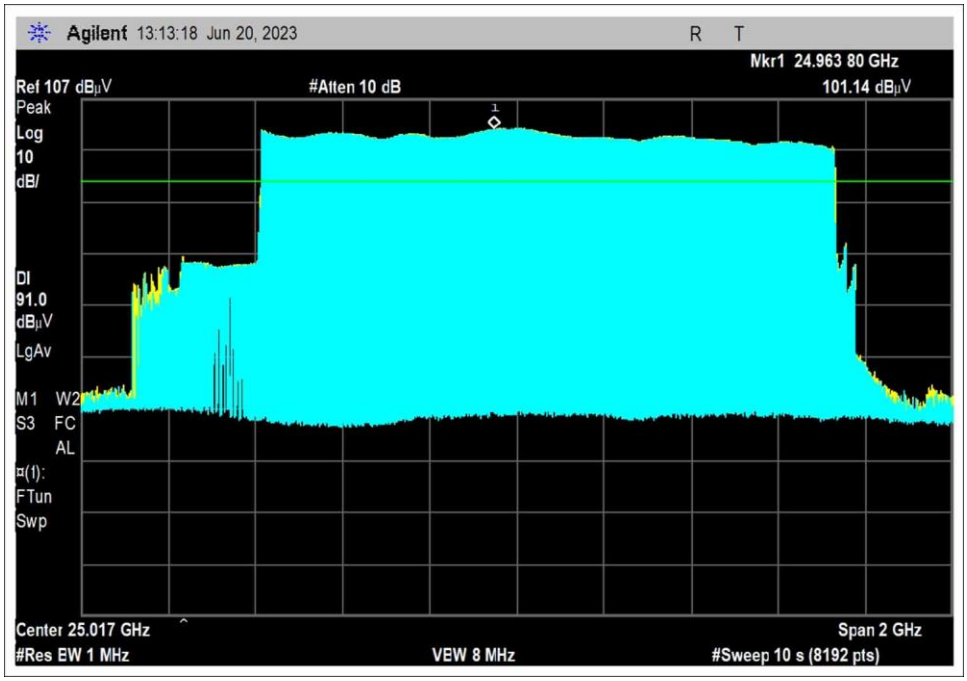
		Fl	Fh
		24.176352	25.822600
Temp (C)	Voltage		
-20	24	24.175429	25.823290
-10	24	24.175212	25.821990
0	24	24.175482	25.822100
10	24	24.175732	25.822400
20	24	24.176352	25.794580
30	24	24.176662	25.824630
40	24	24.177132	25.816290
50	24	24.177352	25.825450

Voltage Variations (±15%)

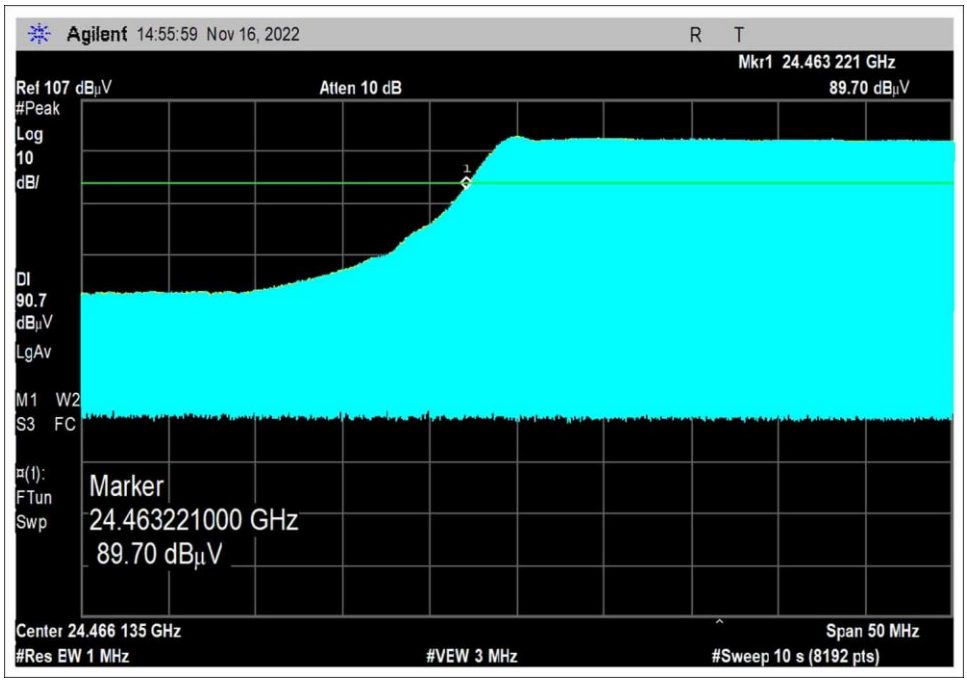
Temp (C)	Voltage		
-20	20.4	24.175429	25.823290
-20	24.0	24.175429	25.823290
-20	27.6	24.175429	25.823290
-10	20.4	24.175212	25.821990
-10	24.0	24.175212	25.821990
-10	27.6	24.175212	25.821990
0	20.4	24.175482	25.822100
0	24.0	24.175482	25.822100
0	27.6	24.175482	25.822100
10	20.4	24.175732	25.822400
10	24.0	24.175732	25.822400
10	27.6	24.175732	25.822400
20	20.4	24.168512	25.794580
20	24.0	24.168512	25.794580
20	27.6	24.168512	25.794580
30	20.4	24.176662	25.824630
30	24.0	24.176662	25.824630
30	27.6	24.176662	25.824630
40	20.4	24.177132	25.816290
40	24.0	24.177132	25.816290
40	27.6	24.177132	25.816290
50	20.4	24.177352	25.825450
50	24.0	24.177352	25.825450
50	27.6	24.177352	25.825450

FL and FL are frequency point at which the Fundamental emission crosses the 15.209 limit as measured/projected at Open Area Test Site. This limit is more stringent than the -10dB BW.

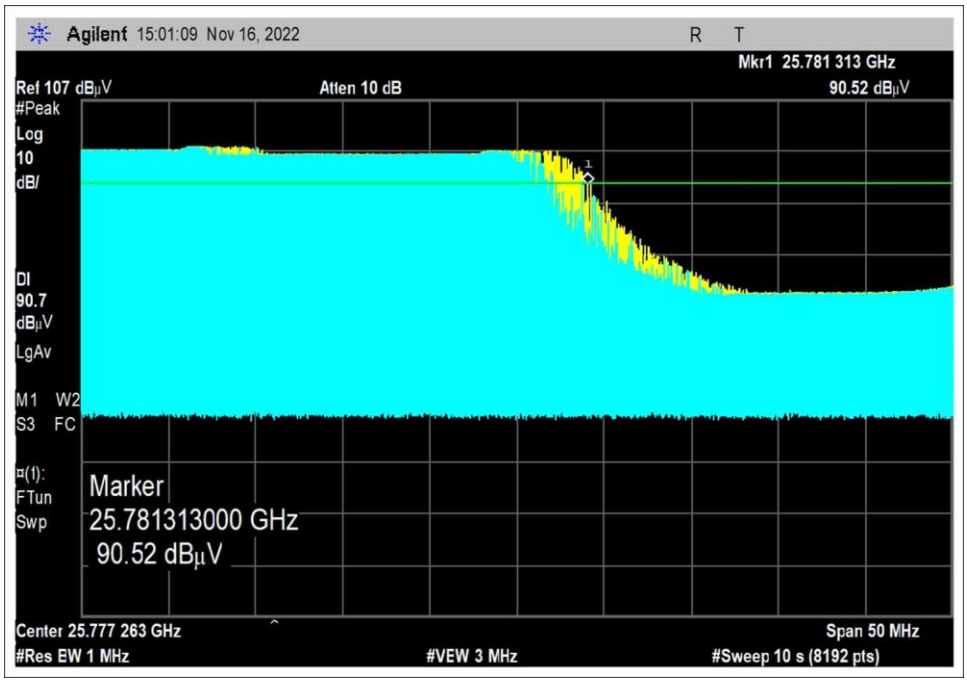
Plot(s)



2GHz Span



Low Channel



High Channel

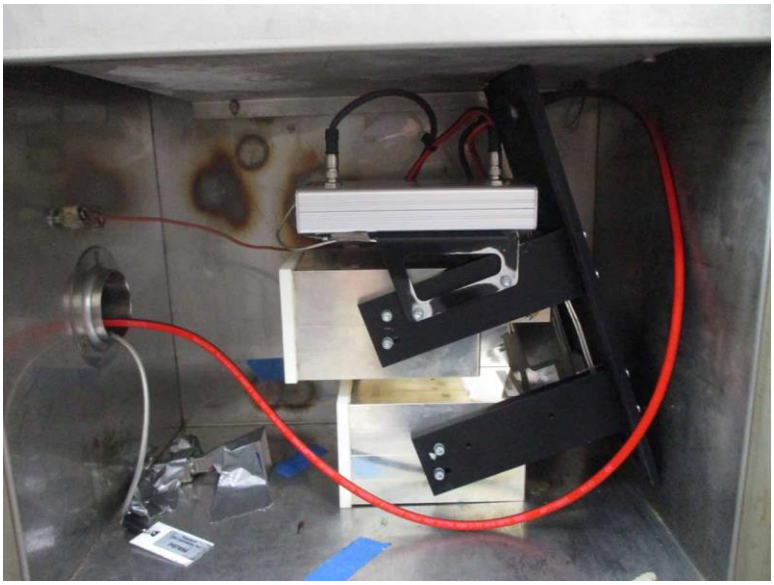
Test Setup Photo(s)

1.5m; View 1

1.5m; View 2

Above 1GHz; View 1

Above 1GHz; View 2



Frequency Stab; View 1

Frequency Stab; View 2

Frequency Stab; View 3

15.256(g)(3) Fundamental Emission

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013) KDB 890966 D01 Meas Level Probing Radar V01r01	Test Date(s):	11/16/2022
Configuration:	4 & 6 (6/21/23 for verification purpose)		

Environmental Conditions			
Temperature (ºC)	22	Relative Humidity (%):	27

Test Data Summary - Voltage Variations					
Frequency (GHz)	**Modulation / unit**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
25. 122 267	FMCW, Ave EIRP	-22.75	-22.75	-22.75	0
25. 122 267	FMCW, Peak EIRP	25.0	25.0	25.0	0

Test performed using operational mode with the highest output power, representing worst case.

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	24.0Vdc
$V_{Minimum}$:	20.4Vdc
$V_{Maximum}$:	27.6 Vdc

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
01413	Horn Antenna	HP	84125-80008	10/3/2022	10/3/2024
07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
01878	Temperature Chamber	Thermotron Corp.	S 1.2 Mini-Max	4/4/2023	4/4/2025
P07164	Multimeter	Fluke	8845A/G	8/13/2021	8/13/2023
05947	Thermometer	Fluke	51	5/19/2022	5/19/2024
01438	DC Power Supply	Topward	6306D	4/4/2023	4/4/2025

Test Data Summary – Radiated Field Strength Measurement					
Frequency (GHz)	**Modulation**	**Ant. Type**	**Measured Ave (EIRP in dBm)**	**Limit Ave (EIRP in dBm/1MHz)**	**Results**
25. 122 267	FMCW	Internal Horn	-22.75	≤ -14	Pass

Average factor calculation IAW Clause F 9 of KDB 890966 D01 Meas Level Probing Radar V01r01

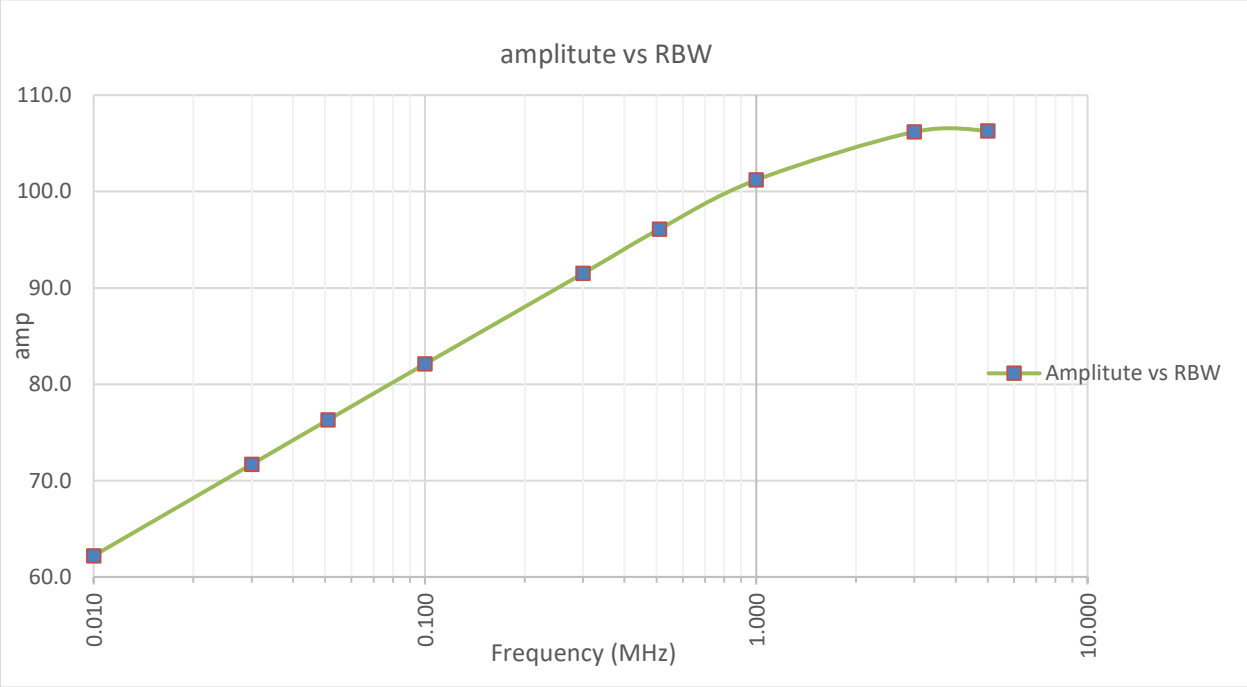
Per manufacturer declaration, firmware setting
V1.56 dwell ime Td = 400us/1500MHz.=0.2666us/MHz (Each channel has 200us sweep time Ts)
Cycle time Tcycle = 5ms
Averaging factor AF(dB) = Td/Tcycle = 10*log10(0.26/5000) = -42.8dB

Peak /1MHz = 115.3 dBuV/m@3m, RBW=1MHz.
Ave/1MHz = 115.3dBuV/m@3m – 42.8dB = 72.5dBuV/m@3m
EIRP (ave) = 72.5– 104.8+20Log3 = -22.8 dBm

Frequency (GHz)	Modulation	Ant. Type	Measured Peak (EIRP in dBm/50MHz)	Limit Peak (EIRP in dBm/50MHz)	Results
25. 122 267	FMCW	Internal Horn	25.0	≤ 26	Pass

KDB 890966 D01 V01r01, Clause 7 b: Radiated emission conversion: EIRP(dBm) = E(dBuV/m)-104.8+20LogD, Where E is the field strength at the far field distance D

*Measured emission in field strength level is 120.3.0dBuV/m@3m with RBW set at **3MHz.**
This measurement is narrow band as increase in amplitude measurement with various RBW were made, the amplitude increase as theoretically predicted for measurement made with RBW <3MHz. For RBW beyond 3MHz, the measured amplitude does not increase hence, no correction factor is necessary to comply with emission limit of 50MHz.



EIRP(dBm) = 120.3-104.8+20 Log 3 = 25.0dBm Peak

Frequency Range (GHz)	Average Emission Limit (EIRP in dBm measured in 1MHz)	Peak Emission Limit (EIRP in dBm measured in 50MHz)
5.925.7-7.250	-33	7
24.05-29.00	-14	26
75.85	-3	34

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.256 Radiated Emissions_Peak/50MHz**		
Work Order #:	**106587**	Date:	6/20/2023
Test Type:	**Radiated Scan**	Time:	14:26:35
Tested By:	E. Wong	Sequence#:	31
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 4			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 4			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: Fundamental
1000 MHz-100 000 MHz;RBW=1 MHz,VBW=1 MHz.

Test Environment Conditions:
Temperature: 28°C
Relative Humidity: 62%
Pressure: 99kPa

KDB 890966 D01 Meas Level Probing Radar v01r01

Site D
Test Method: ANSI C63.10 (2013)

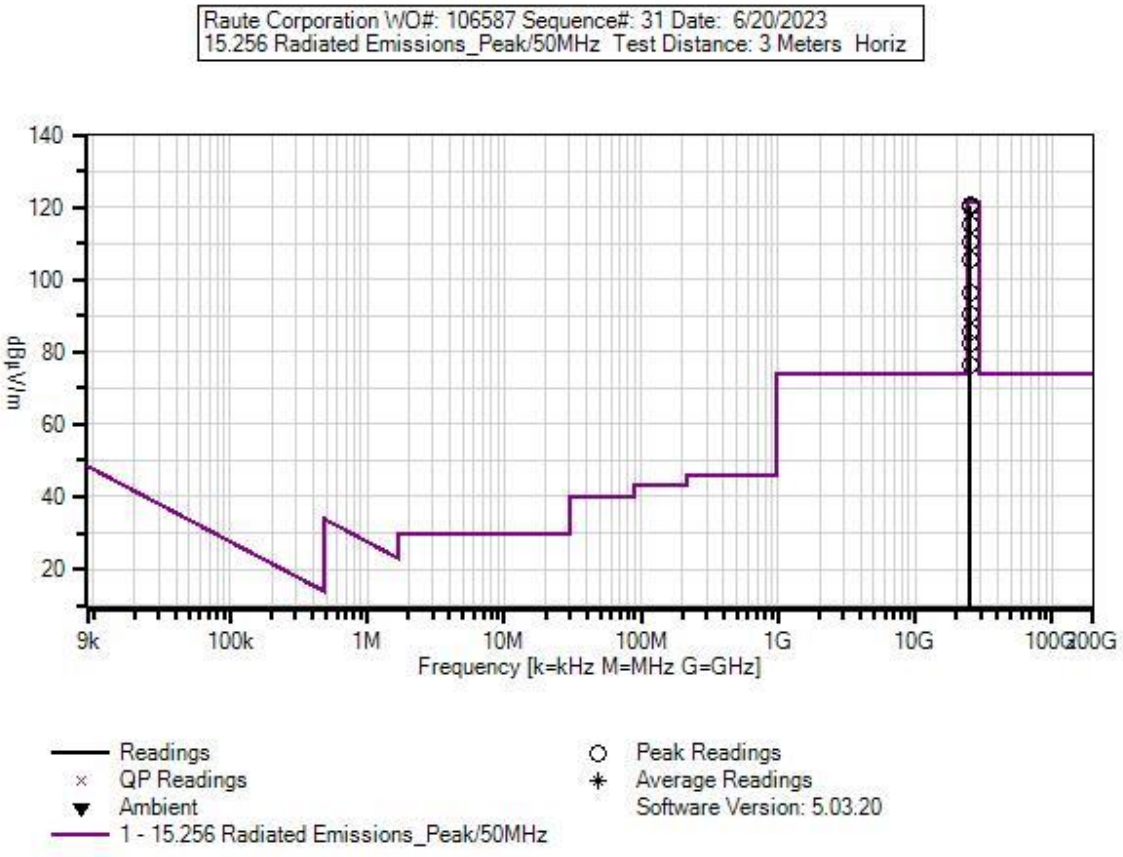
For LPRs that employ frequency-modulated continuous wave (FMCW), frequency hopping or stepped frequency modulation, the fundamental emission bandwidth, the maximum average power level in 1 MHz, the peak power level in 50 MHz and the level of unwanted emissions shall be made with the FMCW, frequency hopping or step function active.

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT evaluated without enclosure.

Limit is 26dBm/50MHz, peak
dBuV 50MHz/m@3m =26dBm/ 50MHz +104.8-20Log 3 = 121.3dBuV/m@3m. Reported field strength of fundamental is measured with RBW=3MHz. No BW adjustment applied to limit.

Emission profile of the EUT rotated along three orthogonal axis was investigated. Both Vertical Horizontal orientation of receiving antenna investigated. Recorded data represent worse case emission.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T2	AN01413	Horn Antenna	84125-80008	10/3/2022	10/3/2024
T3	ANP07657	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	AN00787	Preamp	83017A	6/23/2021	6/23/2023
T5	ANP07655	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T6	ANP07656	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T7	ANP07660	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T8	ANP07659	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	AN03158A	Horn Antenna	GH-28-25	8/10/2021	8/10/2023
	AN01646	Horn Antenna	3115	3/21/2022	3/21/2024
	AN03367	Horn Antenna	62-GH-62-25.	8/3/2021	8/3/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	25025.860 M	106.3	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	120.4	121.3 RBW=5MHz	-0.9	Vert
2	25025.860 M	106.2	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	120.3	121.3 RBW=3MHz_Fundamental	-1.0	Vert
3	25029.280 M	101.2	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	115.3	121.3 RBW=1MHz	-6.0	Vert
4	24977.410 M	101.1	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.4 +1.5	+0.0	115.3	121.3 RBW=1MHz_062023_config6	-6.0	Vert
5	25026.830 M	96.1	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	110.2	121.3 RBW=510kHz	-11.1	Vert
6	25028.790 M	91.5	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	105.6	121.3 RBW=300kHz	-15.7	Vert
7	25028.060 M	82.1	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	96.2	121.3 RBW=100kHz	-25.1	Vert
8	25026.590 M	76.3	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	90.4	121.3 RBW=51kHz	-30.9	Vert
9	25027.810 M	71.7	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	85.8	121.3 RBW=30kHz	-35.5	Vert
10	25028.510 M	68.2	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	82.3	121.3 RBW=1MHz_062023_config6	-39.0	Horiz
11	25049.300 M	62.2	+0.0 +1.7	+40.5 +1.5	+1.7 +1.7	-34.5 +1.5	+0.0	76.3	121.3 RBW=10kHz	-45.0	Vert

Test Setup Photo(s)

1.5m; View 1

1.5m; View 2

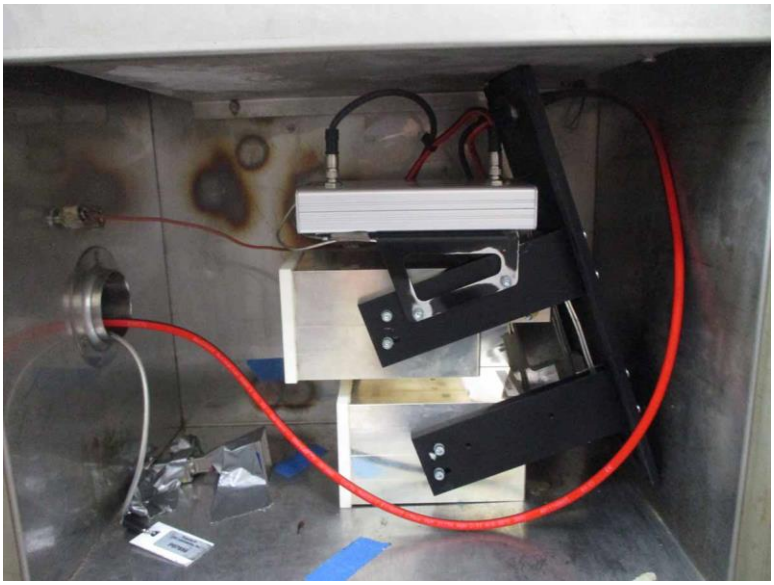
Above 1GHz; View 1

Above 1GHz; View 2

X-Axis

Y-Axis

Z-Axis



Frequency Stab; View 1

Frequency Stab; View 2

Frequency Stab; View 3

15.256(h) Unwanted Emissions

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013) KDB 890966 D01 Meas Level Probing Radar V01r01	Test Date(s):	11/16/2022
Configuration:	4 & 6 (6/21/23 for verification purpose)		
Declaration:	**Modification #1 was in place during testing.**		

Environmental Conditions			
Temperature (ºC)	28	Relative Humidity (%):	62

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112
Customer: **Raute Corporation**
Specification: **15.256 Radiated Emissions**
Work Order #: **106587** Date: 6/20/2023
Test Type: **Maximized Emissions** Time: 10:17:42
Tested By: E. Wong Sequence#: 28
Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 9kHz-1000MHz
9 kH -150 kHz;RBW=200 Hz,VBW=600 Hz;
150 kHz-30 MHz;RBW=9 kHz,VBW=27 kHz;
30 MHz-1000 MHz;RBW=120 kHz,VBW=360 kHz,

There were no emissions found within 20dB of the limit line in the frequency range of 9kHz to 30MHz.

Test Environment Conditions:
Temperature: 21°C
Humidity: 63%
Pressure: 99kPa

Emission profile of the EUT rotated along three orthogonal axis was investigated. Recorded data represent worse case emission.

Site D

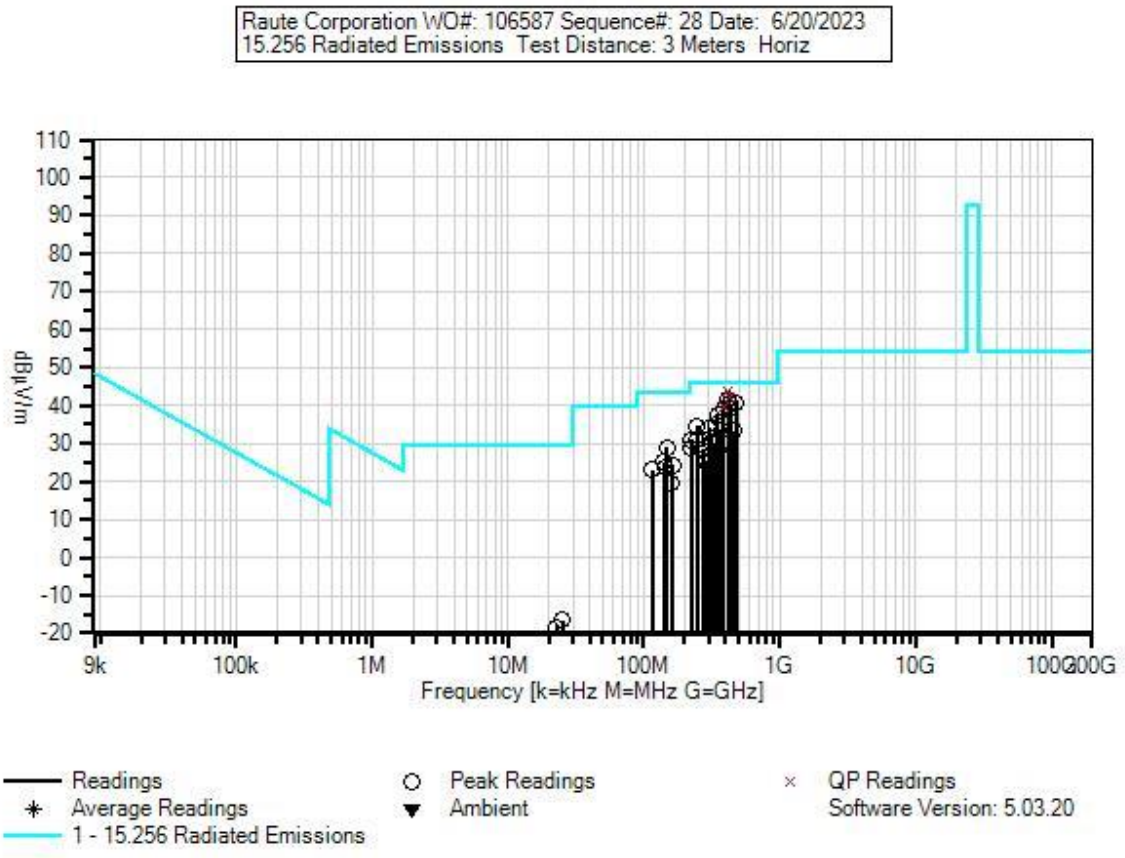
Test Method: ANSI C63.10 (2013)

KDB 890966 D01 Meas Level Probing Radar v01r01

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	AN01994	Biconilog Antenna	CBL6111C	6/1/2022	6/1/2024
T2	ANP05569	Cable-Amplitude +15C to +45C (dB)	RG-214/U	12/31/2022	12/31/2024
T3	ANP04382	Cable	LDF-50	5/18/2022	5/18/2024
T4	AN00010	Preamp	8447D	1/3/2022	1/3/2024
T5	ANP06978	Cable	Sucoflex 104A	3/4/2022	3/4/2024
T6	AN00314	Loop Antenna	6502	3/29/2022	3/29/2024

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	416.017M QP	43.6	+22.6 +0.3	+2.3 +0.0	+2.3	-27.4	+0.0	43.7	46.0	-2.3	Horiz
^	416.017M	44.7	+22.6 +0.3	+2.3 +0.0	+2.3	-27.4	+0.0	44.8	46.0	-1.2	Horiz
3	423.275M QP	41.9	+22.7 +0.3	+2.3 +0.0	+2.3	-27.5	+0.0	42.0	46.0	-4.0	Horiz
^	423.275M	43.6	+22.7 +0.3	+2.3 +0.0	+2.3	-27.5	+0.0	43.7	46.0	-2.3	Horiz
5	417.330M	41.6	+22.7 +0.3	+2.3 +0.0	+2.3	-27.4	+0.0	41.8	46.0	-4.2	Vert
6	476.580M	39.4	+23.6 +0.3	+2.5 +0.0	+2.5	-27.8	+0.0	40.5	46.0	-5.5	Vert
7	431.750M	40.4	+22.5 +0.3	+2.4 +0.0	+2.4	-27.6	+0.0	40.4	46.0	-5.6	Vert
8	385.767M QP	40.8	+21.1 +0.3	+2.2 +0.0	+2.2	-27.2	+0.0	39.4	46.0	-6.6	Vert
^	385.767M	41.6	+21.1 +0.3	+2.2 +0.0	+2.2	-27.2	+0.0	40.2	46.0	-5.8	Vert
10	424.597M	38.8	+22.7 +0.3	+2.4 +0.0	+2.4	-27.5	+0.0	39.1	46.0	-6.9	Vert
11	384.670M	40.3	+21.1 +0.3	+2.2 +0.0	+2.2	-27.2	+0.0	38.9	46.0	-7.1	Horiz
12	345.900M	40.1	+20.2 +0.2	+2.1 +0.0	+2.1	-26.9	+0.0	37.8	46.0	-8.2	Horiz
13	341.030M	37.5	+20.0 +0.2	+2.1 +0.0	+2.1	-26.8	+0.0	35.1	46.0	-10.9	Vert
14	247.977M	39.2	+18.2 +0.2	+1.7 +0.0	+1.9	-26.5	+0.0	34.7	46.0	-11.3	Vert
15	300.013M	37.4	+19.1 +0.2	+1.9 +0.0	+2.0	-26.5	+0.0	34.1	46.0	-11.9	Vert
16	370.160M	35.5	+20.7 +0.2	+2.2 +0.0	+2.2	-27.1	+0.0	33.7	46.0	-12.3	Vert
17	461.940M	32.9	+23.0 +0.3	+2.4 +0.0	+2.4	-27.7	+0.0	33.3	46.0	-12.7	Horiz
18	148.715M	36.2	+16.9 +0.2	+1.2 +0.0	+1.3	-26.9	+0.0	28.9	43.5	-14.6	Vert
19	308.420M	34.7	+19.2 +0.2	+1.9 +0.0	+2.0	-26.6	+0.0	31.4	46.0	-14.6	Horiz
20	246.683M	35.8	+18.0 +0.2	+1.7 +0.0	+1.9	-26.5	+0.0	31.1	46.0	-14.9	Horiz
21	223.783M	38.5	+15.5 +0.2	+1.6 +0.0	+1.8	-26.6	+0.0	31.0	46.0	-15.0	Horiz
22	319.980M	32.9	+19.4 +0.2	+2.0 +0.0	+2.0	-26.7	+0.0	29.8	46.0	-16.2	Vert
23	223.745M	36.4	+15.5 +0.2	+1.6 +0.0	+1.8	-26.6	+0.0	28.9	46.0	-17.1	Vert

24	270.950M	31.9	+19.1 +0.2	+1.8 +0.0	+1.9	-26.5	+0.0	28.4	46.0	-17.6	Vert
25	355.570M	30.3	+20.5 +0.2	+2.1 +0.0	+2.1	-26.9	+0.0	28.3	46.0	-17.7	Horiz
26	141.485M	32.1	+17.2 +0.2	+1.2 +0.0	+1.3	-26.9	+0.0	25.1	43.5	-18.4	Vert
27	163.281M	32.2	+16.1 +0.2	+1.3 +0.0	+1.4	-26.8	+0.0	24.4	43.5	-19.1	Vert
28	278.180M	30.1	+18.7 +0.2	+1.8 +0.0	+2.0	-26.5	+0.0	26.3	46.0	-19.7	Horiz
29	142.658M	30.8	+17.2 +0.2	+1.2 +0.0	+1.3	-26.9	+0.0	23.8	43.5	-19.7	Horiz
30	115.733M	30.5	+17.1 +0.1	+1.1 +0.0	+1.2	-27.0	+0.0	23.0	43.5	-20.5	Vert
31	285.450M	29.2	+18.7 +0.2	+1.8 +0.0	+2.0	-26.5	+0.0	25.4	46.0	-20.6	Horiz
32	159.650M	27.2	+16.3 +0.2	+1.3 +0.0	+1.4	-26.9	+0.0	19.5	43.5	-24.0	Horiz
33	25.020M	16.0	+0.0 +0.0	+0.5 +6.2	+0.7	+0.0	-40.0	-16.6	29.5	-46.1	Paral
34	22.840M	13.1	+0.0 +0.0	+0.5 +7.4	+0.7	+0.0	-40.0	-18.3	29.5	-47.8	Paral

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.256 Radiated Emissions**		
Work Order #:	**106587**	Date:	6/20/2023
Test Type:	**Maximized Emissions**	Time:	10:49:27
Tested By:	E. Wong	Sequence#:	29
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 1000-18000MHz
1000 MHz-18000 MHz;RBW=1MHz,VBW=3 MHz.

Test Environment Conditions:
Temperature: 21°C
Humidity: 63%
Pressure: 99kPa

Emission profile of the EUT rotated along three orthogonal axis was investigated. Recorded data represent worse case emission.

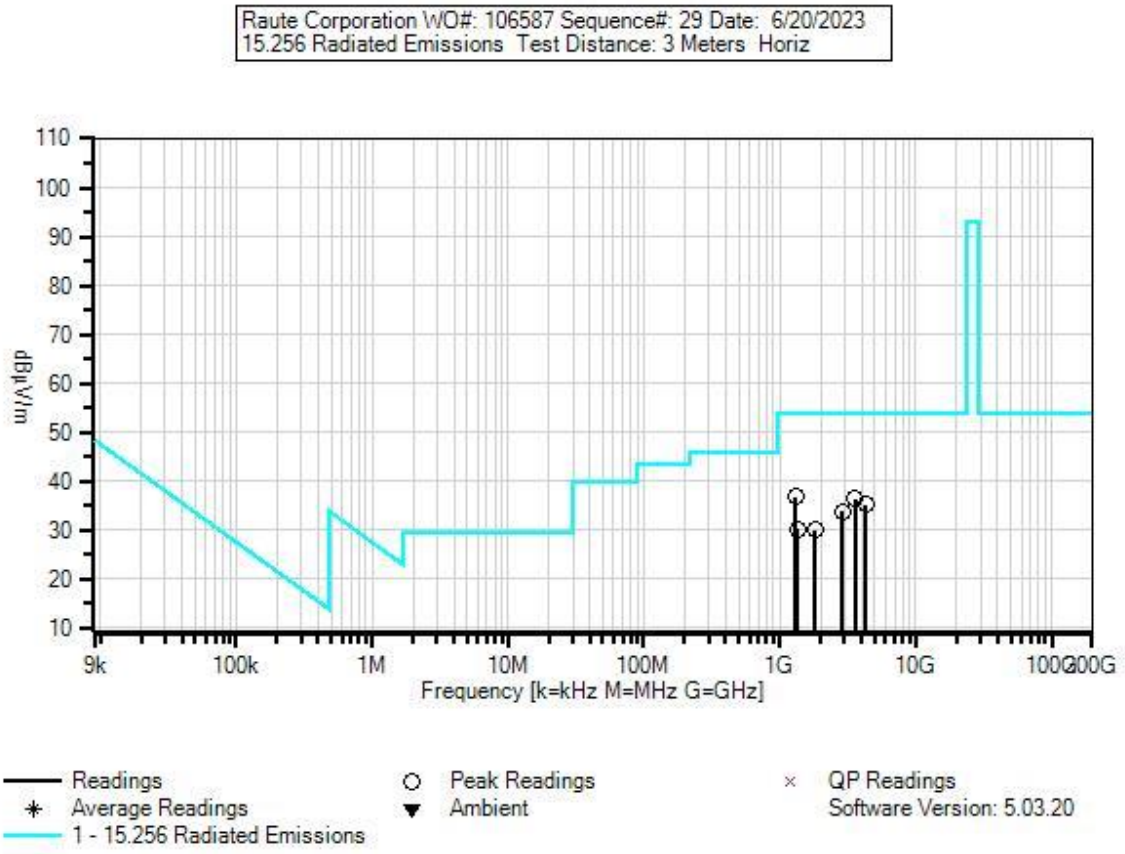
Site D
Test Method: ANSI C63.10 (2013)

KDB 890966 D01 Meas Level Probing Radar v01r01

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	AN01646	Horn Antenna	3115	3/21/2022	3/21/2024
T2	ANP07657	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T3	AN00787	Preamp	83017A	6/23/2021	6/23/2023
T4	ANP07691	Cable	LDF1-50	9/9/2022	9/9/2024
T5	ANP04382	Cable	LDF-50	5/18/2022	5/18/2024
	AN03367	Horn Antenna	62-GH-62-25.	8/3/2021	8/3/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1300.330M	43.9	+25.5 +4.2	+0.3	-39.7	+2.6	+0.0	36.8	54.0	-17.2	Vert
2	3575.000M	32.4	+31.3 +7.2	+0.5	-39.4	+4.5	+0.0	36.5	54.0	-17.5	Horiz
3	4310.000M	29.2	+32.1 +7.8	+0.6	-39.4	+4.9	+0.0	35.2	54.0	-18.8	Horiz
4	2912.500M	32.6	+29.7 +6.3	+0.5	-39.3	+4.0	+0.0	33.8	54.0	-20.2	Horiz
5	1355.000M	37.0	+25.6 +4.3	+0.3	-39.6	+2.7	+0.0	30.3	54.0	-23.7	Horiz
6	1827.500M	33.5	+27.1 +5.0	+0.4	-39.1	+3.1	+0.0	30.0	54.0	-24.0	Horiz

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.256 Radiated Emissions**		
Work Order #:	**106587**	Date:	6/20/2023
Test Type:	**Maximized Emissions**	Time:	14:40:13
Tested By:	E. Wong	Sequence#:	30
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 18-24GHz, 25-40GHz
18 000 MHz-40 0000 MHz;RBW=1MHz,VBW=3 MHz

Test Environment Conditions:
Temperature: 21°C
Humidity: 63%
Pressure: 99kPa

Emission profile of the EUT rotated along three orthogonal axis was investigated. Recorded data represent worse case emission.

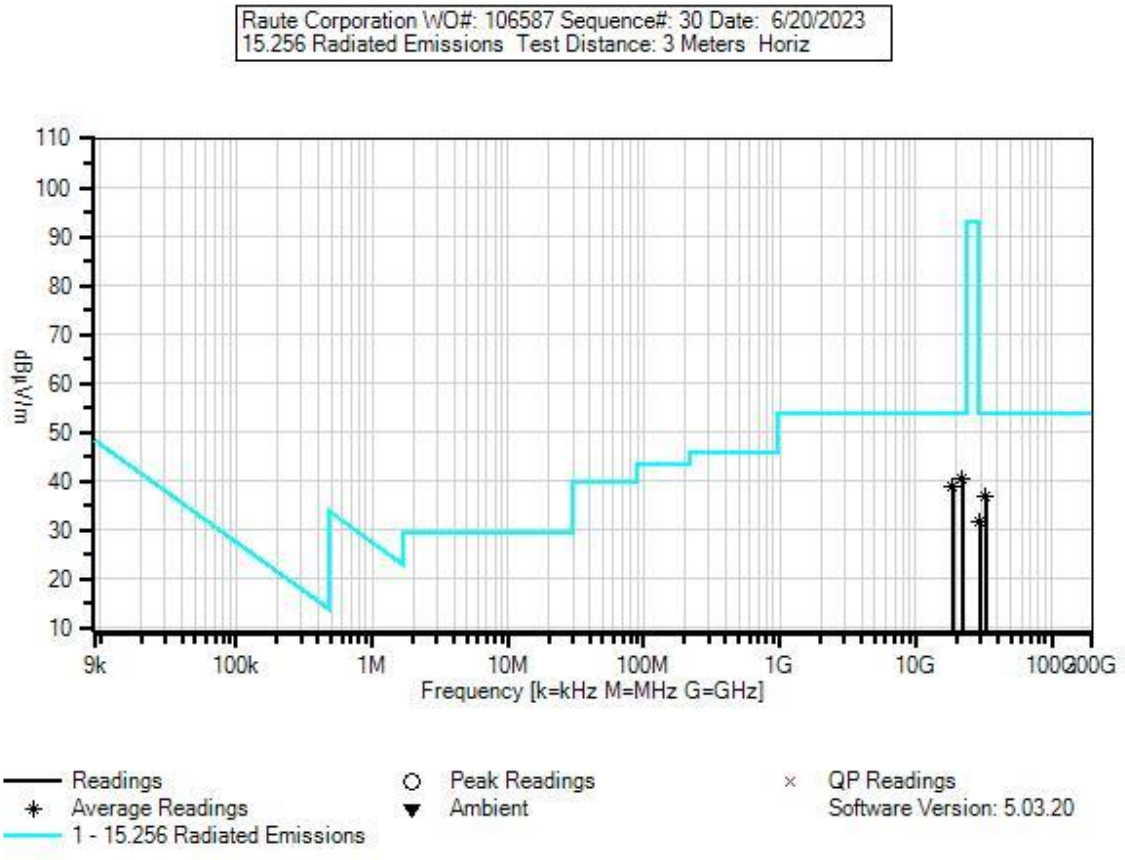
Site D
Test Method: ANSI C63.10 (2013)

KDB 890966 D01 Meas Level Probing Radar v01r01

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T2	AN01413	Horn Antenna	84125-80008	10/3/2022	10/3/2024
T3	ANP07657	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	AN00787	Preamp	83017A	6/23/2021	6/23/2023
T5	ANP07656	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T6	ANP07655	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T7	ANP07659	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T8	ANP07660	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T9	AN03158A	Horn Antenna	GH-28-25	8/10/2021	8/10/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	22000.000 M Ave	28.1	+0.0 +1.3 +0.0	+40.4 +1.5	+1.6 +1.4	-35.2 +1.5	+0.0	40.6	54.0	-13.4	Vert
^	22000.000 M	29.7	+0.0 +1.3 +0.0	+40.4 +1.5	+1.6 +1.4	-35.2 +1.5	+0.0	42.2	54.0	-11.8	Vert
3	18600.000 M Ave	27.7	+0.0 +1.4 +0.0	+40.2 +1.4	+1.4 +1.5	-36.1 +1.4	+0.0	38.9	54.0	-15.1	Vert
^	18600.000 M	40.4	+0.0 +1.4 +0.0	+40.2 +1.4	+1.4 +1.5	-36.1 +1.4	+0.0	51.6	54.0	-2.4	Vert
5	33000.000 M Ave	25.2	+0.0 +1.8 +4.3	+0.0 +2.0	+0.0 +1.8	+0.0 +1.9	+0.0	37.0	54.0	-17.0	Horiz
^	33000.000 M	31.2	+0.0 +1.8 +4.3	+0.0 +2.0	+0.0 +1.8	+0.0 +1.9	+0.0	43.0	54.0	-11.0	Horiz
7	29758.000 M Ave	20.2	+0.0 +1.6 +4.7	+0.0 +1.7	+0.0 +1.7	+0.0 +1.7	+0.0	31.6	54.0	-22.4	Vert
^	29758.000 M	30.2	+0.0 +1.6 +4.7	+0.0 +1.7	+0.0 +1.7	+0.0 +1.7	+0.0	41.6	54.0	-12.4	Vert

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.256 Radiated Emissions_ave**		
Work Order #:	**106587**	Date:	6/20/2023
Test Type:	**Radiated Scan**	Time:	15:24:58
Tested By:	E. Wong	Sequence#:	32
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 40-100GHz
40000 MHz-100 000 MHz;RBW=1 MHz,VBW=3 MHz

Test Environment Conditions:
Temperature: 28°C
Relative Humidity: 62%
Pressure: 99kPa

Emission profile of the EUT rotated along three orthogonal axis was investigated. Recorded data represent worse case emission.

Site D
Test Method: ANSI C63.10 (2013)

KDB 890966 D01 Meas Level Probing Radar v01r01

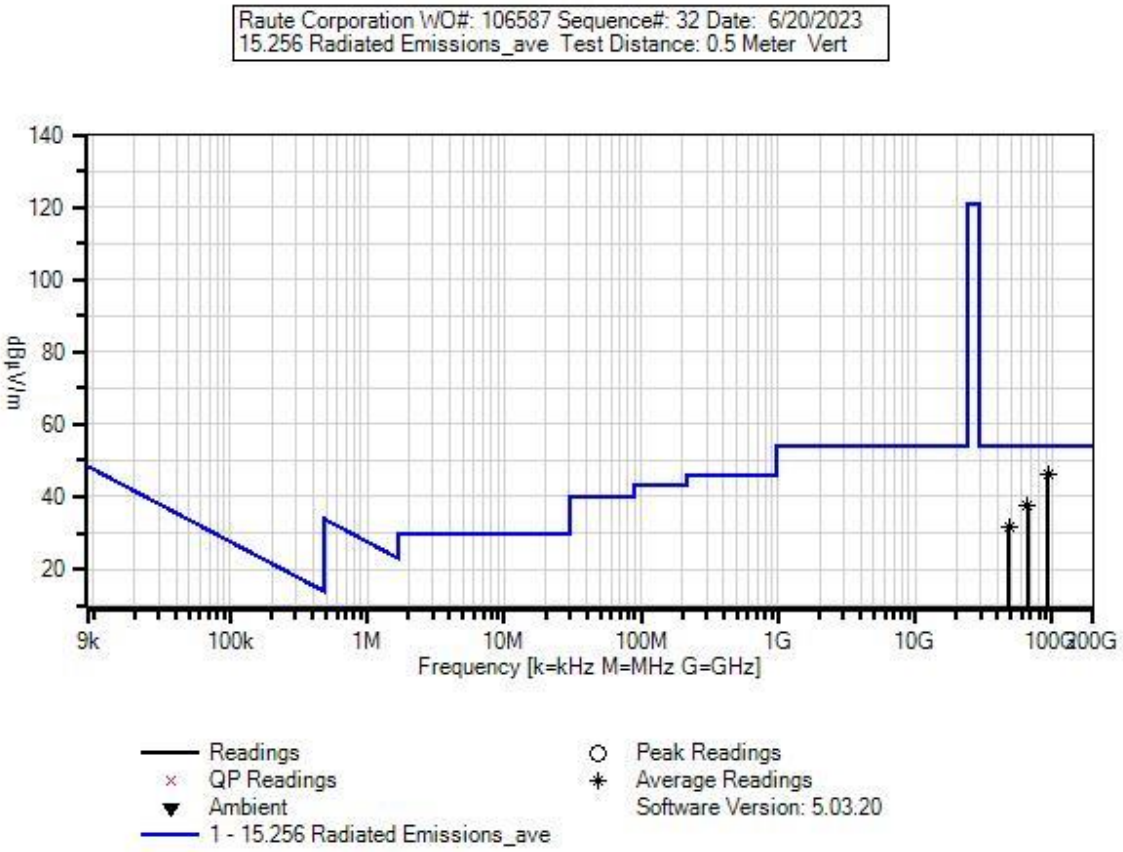
For LPRs that employ frequency-modulated continuous wave (FMCW), frequency hopping or stepped frequency modulation, the fundamental emission bandwidth, the maximum average power level in 1 MHz, the peak power level in 50 MHz and the level of unwanted emissions shall be made with the FMCW, frequency hopping or step function active.

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Measurement made with reduced RBW; the receiving antennas were placed at closer distance to the transmitting antennas for detection. No emission found; recorded data represent the noise floor at reduced RBW. (Down to 100Hz)

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	AN02347	Horn Antenna	M19HWA	2/14/2023	2/14/2025
T2	ANP07655-A	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T3	ANP07656-A	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	ANP07659-A	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T5	ANP07660-A	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T6	AN02348	Horn Antenna	M12HWA	2/14/2023	2/14/2025
T7	ANP07655-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T8	ANP07656-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T9	ANP07659-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

T10	ANP07660-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T11	AN02349	Horn Antenna	M08HWA	2/14/2023	2/14/2025
T12	ANP07655-C	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T13	ANP07656-C	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T14	ANP07659-C	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T15	ANP07660-C	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

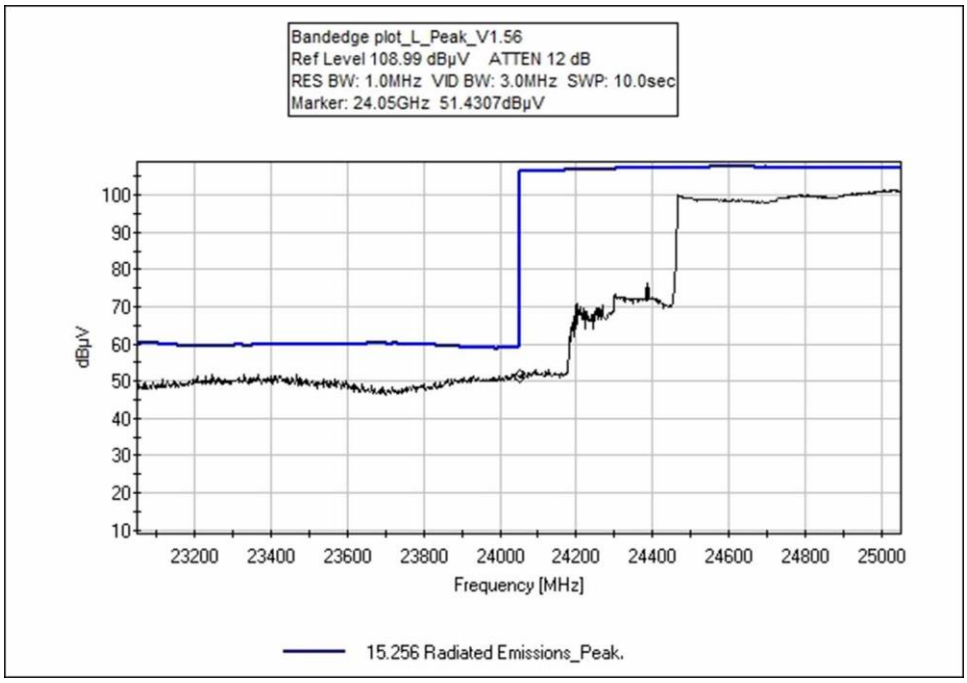
Measurement Data: Reading listed by margin. Test Distance: 0.5 Meter

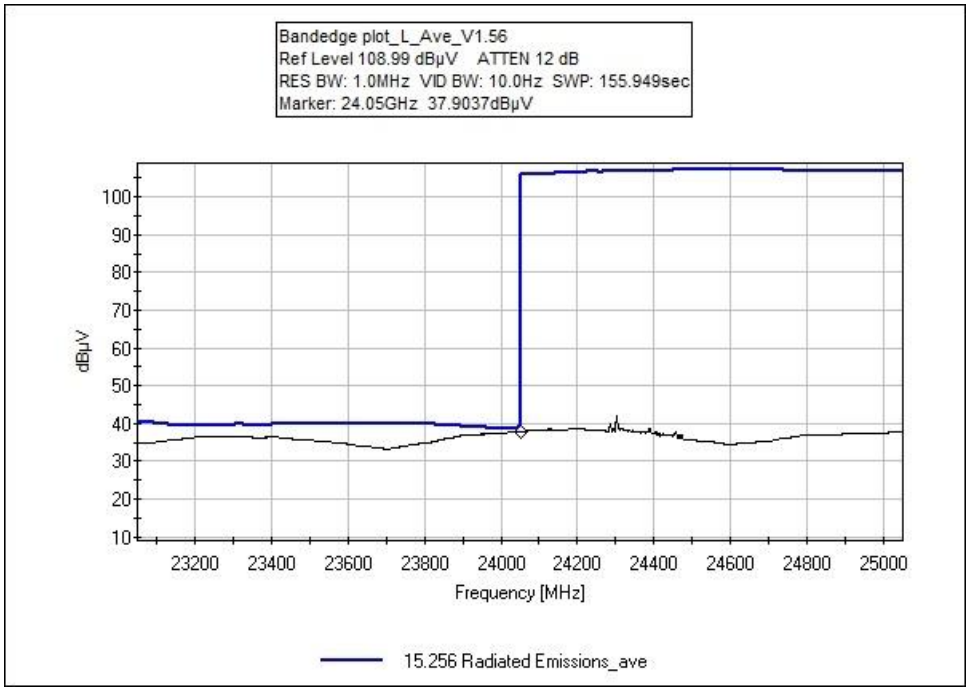
#	Freq	Rdng	T1 T5 T9 T13	T2 T6 T10 T14	T3 T7 T11 T15	T4 T8 T12	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	92683.333	-33.1	+0.0	+0.0	+0.0	+0.0	-15.6	46.1	54.0	-7.9	Vert
	M		+0.0	+0.0	+0.0	+0.0					
	Ave		+0.0	+0.0	+92.3	+0.6					
			+0.7	+0.6	+0.6						
^	92683.333	-24.6	+0.0	+0.0	+0.0	+0.0	-15.6	54.6	54.0	+0.6	Vert
	M		+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+92.3	+0.6					
			+0.7	+0.6	+0.6						
3	66050.000	-34.5	+0.0	+0.0	+0.0	+0.0	-15.6	37.7	54.0	-16.3	Vert
	M		+0.0	+85.3	+0.6	+0.7					
	Ave		+0.6	+0.6	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	66050.000	-26.8	+0.0	+0.0	+0.0	+0.0	-15.6	45.4	54.0	-8.6	Vert
	M		+0.0	+85.3	+0.6	+0.7					
			+0.6	+0.6	+0.0	+0.0					
			+0.0	+0.0	+0.0						
5	48700.000	-27.4	+71.8	+0.7	+0.7	+0.6	-15.6	31.4	54.0	-22.6	Vert
	M		+0.6	+0.0	+0.0	+0.0					
	Ave		+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	48700.000	-17.2	+71.8	+0.7	+0.7	+0.6	-15.6	41.6	54.0	-12.4	Vert
	M		+0.6	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

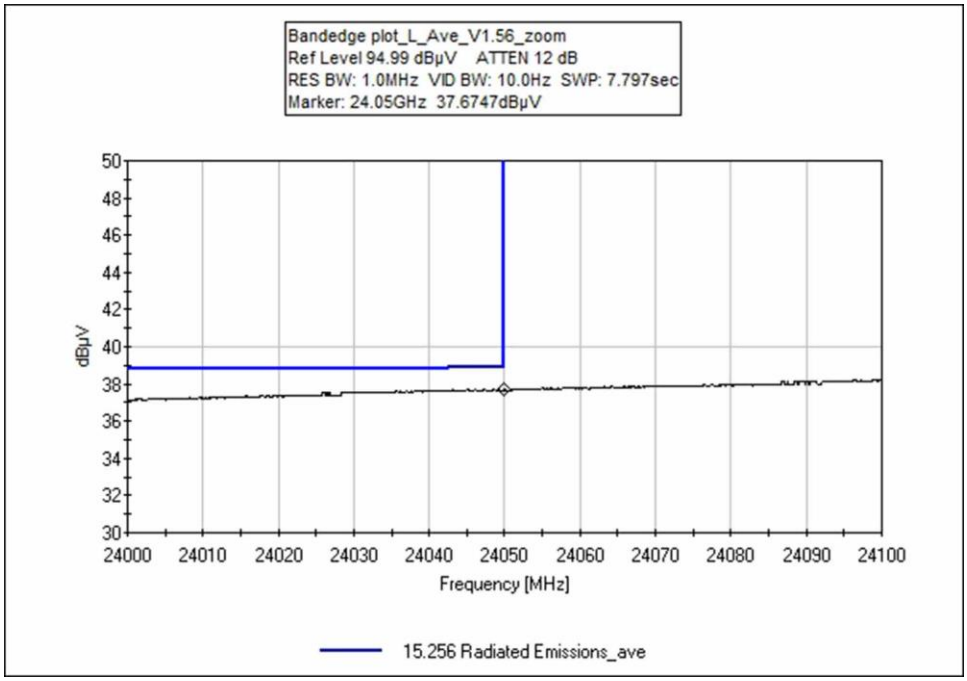
Band Edge

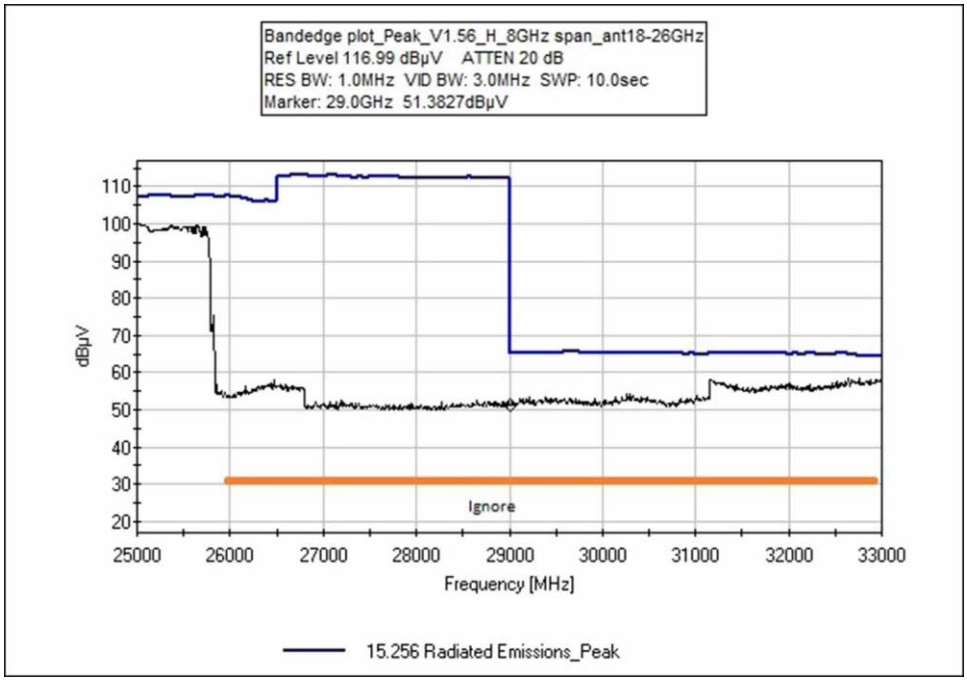
Band Edge Summary					
Frequency (GHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
24.05	FMCW	Internal Horn	52.9 ave	<54	Pass
24.05	FMCW	Internal Horn	66.4 pk	<74	Pass
29.00	FMCW	Internal Horn	40.7 ave	<54	Pass
29.00	FMCW	Internal Horn	53.6 pk	<74	Pass

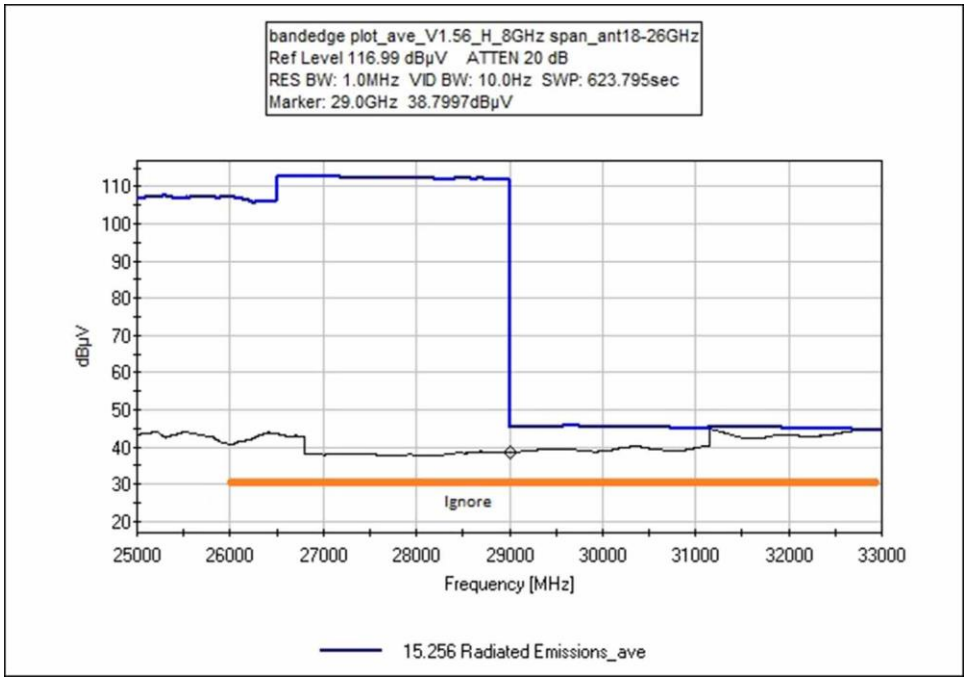
Band Edge Plots

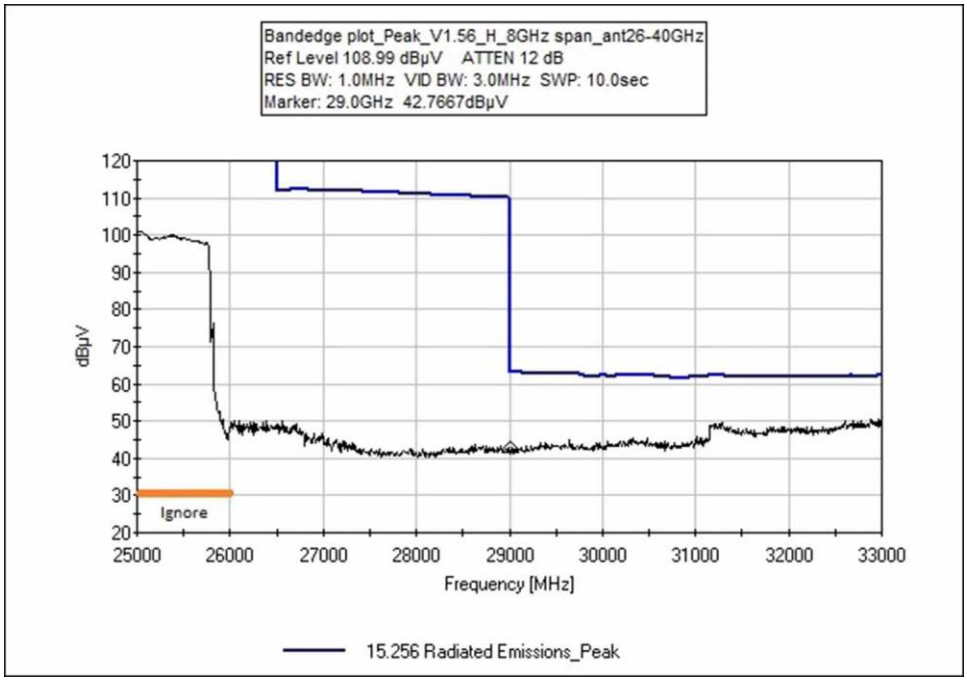


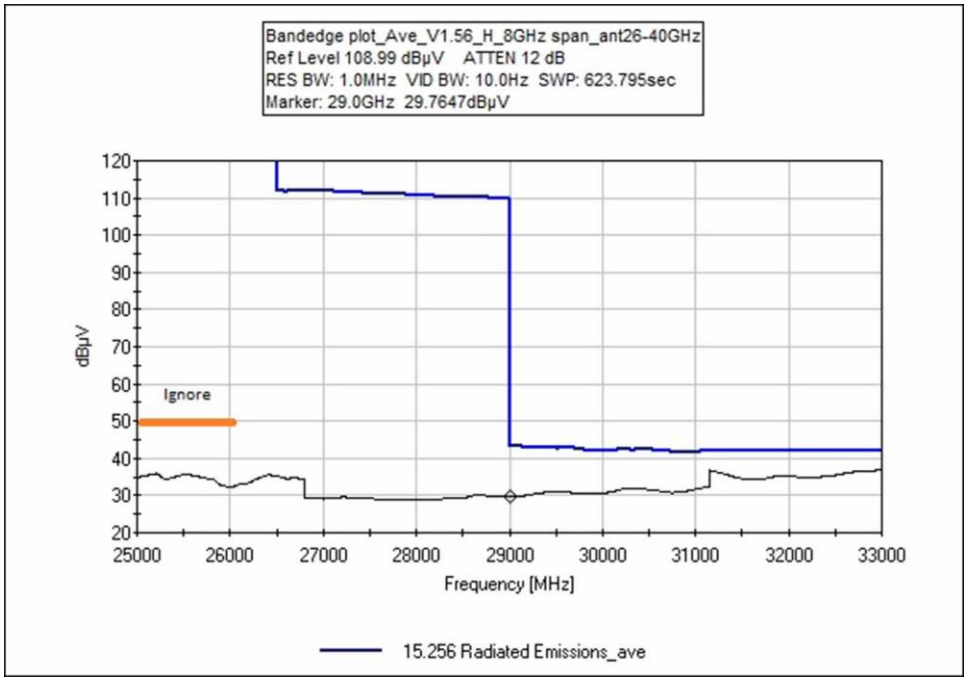



Bandedge plot_L_Ave_V1.56_zoom
Ref Level 94.99 dBµV ATTEN 12 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 7.797sec
Marker: 24.05GHz 37.6747dBµV
dBµV
Frequency [MHz]
15.256 Radiated Emissions_ave


Bandedge plot_Peak_V1.56_H_8GHz span_ant18-26GHz
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 10.0sec
Marker: 29.0GHz 51.3827dBµV
dBµV
Ignore
Frequency [MHz]
15.256 Radiated Emissions_Peak


bandedge plot_ave_V1.56_H_8GHz span_ant18-26GHz
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 623.795sec
Marker: 29.0GHz 38.7997dBµV
dBµV
Ignore
Frequency [MHz]
15.256 Radiated Emissions_ave


Bandedge plot_Peak_V1.56_H_8GHz span_ant26-40GHz
Ref Level 108.99 dBµV ATTEN 12 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 10.0sec
Marker: 29.0GHz 42.7667dBµV
dBµV
Ignore
Frequency [MHz]
15.256 Radiated Emissions_Peak


Bandedge plot_Ave_V1.56_H_8GHz span_ant26-40GHz
Ref Level 108.99 dBµV ATTEN 12 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 623.795sec
Marker: 29.0GHz 29.7647dBµV
dBµV
Ignore
Frequency [MHz]
15.256 Radiated Emissions_ave

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.256 Radiated Emissions_ave**		
Work Order #:	**106587**	Date:	6/20/2023
Test Type:	**Radiated Scan**	Time:	14:26:35
Tested By:	E. Wong	Sequence#:	31
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 4			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 4			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: Bandedge
1000 MHz-100 000 MHz;RBW=1 MHz,VBW=1 MHz

Test Environment Conditions:
Temperature: 28°C
Relative Humidity: 62%
Pressure: 99kPa

Site D
Test Method: ANSI C63.10 (2013)

KDB 890966 D01 Meas Level Probing Radar v01r01

For LPRs that employ frequency-modulated continuous wave (FMCW), frequency hopping or stepped frequency modulation, the fundamental emission bandwidth, the maximum average power level in 1 MHz, the peak power level in 50 MHz and the level of unwanted emissions shall be made with the FMCW, frequency hopping or step function active.

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT evaluated without enclosure.

Emission profile of the EUT rotated along three orthogonal axis was investigated. Both Vertical Horizontal orientation of receiving antenna investigated. Recorded data represent worse case emission.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T2	AN01413	Horn Antenna	84125-80008	10/3/2022	10/3/2024
T3	ANP07657	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	AN00787	Preamp	83017A	6/23/2021	6/23/2023
T5	ANP07655	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T6	ANP07656	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T7	ANP07660	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T8	ANP07659	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T9	AN03158A	Horn Antenna	GH-28-25	8/10/2021	8/10/2023
	AN01646	Horn Antenna	3115	3/21/2022	3/21/2024
	AN03367	Horn Antenna	62-GH-62-25.	8/3/2021	8/3/2023

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	24050.000 M Ave	37.9	+0.0 +1.7 +0.0	+40.3 +1.4	+1.7 +1.8	-33.4 +1.5	+0.0	52.9	54.0 Bandedge_L_ave	-1.1	Vert
2	24050.000 M Ave	34.9	+0.0 +1.7 +0.0	+40.3 +1.4	+1.7 +1.8	-33.4 +1.5	+0.0	49.9	54.0 Bandedge_L_ave_062023_config6	-4.1	Vert
^	24050.000 M	51.4	+0.0 +1.7 +0.0	+40.3 +1.4	+1.7 +1.8	-33.4 +1.5	+0.0	66.4	74.0 Bandedge_L_peak	-7.6	Vert
^	24050.000 M	49.1	+0.0 +1.7 +0.0	+40.3 +1.4	+1.7 +1.8	-33.4 +1.5	+0.0	64.1	74.0 Bandedge_L_peak_062023_config6	-9.9	Vert

5	29000.000 M Ave	29.8	+0.0 +1.7 +4.1	+0.0 +1.7	+0.0 +1.7	+0.0 +1.7	+0.0	40.7	54.0 Bandedge_H_Ave	-13.3	Vert
6	29000.000 M Ave	30.9	+0.0 +1.7 +0.0	+0.0 +1.7	+1.9 +1.7	+0.0 +1.7	+0.0	39.6	54.0 Bandedge_H_Ave_ 062023_config6	-14.4	Vert
^	29000.000 M	42.7	+0.0 +1.7 +4.1	+0.0 +1.7	+0.0 +1.7	+0.0 +1.7	+0.0	53.6	74.0 Bandedge_H_Peak	-20.4	Vert
^	29000.000 M	43.1	+0.0 +1.7 +0.0	+0.0 +1.7	+1.9 +1.7	+0.0 +1.7	+0.0	51.8	74.0 Bandedge_H_Peak_ 062023_config6	-22.2	Vert

Test Setup Photo(s)

0.8m; View 1

0.8m; View 2

1.5m; View 1

1.5m; View 2

Above 1GHz; View 1

Above 1GHz; View 2

15.256(h)(i)(A) Antenna Beamwidth

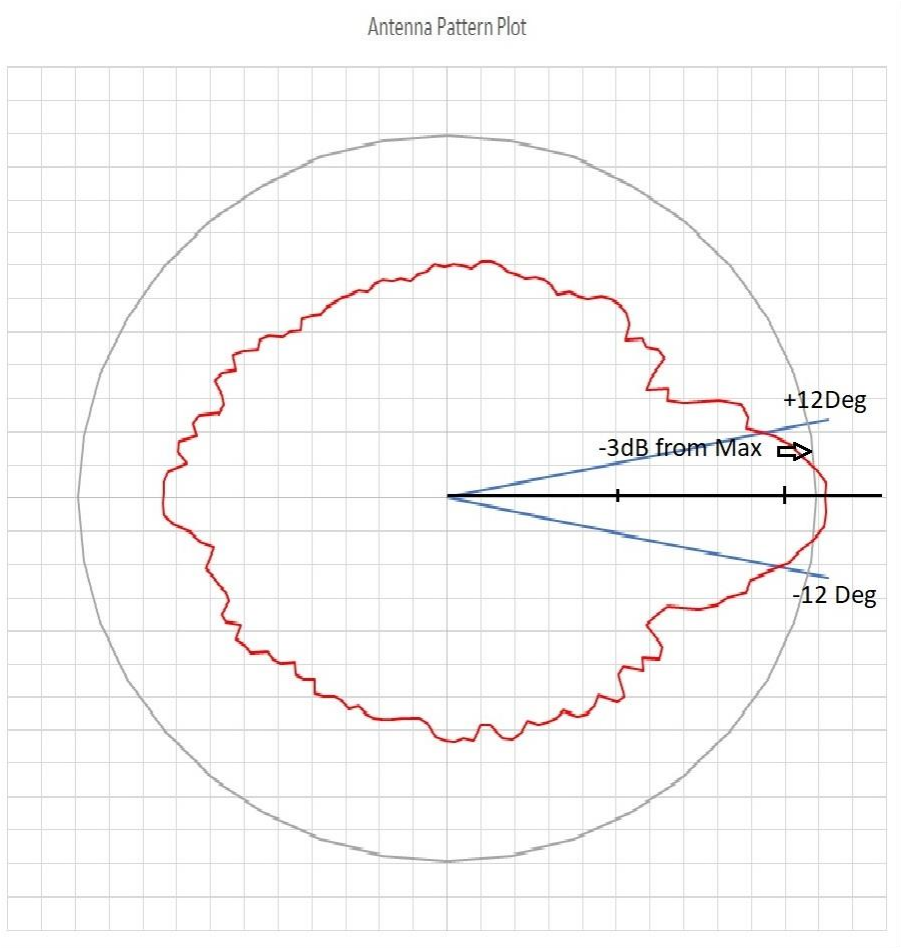
Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013) KDB 890966 D01 Meas Level Probing Radar V01r01	Test Date(s):	6/21/2023
Configuration:	6 (Firmware V1.56_CW mode for antenna pattern evaluation)		
Declaration:	**Modification #1 was in place during testing.**		

Environmental Conditions			
Temperature (ºC)	22	Relative Humidity (%):	58

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
01413	Horn Antenna	HP	84125-80008	10/3/2022	10/3/2024
07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

Limit: LPR devices operating under the provisions of this section within the 5.925-7.250 GHz and 24.05-29.00 GHz bands must use an antenna with a −3 dB beamwidth no greater than 12 degrees.

Test Plot



EUT X position, Receiving ant Vertical polarity

15.256(j) Antenna Side Lobe Gain

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013) KDB 890966 D01 Meas Level Probing Radar V01r01	Test Date(s):	6/21/2023
Configuration:	6 (Firmware V1.56_CW mode for antenna pattern evaluation)		
Declaration:	**Modification #1 was in place during testing.**		

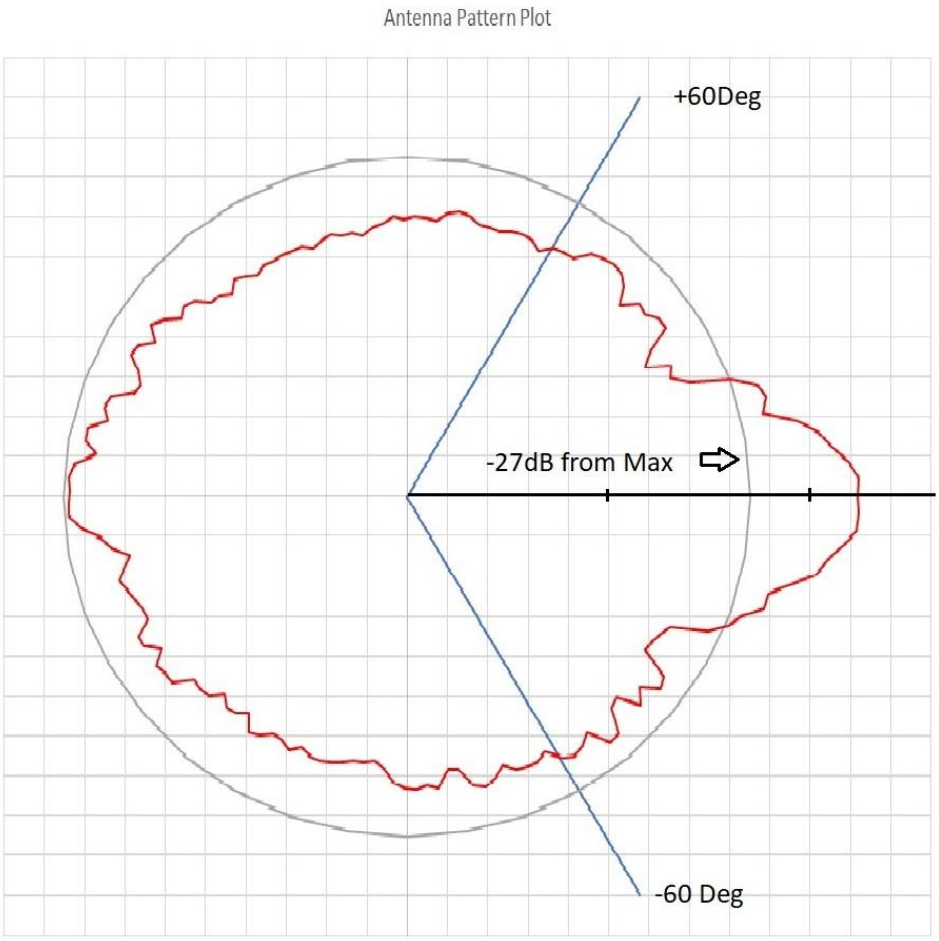
Environmental Conditions			
Temperature (ºC)	22	Relative Humidity (%):	58

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
01413	Horn Antenna	HP	84125-80008	10/3/2022	10/3/2024
07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2.

Frequency Range (GHz)	Antenna side lobe gain limit relative to main beam gain (dB)
5.925.7-7.250	-22
24.05-29.00	-27
75.85	-38

Test Plot



EUT X position, Receiving ant Vertical polarity

(Close to limit data point , evaluated in detail, to ensure compliance)

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**106587**	Date:	6/21/2023
Test Type:	**Conducted Emissions**	Time:	13:40:03
Tested By:	E. Wong	Sequence#:	40
Software:	EMITest 5.03.20		120/60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 150kHz-30MHz
150 kHz-30 MHz;RBW=9 kHz,VBW=30kHz

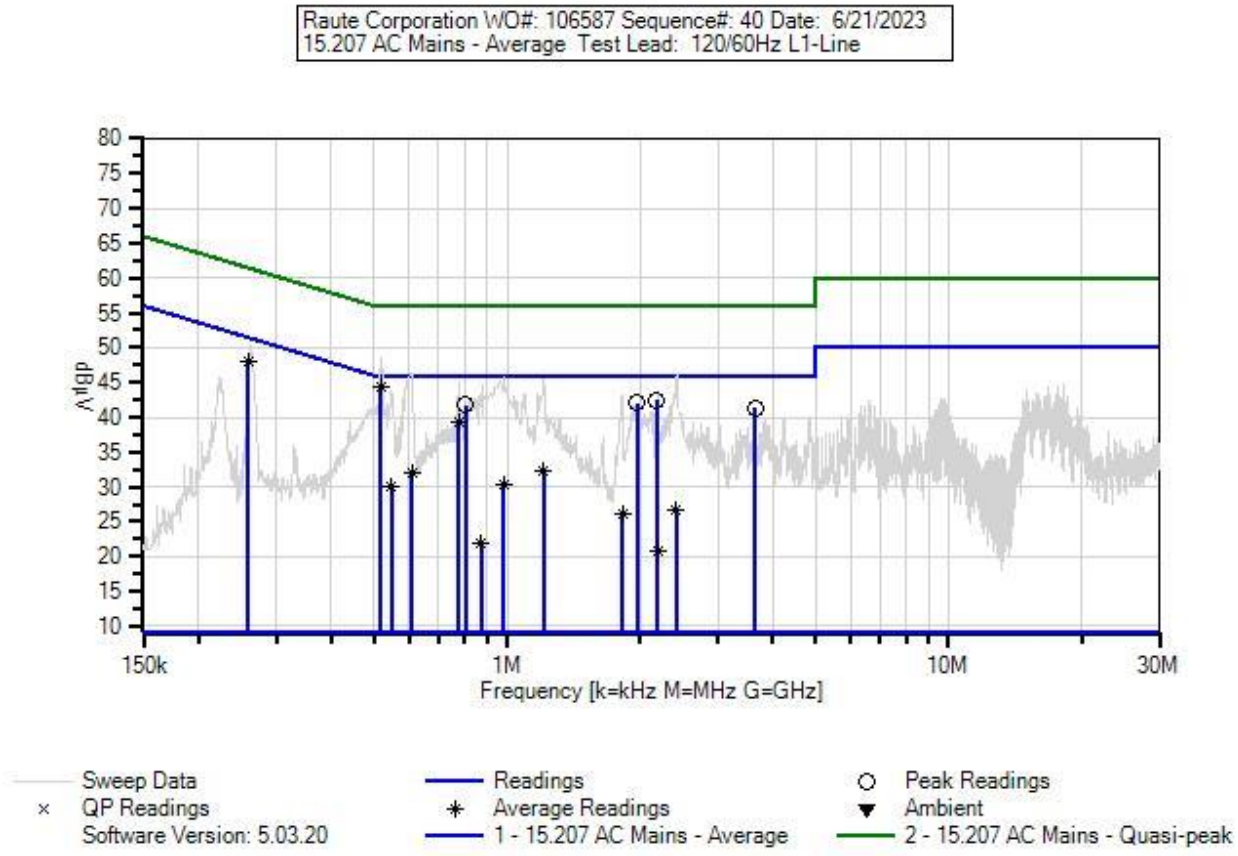
Test Environment Conditions:
Temperature: 25°C
Humidity: 50%
Pressure: 99kPa

Site D
Test Method: ANSI C63.10 (2013)
KDB 890966 D01 Meas Level Probing Radar v01r01

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	AN02610	High Pass Filter	HE9615-150K-50-720B	9/8/2021	9/8/2023
T2	ANP01910	Cable	RG-142	9/8/2021	9/8/2023
T3	ANP06085	Attenuator	SA18N10W-06	10/24/2022	10/24/2024
T4	AN00847.1	50uH LISN-Line 1	3816/2NM	4/19/2023	4/19/2024
	AN00847.1	50uH LISN-Line 2(N)	3816/2NM	4/19/2023	4/19/2024

Measurement Data: Reading listed by margin. Test Lead: L1-Line

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	518.693k Ave	38.1	+0.3	+0.1	+5.8	+0.0	+0.0	44.3	46.0	-1.7	L1-Li
^	518.693k	42.5	+0.3	+0.1	+5.8	+0.0	+0.0	48.7	46.0	+2.7	L1-Li
3	2.183M	36.5	+0.1	+0.1	+5.8	+0.0	+0.0	42.5	46.0	-3.5	L1-Li
4	258.696k Ave	42.0	+0.1	+0.1	+5.8	+0.0	+0.0	48.0	51.5	-3.5	L1-Li
^	262.716k	44.4	+0.1	+0.1	+5.8	+0.0	+0.0	50.4	51.3	-0.9	L1-Li
6	1.974M	36.1	+0.1	+0.1	+5.8	+0.0	+0.0	42.1	46.0	-3.9	L1-Li
7	804.485k	35.5	+0.3	+0.1	+5.8	+0.0	+0.0	41.7	46.0	-4.3	L1-Li
8	3.650M	35.3	+0.1	+0.2	+5.8	+0.0	+0.0	41.4	46.0	-4.6	L1-Li
9	776.852k Ave	33.2	+0.3	+0.1	+5.8	+0.0	+0.0	39.4	46.0	-6.6	L1-Li
^	776.851k	38.7	+0.3	+0.1	+5.8	+0.0	+0.0	44.9	46.0	-1.1	L1-Li
11	1.209M Ave	26.3	+0.2	+0.1	+5.8	+0.0	+0.0	32.4	46.0	-13.6	L1-Li
^	1.209M	39.4	+0.2	+0.1	+5.8	+0.0	+0.0	45.5	46.0	-0.5	L1-Li
13	607.413k Ave	25.8	+0.3	+0.1	+5.8	+0.0	+0.0	32.0	46.0	-14.0	L1-Li
^	607.412k	40.3	+0.3	+0.1	+5.8	+0.0	+0.0	46.5	46.0	+0.5	L1-Li
15	983.523k Ave	24.2	+0.2	+0.1	+5.8	+0.0	+0.0	30.3	46.0	-15.7	L1-Li
^	983.523k	39.8	+0.2	+0.1	+5.8	+0.0	+0.0	45.9	46.0	-0.1	L1-Li
17	547.782k Ave	23.9	+0.3	+0.1	+5.8	+0.0	+0.0	30.1	46.0	-15.9	L1-Li
^	547.781k	37.7	+0.3	+0.1	+5.8	+0.0	+0.0	43.9	46.0	-2.1	L1-Li
19	2.417M Ave	20.7	+0.1	+0.1	+5.8	+0.0	+0.0	26.7	46.0	-19.3	L1-Li
^	2.417M	40.0	+0.1	+0.1	+5.8	+0.0	+0.0	46.0	46.0	+0.0	L1-Li

21 Ave	1.826M	19.9	+0.2	+0.1	+5.8	+0.0	+0.0	26.0	46.0	-20.0	L1-Li
^	1.826M	37.1	+0.2	+0.1	+5.8	+0.0	+0.0	43.2	46.0	-2.8	L1-Li
23 Ave	871.388k	15.8	+0.3	+0.1	+5.8	+0.0	+0.0	22.0	46.0	-24.0	L1-Li
^	871.388k	37.2	+0.3	+0.1	+5.8	+0.0	+0.0	43.4	46.0	-2.6	L1-Li
25 Ave	2.196M	14.8	+0.1	+0.1	+5.8	+0.0	+0.0	20.8	46.0	-25.2	L1-Li
^	2.196M	37.8	+0.1	+0.1	+5.8	+0.0	+0.0	43.8	46.0	-2.2	L1-Li

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • (714) 993-6112		
Customer:	**Raute Corporation**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**106587**	Date:	6/21/2023
Test Type:	**Conducted Emissions**	Time:	13:47:22
Tested By:	E. Wong	Sequence#:	41
Software:	EMITest 5.03.20		120/60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 6			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 6			

Test Conditions / Notes:

The EUT seeking limited modulator approval is placed on the Styrofoam block.

Power is applied to the EUT via X1 port, both transmitters are active, transmitting as intended.

Frequency Range of Measurement: 150kHz-30MHz
150 kHz-30 MHz;RBW=9 kHz,VBW=30kHz

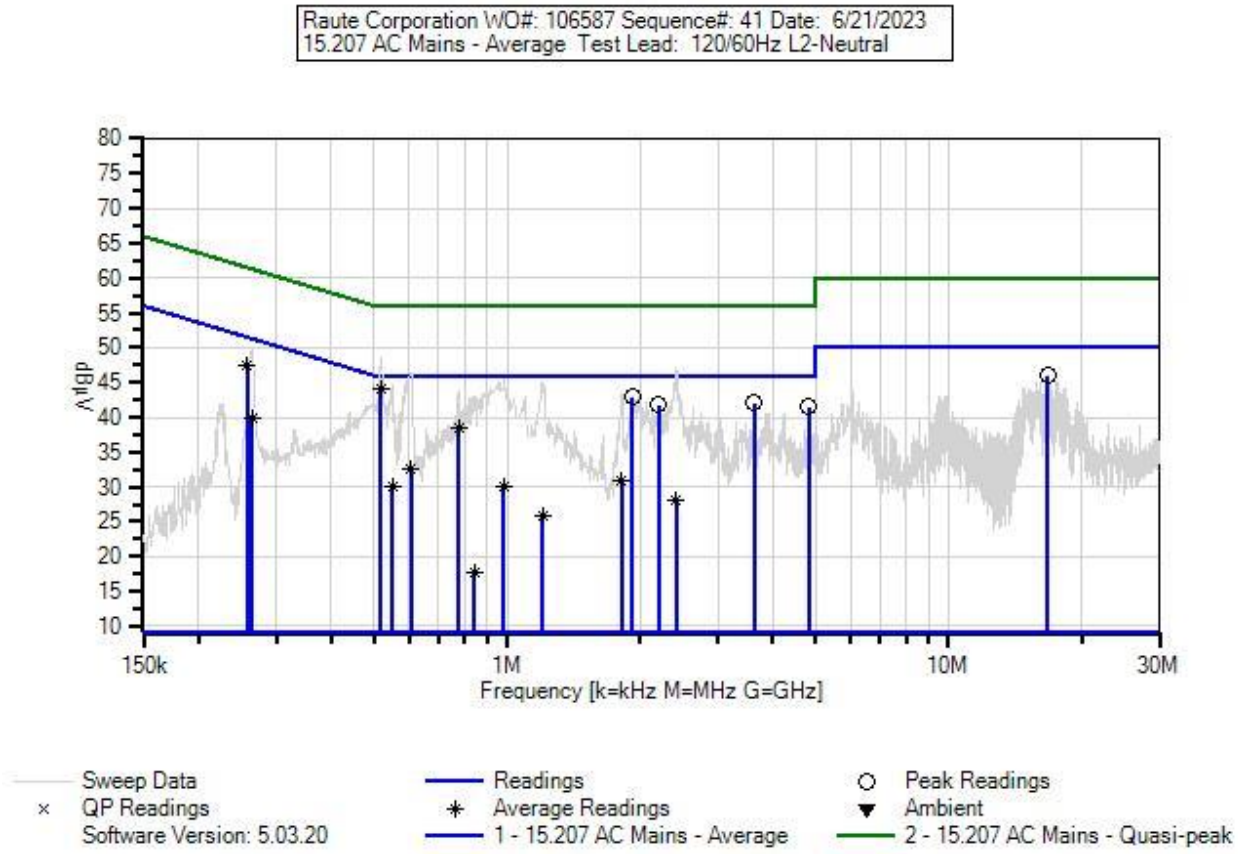
Test Environment Conditions:
Temperature: 25°C
Humidity: 50%
Pressure: 99kPa

Site D
Test Method: ANSI C63.10 (2013)
KDB 890966 D01 Meas Level Probing Radar v01r01

Firmware 1.56

A section of unterminated cable if connected to X2 port.
EUT tested without enclosure. PCB section is enclosed in metal enclosure.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	AN02610	High Pass Filter	HE9615-150K-50-720B	9/8/2021	9/8/2023
T2	ANP01910	Cable	RG-142	9/8/2021	9/8/2023
T3	ANP06085	Attenuator	SA18N10W-06	10/24/2022	10/24/2024
	AN00847.1	50uH LISN-Line 1	3816/2NM	4/19/2023	4/19/2024
T4	AN00847.1	50uH LISN-Line 2(N)	3816/2NM	4/19/2023	4/19/2024

Measurement Data: Reading listed by margin. Test Lead: L2-Neutral

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	517.966k Ave	37.9	+0.3	+0.1	+5.8	+0.0	+0.0	44.1	46.0	-1.9	L2-Ne
^	517.966k	42.5	+0.3	+0.1	+5.8	+0.0	+0.0	48.7	46.0	+2.7	L2-Ne
3	1.923M	36.9	+0.1	+0.1	+5.8	+0.0	+0.0	42.9	46.0	-3.1	L2-Ne
4	16.779M	39.5	+0.2	+0.3	+5.8	+0.2	+0.0	46.0	50.0	-4.0	L2-Ne
5	3.629M	35.8	+0.1	+0.2	+5.8	+0.1	+0.0	42.0	46.0	-4.0	L2-Ne
6	257.888k Ave	41.4	+0.1	+0.1	+5.8	+0.0	+0.0	47.4	51.5	-4.1	L2-Ne
7	2.204M	35.7	+0.1	+0.1	+5.8	+0.0	+0.0	41.7	46.0	-4.3	L2-Ne
8	4.824M	35.3	+0.1	+0.2	+5.8	+0.1	+0.0	41.5	46.0	-4.5	L2-Ne
9	779.033k Ave	32.3	+0.3	+0.1	+5.8	+0.0	+0.0	38.5	46.0	-7.5	L2-Ne
^	779.033k	37.5	+0.3	+0.1	+5.8	+0.0	+0.0	43.7	46.0	-2.3	L2-Ne
11	264.171k Ave	34.0	+0.1	+0.1	+5.8	+0.0	+0.0	40.0	51.3	-11.3	L2-Ne
^	264.171k	43.9	+0.1	+0.1	+5.8	+0.0	+0.0	49.9	51.3	-1.4	L2-Ne
13	606.685k Ave	26.3	+0.3	+0.1	+5.8	+0.0	+0.0	32.5	46.0	-13.5	L2-Ne
^	606.685k	40.2	+0.3	+0.1	+5.8	+0.0	+0.0	46.4	46.0	+0.4	L2-Ne
15	1.813M Ave	24.9	+0.2	+0.1	+5.8	+0.0	+0.0	31.0	46.0	-15.0	L2-Ne
^	1.813M	37.3	+0.2	+0.1	+5.8	+0.0	+0.0	43.4	46.0	-2.6	L2-Ne
17	549.236k Ave	23.9	+0.3	+0.1	+5.8	+0.0	+0.0	30.1	46.0	-15.9	L2-Ne
^	549.236k	38.5	+0.3	+0.1	+5.8	+0.0	+0.0	44.7	46.0	-1.3	L2-Ne
19	983.523k Ave	23.9	+0.2	+0.1	+5.8	+0.0	+0.0	30.0	46.0	-16.0	L2-Ne
^	983.523k	39.4	+0.2	+0.1	+5.8	+0.0	+0.0	45.5	46.0	-0.5	L2-Ne

21	2.417M Ave	22.0	+0.1	+0.1	+5.8	+0.0	+0.0	28.0	46.0	-18.0	L2-Ne
^	2.417M	41.0	+0.1	+0.1	+5.8	+0.0	+0.0	47.0	46.0	+1.0	L2-Ne
23	1.200M Ave	19.8	+0.2	+0.1	+5.8	+0.0	+0.0	25.9	46.0	-20.1	L2-Ne
^	1.200M	38.9	+0.2	+0.1	+5.8	+0.0	+0.0	45.0	46.0	-1.0	L2-Ne
25	840.846k Ave	11.6	+0.3	+0.1	+5.8	+0.0	+0.0	17.8	46.0	-28.2	L2-Ne
^	840.845k	37.0	+0.3	+0.1	+5.8	+0.0	+0.0	43.2	46.0	-2.8	L2-Ne

Test Setup Photo(s)

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.