PTI Project 21110-15

RACOM s.r.o.
RipEX2-4

Data Transceiver
400.000 to 470.000 MHz

Wireless Certification Report

FCC Part 90 and IC RSS-119

Prepared for:

RACOM s.r.o.
Mirova cp. 1283
592 31 Nove Mesto na Morave
Czech Republic

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

30 Oct 2019

Reviewed by

Shakil Murad
Lead EMC Engineer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
03 DRAFT	Draft for review.	15 Nov 2019
03	Technical Review	11/15/19
02 Final	Additional statements added regarding applicable bands.	10 Dec 2019

Corrections:

None.

Table of Contents

Certificate of Compliance

FCC MRA Designation Number: US5270
NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification	
RACOM s.r.o. Mirova cp. 1283 592 31 Nove Mesto na Morave Czech Republic Certificate Date: 29 Oct 2019	FCC ID: IC ID: Model(s): Laboratory Project ID:	SQT-RIPEX2-4A 24993-RIPEX24A RipEX2-4 21110-15

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR (USA) FCC, RSS IC(Industry Canada)		
Parameter	**FCC: Licensed to 406.1-470 MHz**	**IC: Licensed to 406.1-430 MHz and 450-470 MHz**
Conducted Output Power	90.210, 2.1046	RSS-119 Issue 12, 5.4
Emission Mask (C, D, E)	90.210, 2.1047	RSS-119 Issue 12, 5.8
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051	RSS-119 Issue 12, 5.8; RSS-Gen Issue 4
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 15.209, 2.1053	RSS-119 Issue 12, 5.8
Transient Frequency Behavior	90.214, TIA/EIA-603-E	RSS-119 Issue 12, 5.9
Frequency Stability	90.213, 2.1055	RSS-119 Issue 12, 5.3
Modulation; Frequency Response & Limiting	2.1047(a), (b)	
Occupied Bandwidth, 20 dB, < 11.5 kHz	90.209, 2.1049	RSS-119 Issue 12, 5.5
Radiated Emissions 30 MHz – 5 GHz	15.109	RSS-Gen Issue 4, ICES-003

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of North America.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing. The methods of TIA/EIA-603 were applied unless specified otherwise in the associated agency rules and procedures.

1.2 EUT Description

Table 1.2.1 Equipment Under Test	
Manufacturer & Model	**Basic Properties**
RACOM s.r.o. Model RipEX2-4 Serial Numbers: 1901665415, 1901665515	Dimensions 218 x 126 x 68 cm. Typically rack mounted. Requires professional installation. Powered externally 10 to 30 VDC.

Table 1.2.2: EUT RF Specifications	
Power Output to Antenna	+40 dBm Maximum
Frequency Range	400 to 470 MHz (Licensed channels only.)
Channel Bandwidths Supported (kHz)	25, 12.5, 6.25
Modulation Methods Supported	4CPFSK pi/4DQPSK D8PSK 16DEQAM 64QAM 256QAM
Declaration of Minimum Baud Rate for Spectrum Efficiency	This equipment is capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth.

Table 1.2.3 Antenna Description
Antenna system provided at installation time.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

Table 1.3.1 Operating Frequency/Range* (Only for licensed frequencies per localized regulations.)			
Lowest Frequency	**Center Frequency**	**Highest Frequency**	**Total Frequency Range**
400.000 MHz	435.000 MHz	470.000 MHz	70 MHz
The three channels were tested per customary practice for a frequency range exceeding 10 MHz.			

*All references to bottom/low, middle/center/nominal, and top/high channels are from this table unless otherwise specified.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

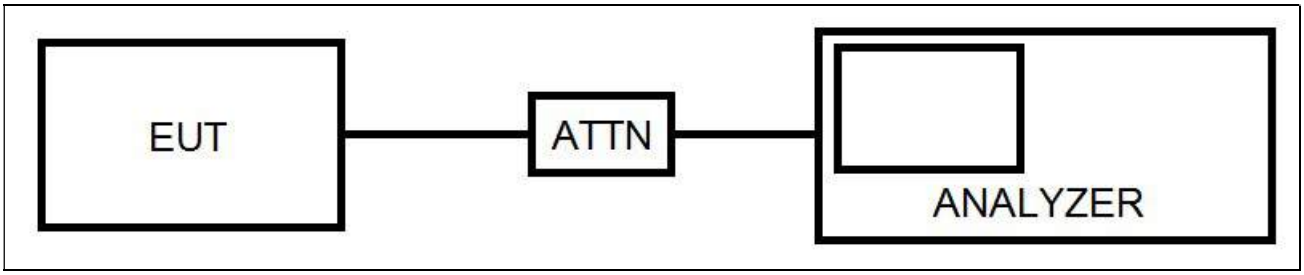
1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-Gen, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Applicable Documents

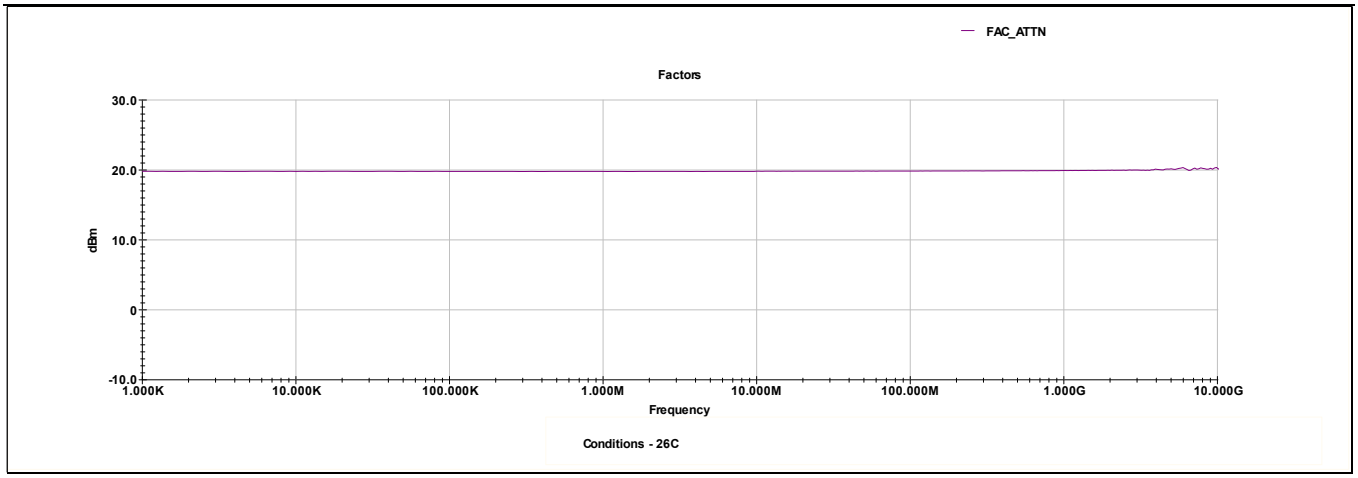
Table 1.6.1: Applicable Documents		
Document #	**Title/Description**	**Date**
47 CFR	FCC Part 90	
IC RSS-119 Issue 12	Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz	2015
IC RSS-Gen Issue 4	General Requirements for Compliance of Radio Apparatus	2014
TIA/EIA-603-E	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services;	2015

1.7 Test Setup Diagram



Setup for Conducted Port Measurements
Power, Mask, Spurious, Bandwidth

External fixed attenuation is employed to protect the spectrum analyzer from overload damage. The attenuation factor is applied automatically in software and is graphically represented by that software below.



Attenuator Factor vs Frequency
Asset Number A105
20 dB 20 W Narda Attenuator

2.0 Conducted Output Power

2.1 Procedure

The EUT is placed into continuous transmit mode without modulation for peak power measurement.

2.2 Criteria

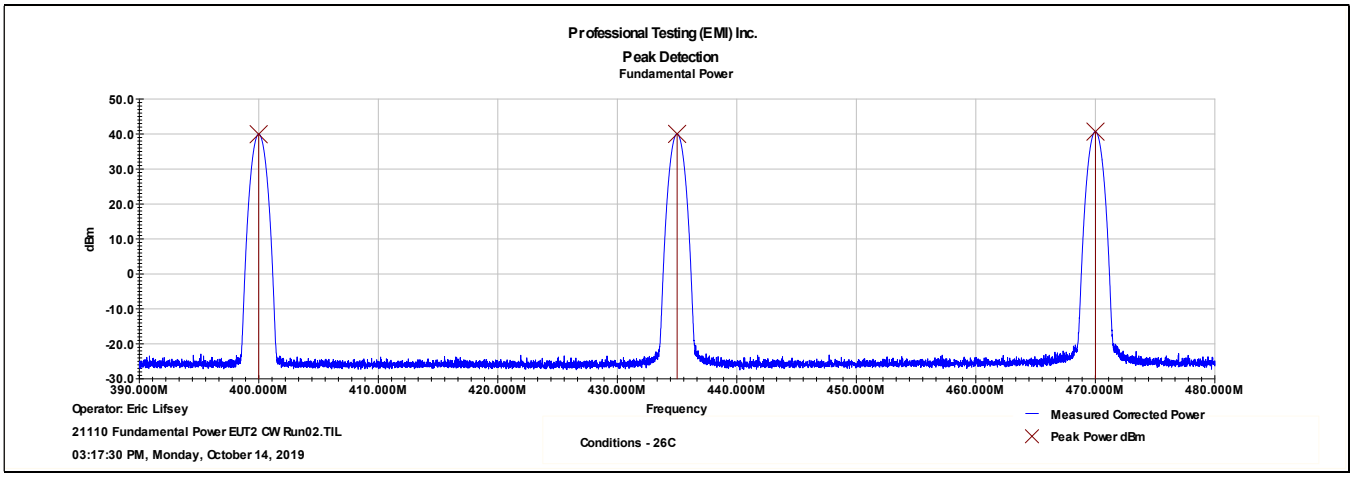
Parameter	Section Reference	Date
Conducted Output Power	90.210, 2.1046 | RSS-119 Issue 12, 5.4	14 Oct 2019

2.3 Results

Setup per section 1.7.

The EUT satisfied the requirement. Tabular results are presented below.

Table 2.3.1 Power, Peak, Conducted, Unmodulated		
Frequency (MHz)	**Power (dBm)**	**Power (W)**
400	39.9	9.8
435	40.0	10.0
470	40.7	11.8



Corrected Measured Power

2.4 Calculated Attenuation and Spurious Limits Beyond Authorized Bandwidth

Table 2.4.1 Attenuation and Limits Beyond Authorized Bandwidth Limit(dBm) = Fundamental_Power(dBm) – Attenuation(dB) Fundamental Power = 10 W		
Paragraph/Mask & BW Reference	**Calculated Attenuation dB**	**Calculated Spurious Limit dBm**
90.210(c) 25 kHz	43 + 10 Log_{10}(10 W) = 53 dB	40 – 53 dB = -13
90.210(d) 12.5 kHz	50 + 10 Log_{10}(10 W) = 60 dB	40 – 60 dB = -20
90.210(e) 6.25 kHz	55 + 10 Log_{10}(10 W) = 65 dB	40 – 65 dB = -25

3.0 Emission Mask

3.1 Procedure

Emissions are measured using peak detection with the mask superimposed on the graph.

3.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals	90.210, 2.1047| RSS-119 Issue 12, 5.8	9 Oct 2019

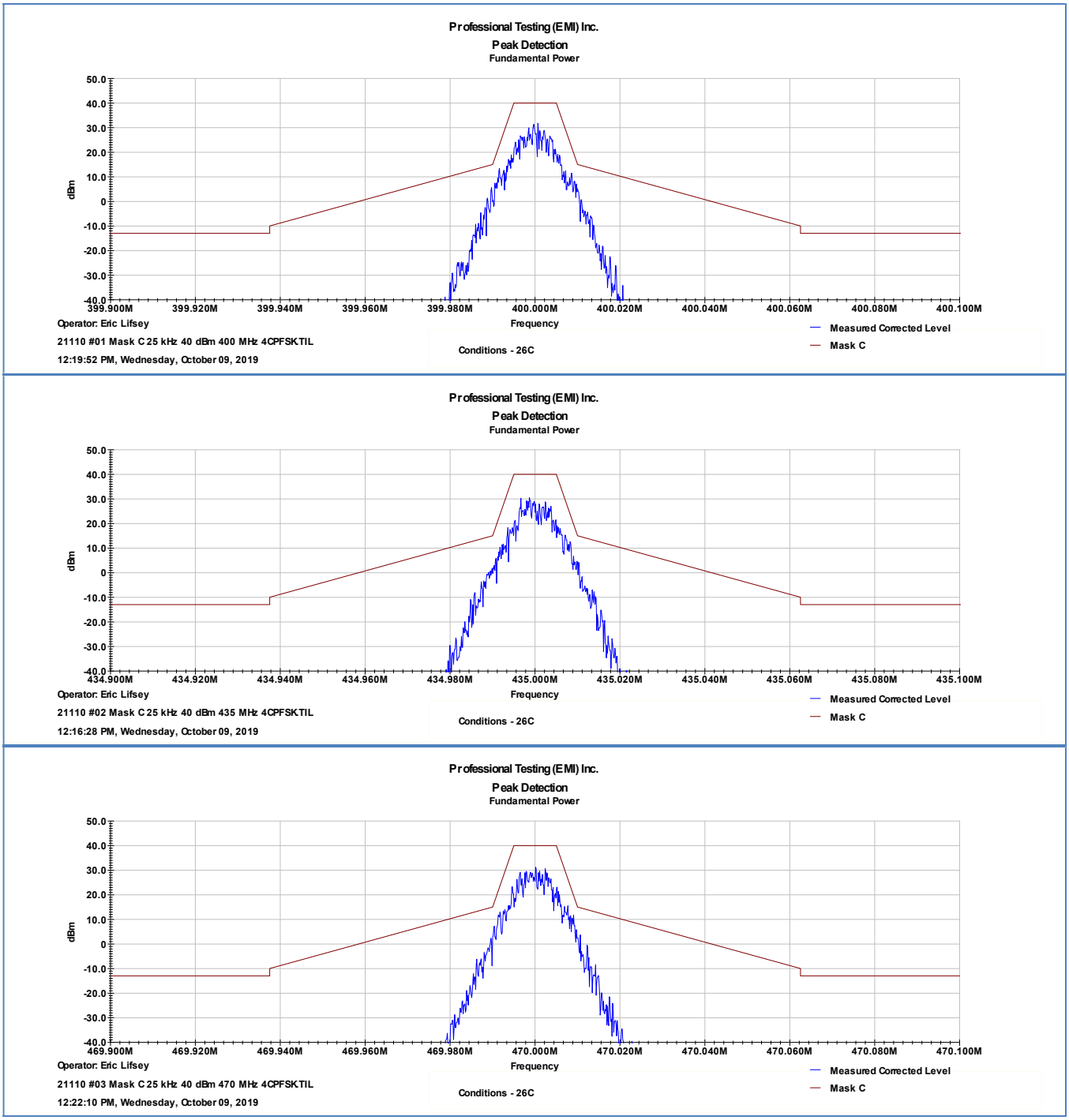
3.3 Results

Setup per section 1.7.

The EUT satisfied the requirement.

Table 3.3.1 Modulation Settings As noted on each graph.
4CPFSK
pi/4DQPSK
D8PSK
16DEQAM
64QAM
256QAM

3.3.1 Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.900M
399.920M
399.940M
399.960M
399.980M
400.000M
400.020M
400.040M
400.060M
400.080M
400.100M
Frequency
Operator: Eric Lifsey
21110 #01 Mask C 25 kHz 40 dBm 400 MHz 4CPFSK.TIL
12:19:52 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask C
Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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434.920M
434.940M
434.960M
434.980M
435.000M
435.020M
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435.060M
435.080M
435.100M
Frequency
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Measured Corrected Level
Mask C
Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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469.920M
469.940M
469.960M
469.980M
470.000M
470.020M
470.040M
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470.080M
470.100M
Frequency
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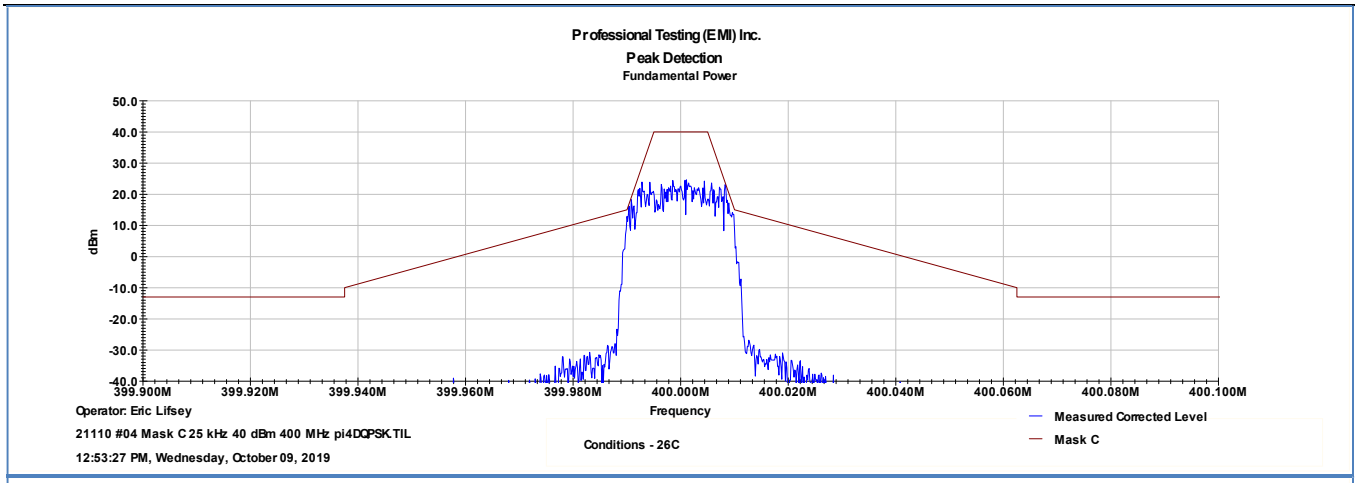
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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30.0
20.0
10.0
0
-10.0
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-30.0
-40.0
399.900M
399.920M
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Frequency
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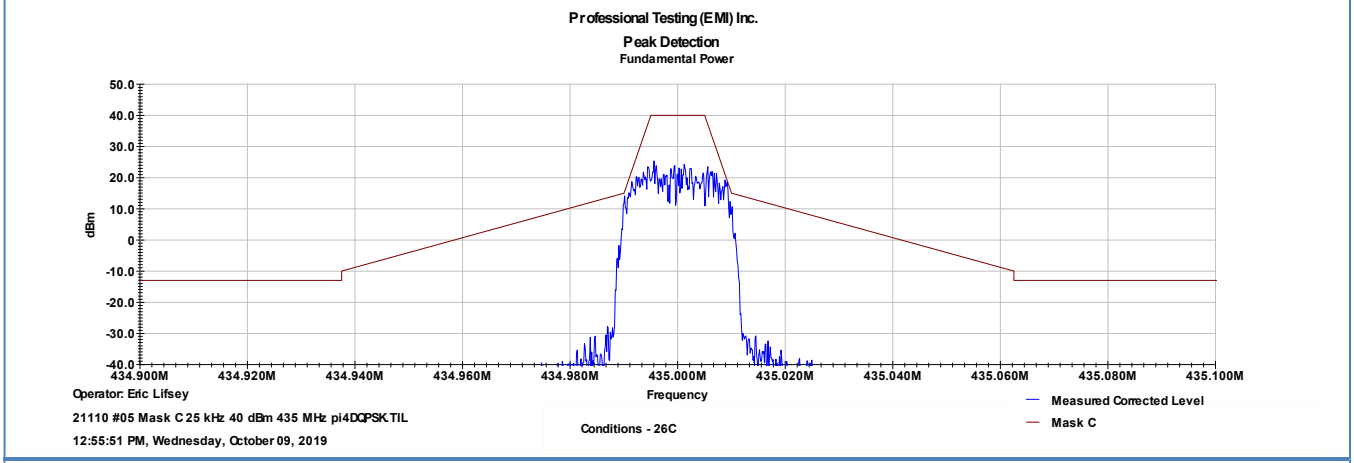
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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10.0
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-20.0
-30.0
-40.0
434.900M
434.920M
434.940M
434.960M
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435.080M
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Frequency
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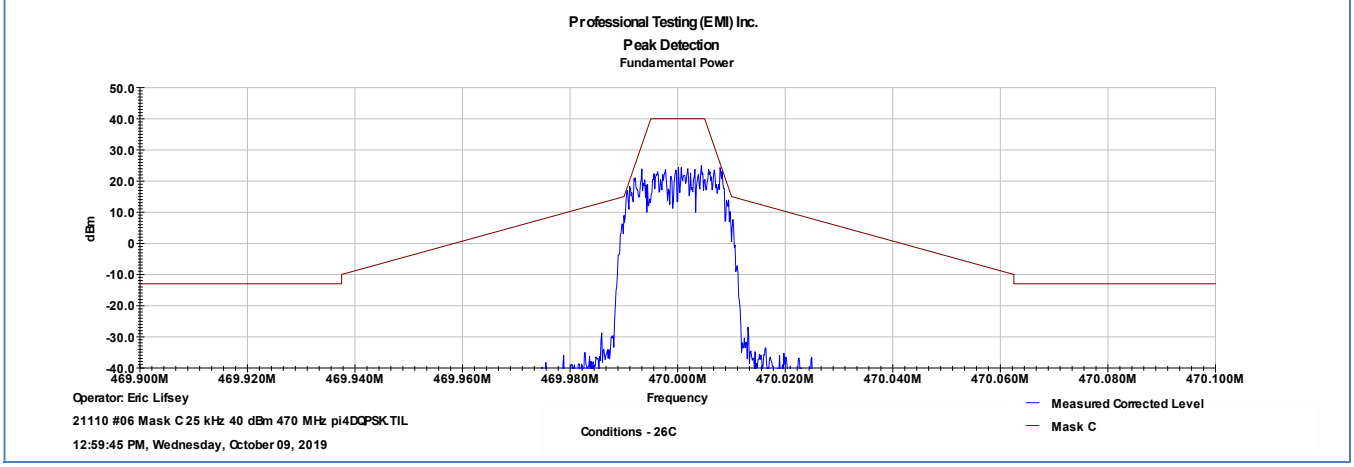
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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10.0
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-20.0
-30.0
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469.900M
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Frequency
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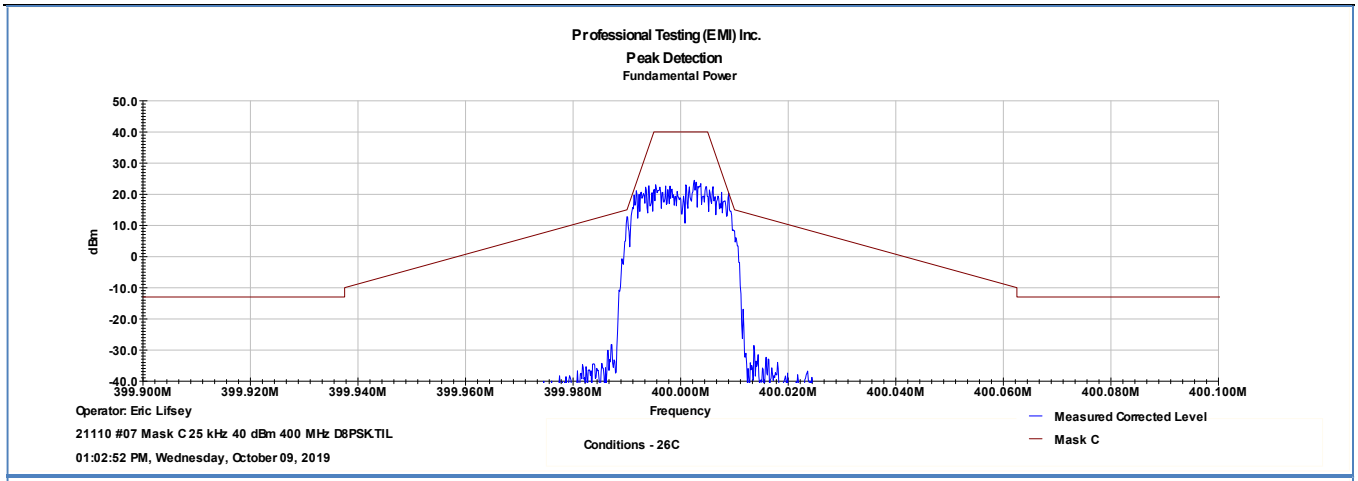
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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Frequency
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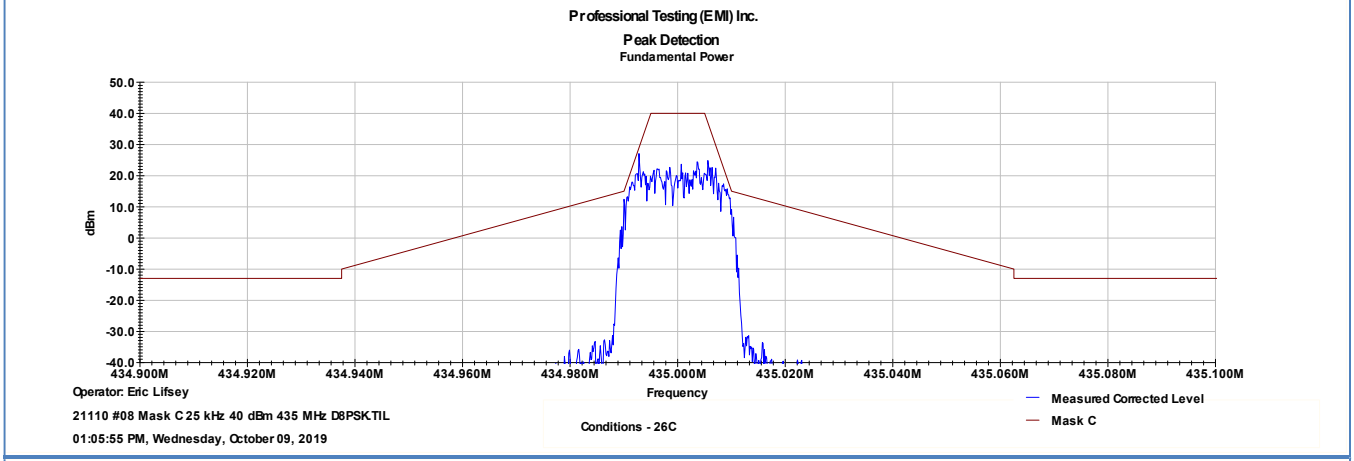
Measured Corrected Level
Mask C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Peak Detection
Fundamental Power
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Frequency
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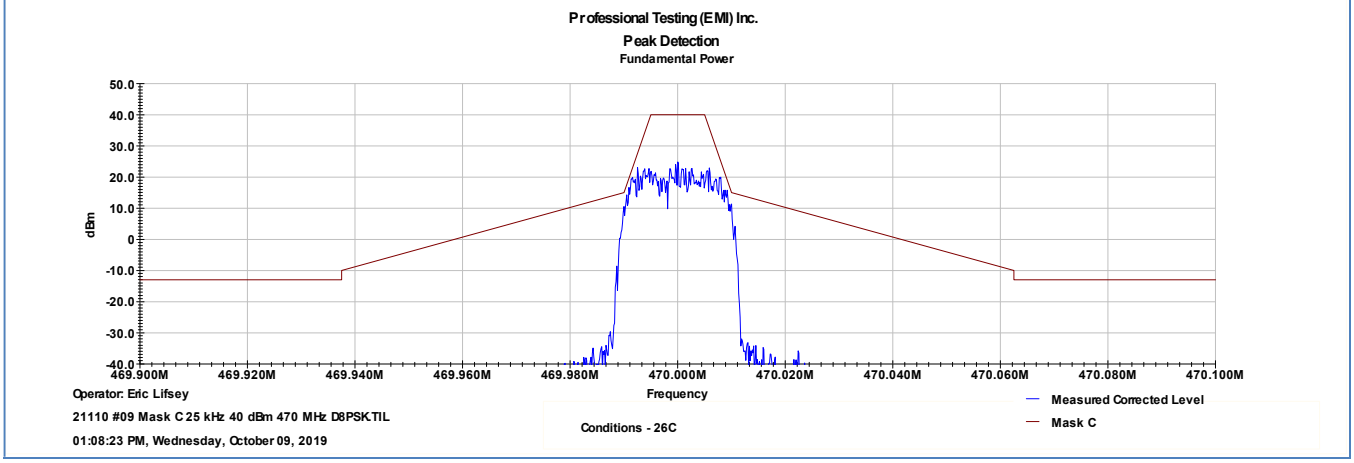
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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Frequency
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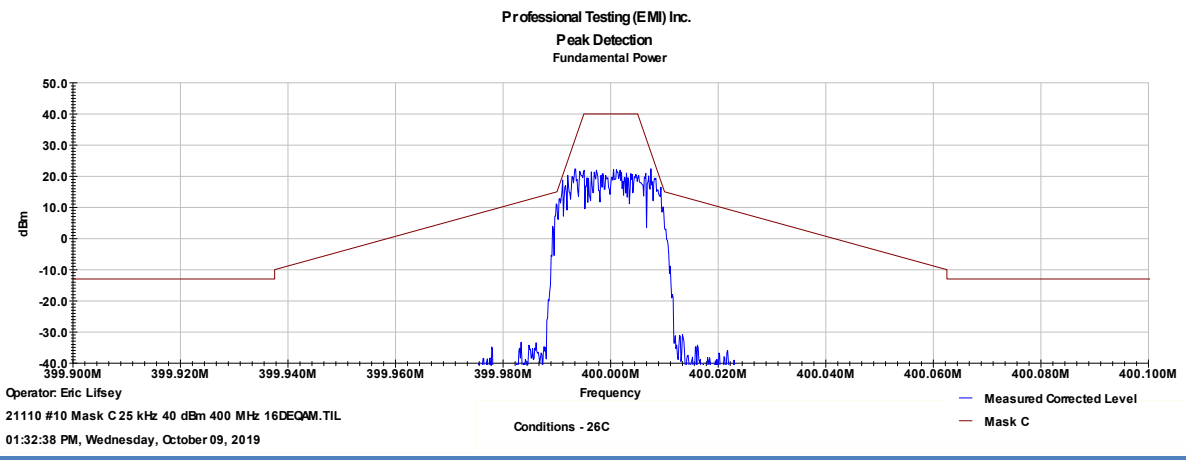
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Frequency
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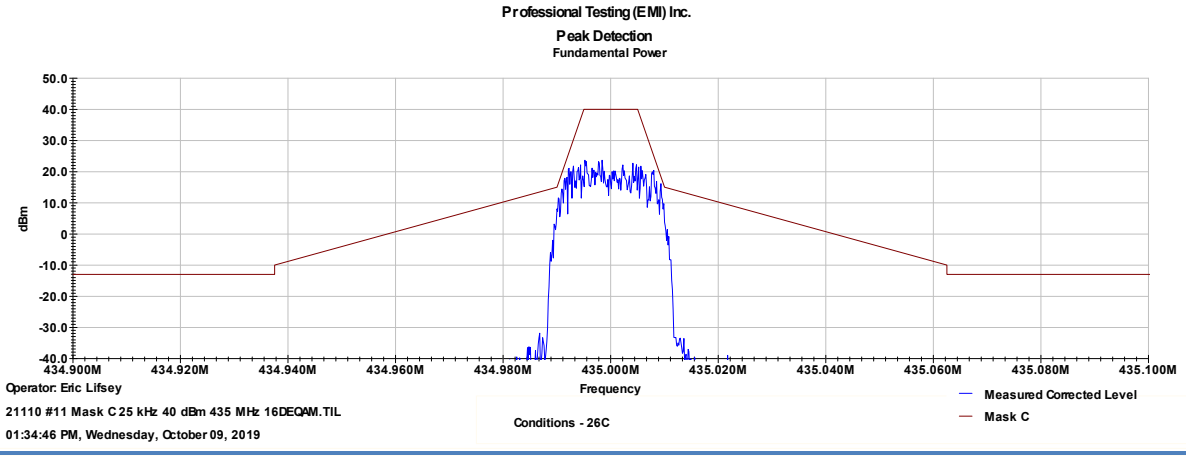
Professional Testing (EMI) Inc.
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-40.0
dBm
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434.920M
434.940M
434.960M
434.980M
435.000M
435.020M
435.040M
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435.080M
435.100M
Frequency
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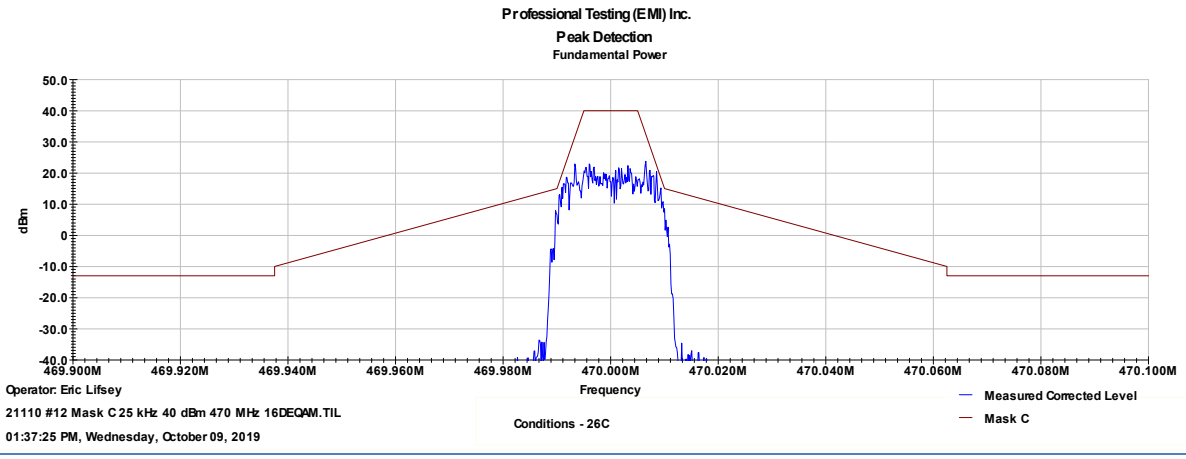
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
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-40.0
dBm
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469.920M
469.940M
469.960M
469.980M
470.000M
470.020M
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470.100M
Frequency
Operator: Eric Lifsey
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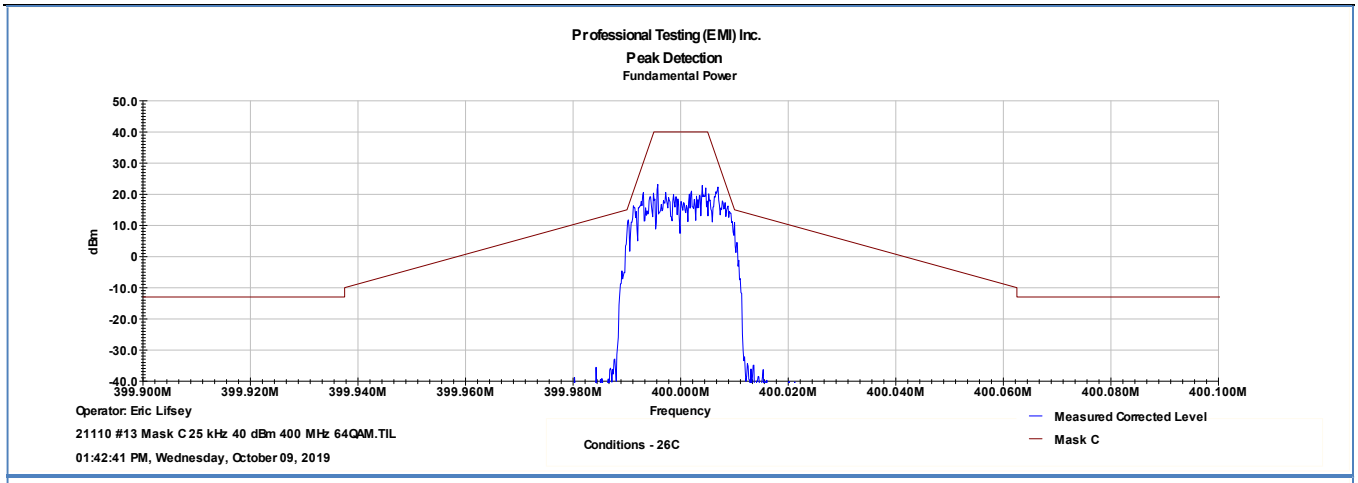
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
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400.100M
Frequency
Operator: Eric Lifsey
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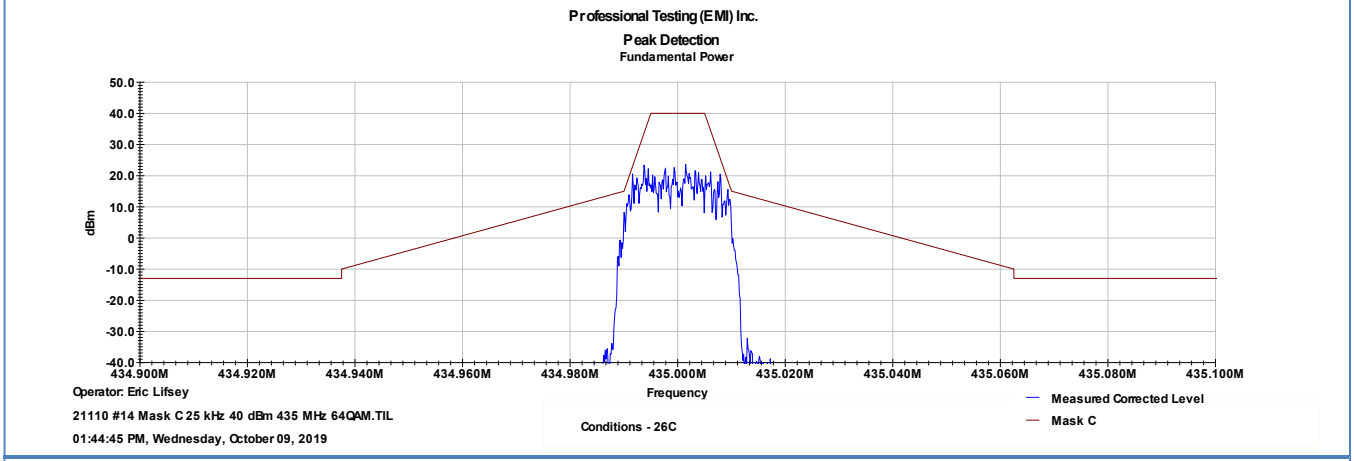
Conditions - 26C
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
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Frequency
Operator: Eric Lifsey
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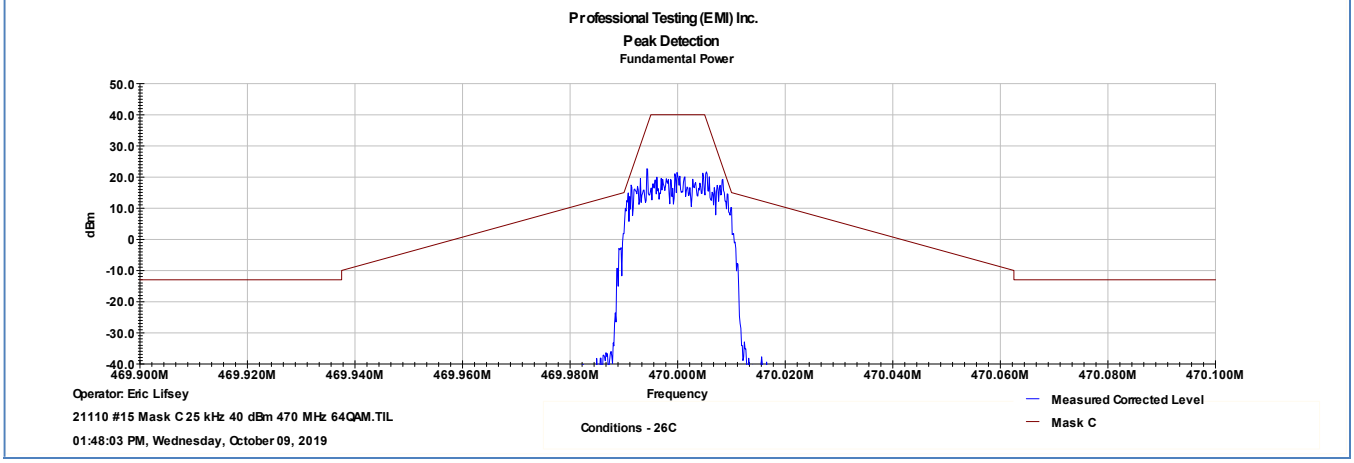
Conditions - 26C
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
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Frequency
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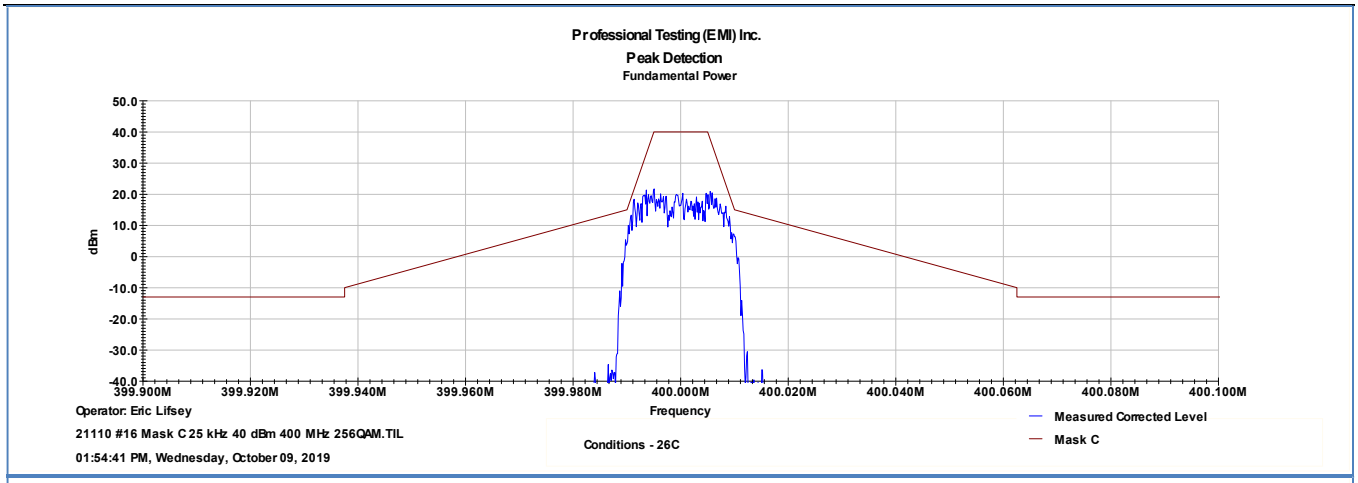
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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Frequency
Operator: Eric Lifsey
21110 #16 Mask C 25 kHz 40 dBm 400 MHz 256QAM.TIL
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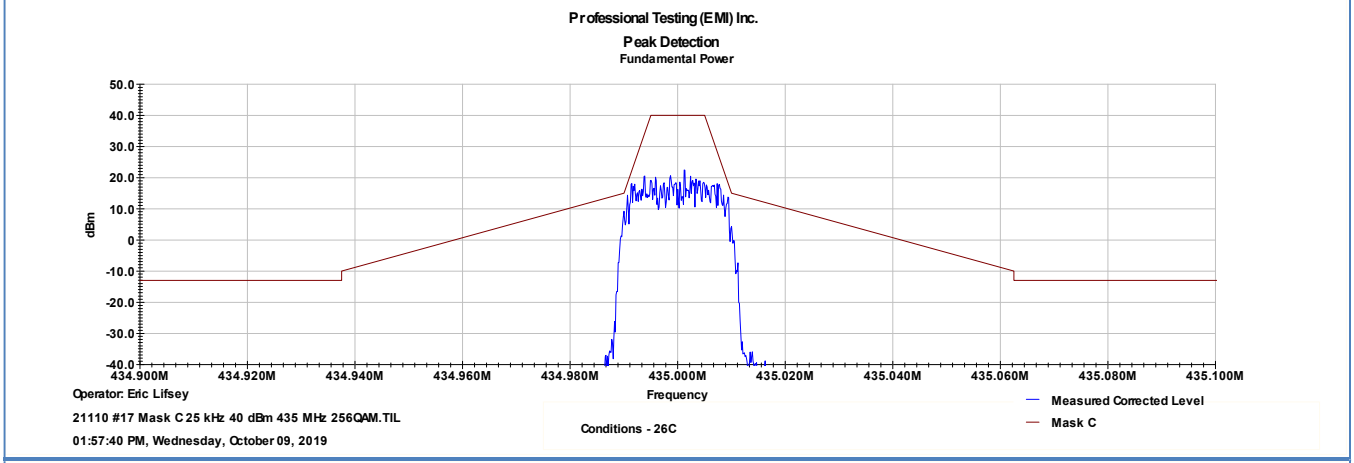
Conditions - 26C
Measured Corrected Level
Mask C


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
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Frequency
Operator: Eric Lifsey
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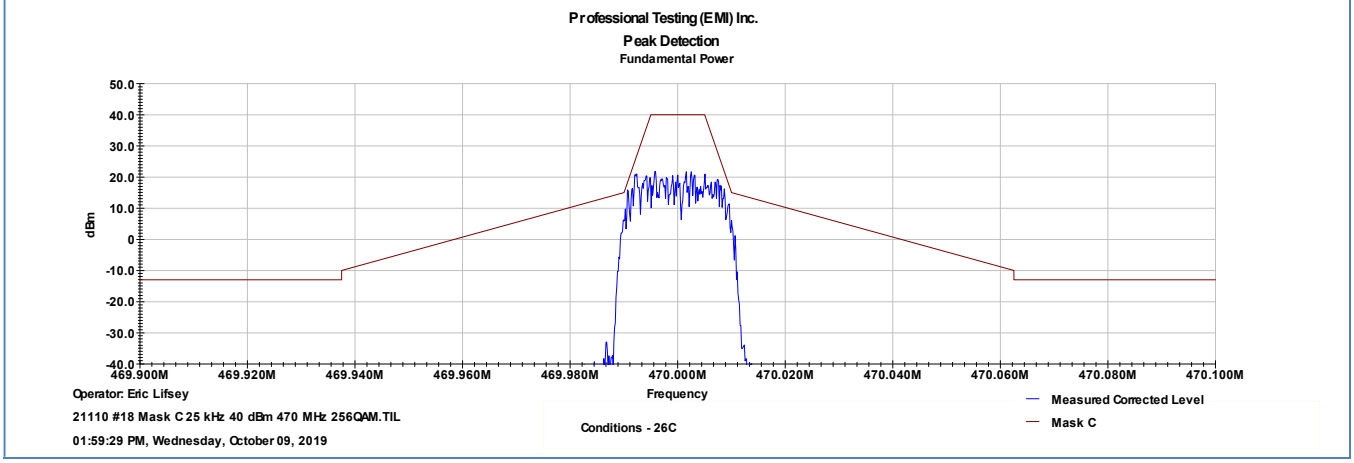
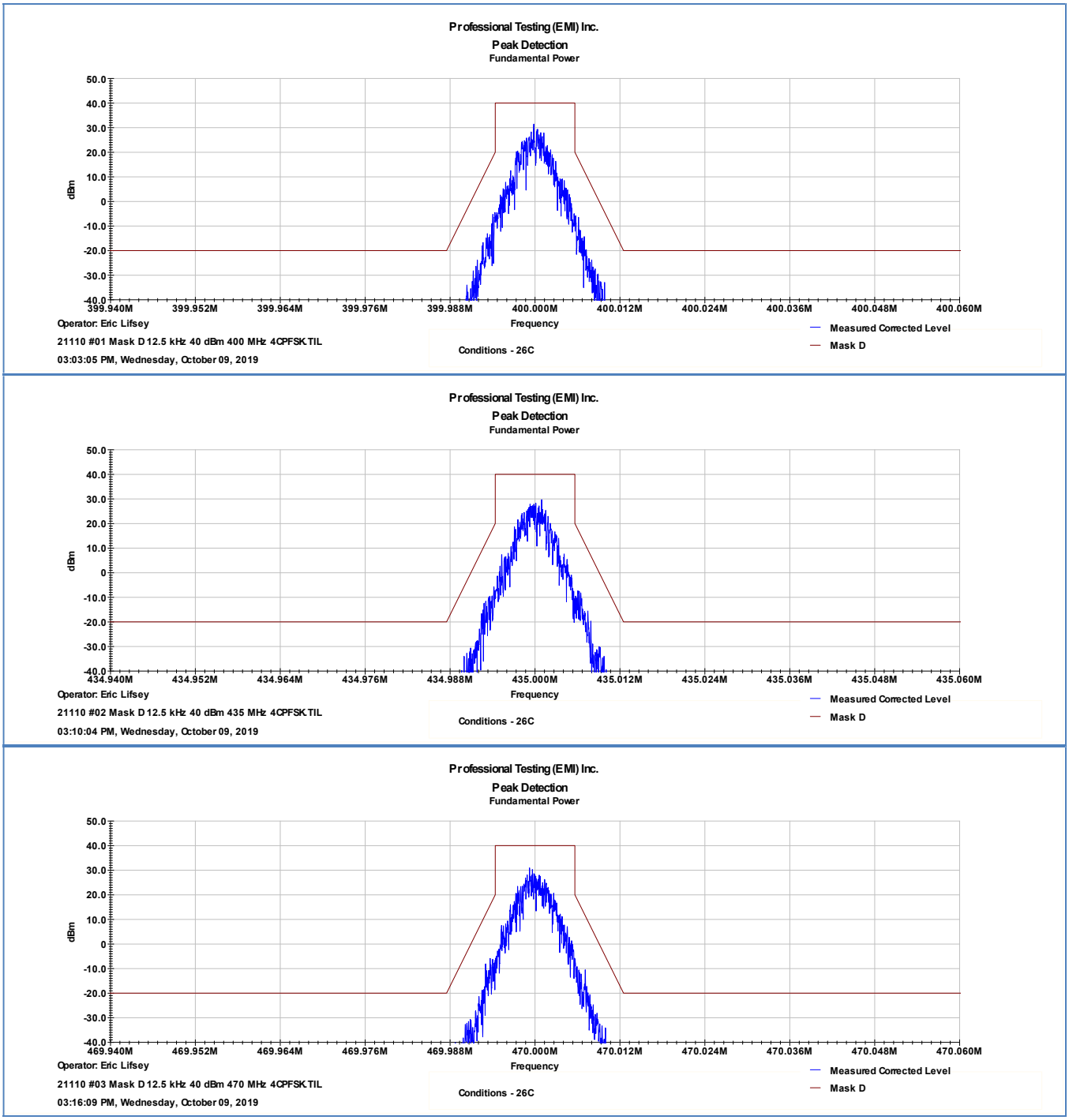
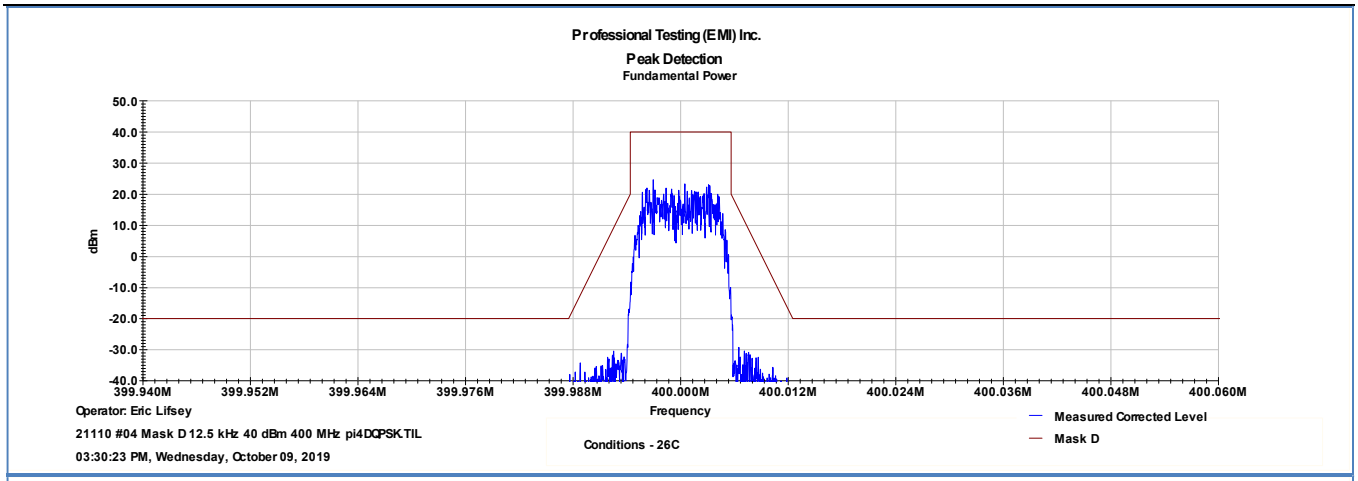
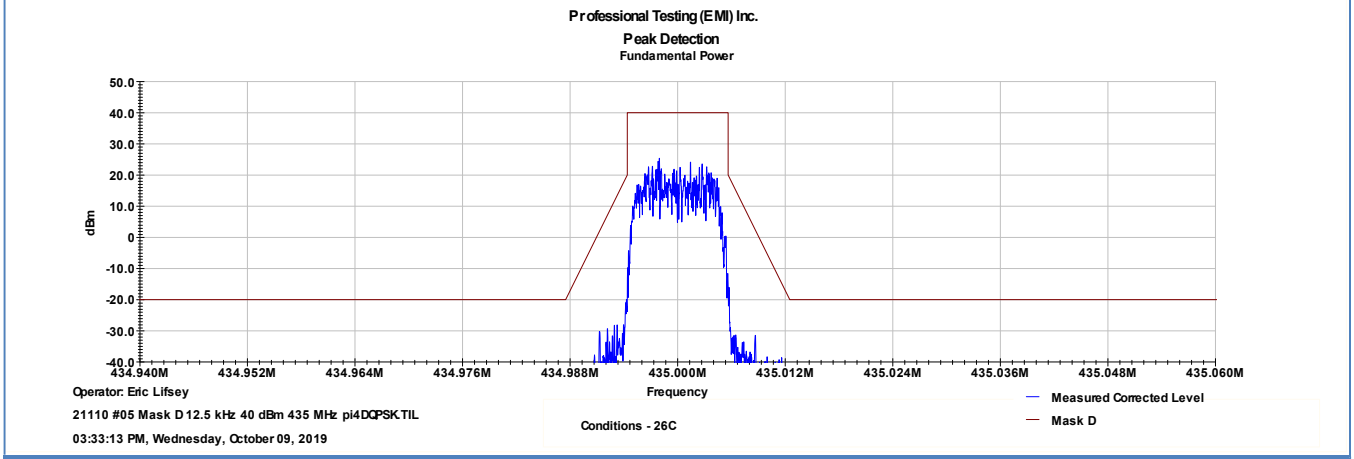
Conditions - 26C
Measured Corrected Level
Mask C

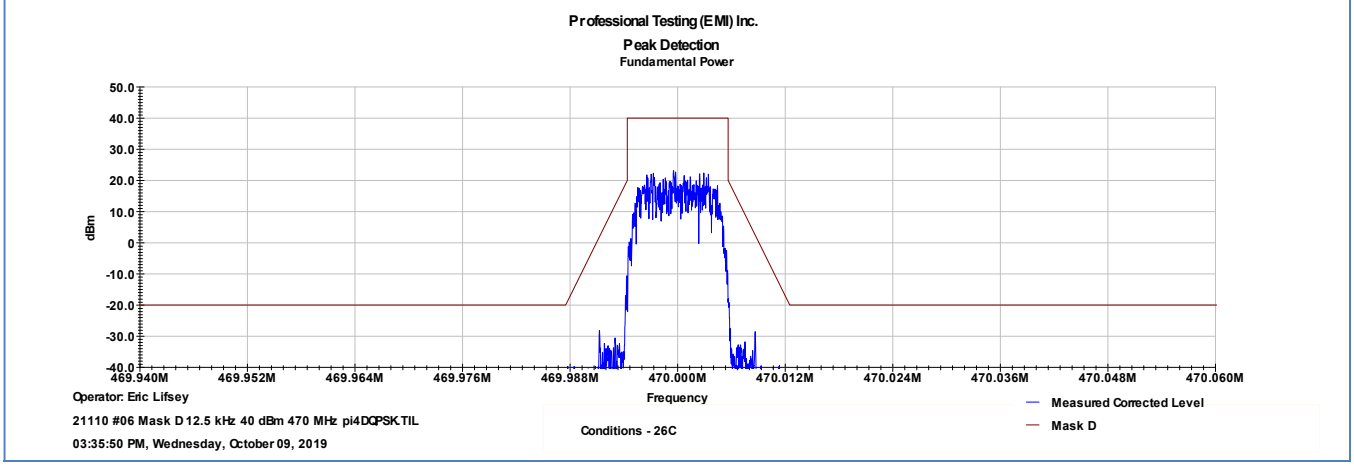

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.900M
469.920M
469.940M
469.960M
469.980M
470.000M
470.020M
470.040M
470.060M
470.080M
470.100M
Frequency
Operator: Eric Lifsey
21110 #18 Mask C 25 kHz 40 dBm 470 MHz 256QAM.TIL
01:59:29 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask C

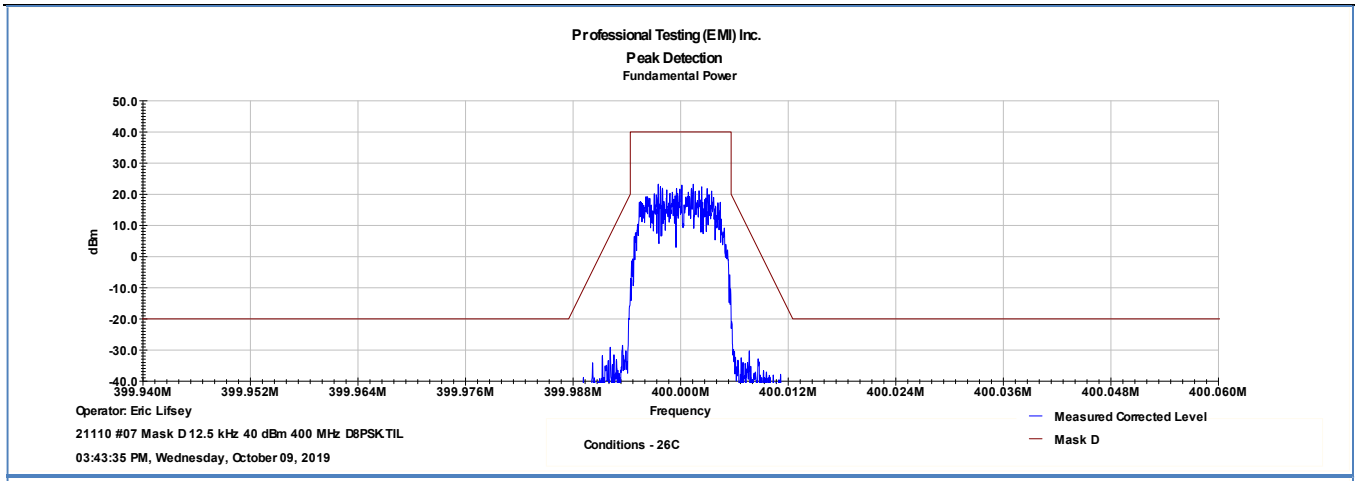
3.3.2 Mask D

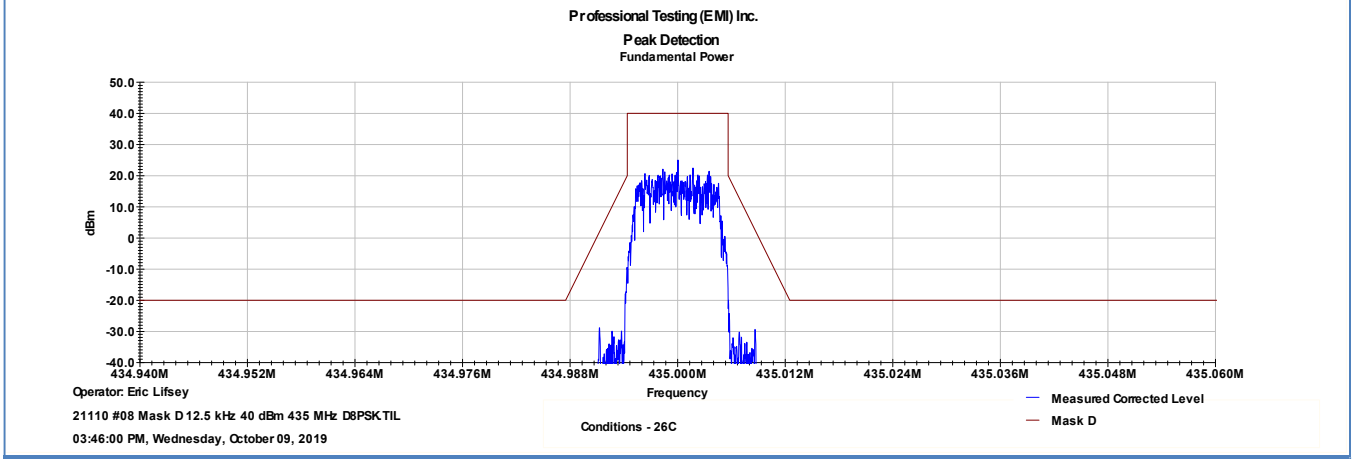

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #01 Mask D 12.5 kHz 40 dBm 400 MHz 4CPFSK.TIL
03:03:05 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D
Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #02 Mask D 12.5 kHz 40 dBm 435 MHz 4CPFSK.TIL
03:10:04 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D
Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #03 Mask D 12.5 kHz 40 dBm 470 MHz 4CPFSK.TIL
03:16:09 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

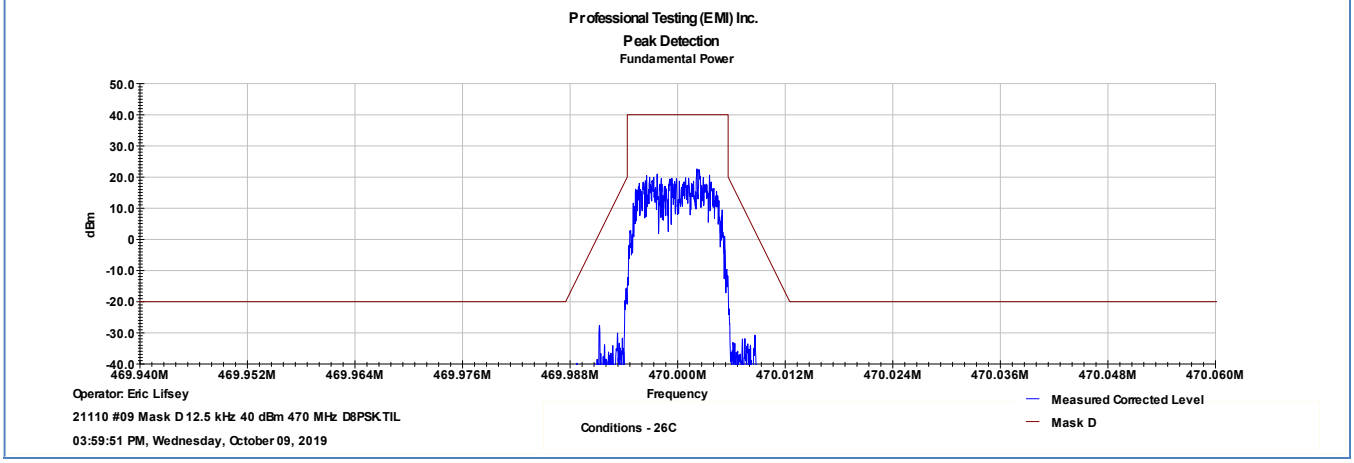

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #04 Mask D 12.5 kHz 40 dBm 400 MHz pi4DQPSK.TIL
03:30:23 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

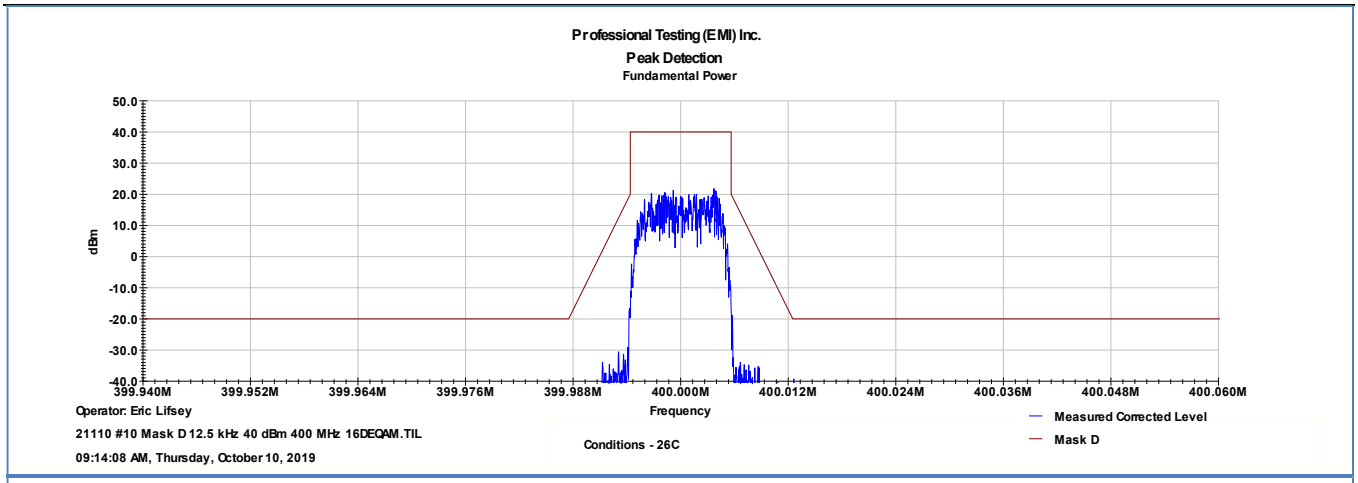

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #05 Mask D 12.5 kHz 40 dBm 435 MHz pi4DQPSK.TIL
03:33:13 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

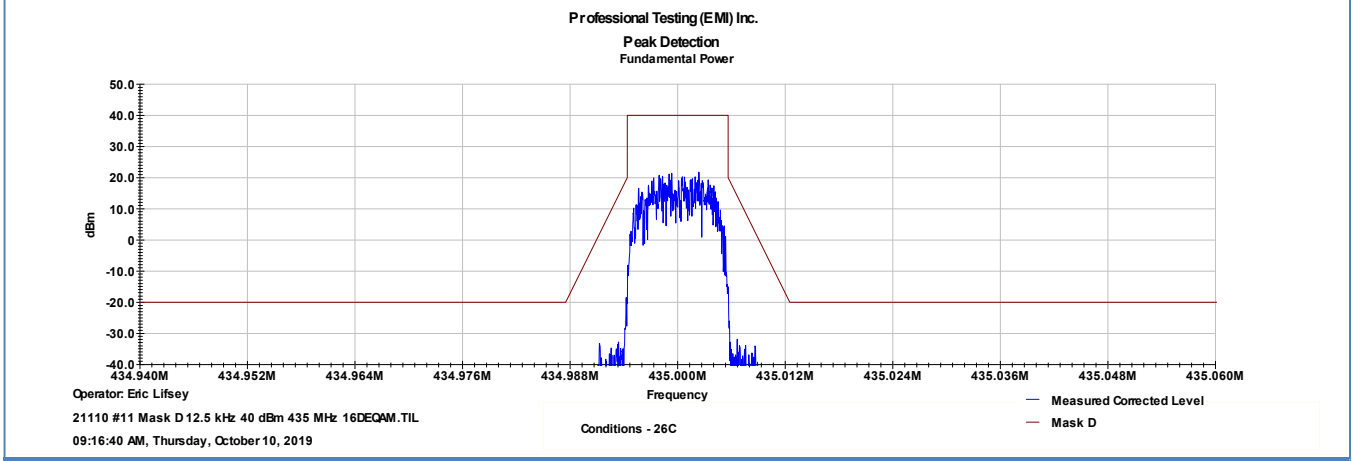

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #06 Mask D 12.5 kHz 40 dBm 470 MHz pi4DQPSK.TIL
03:35:50 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

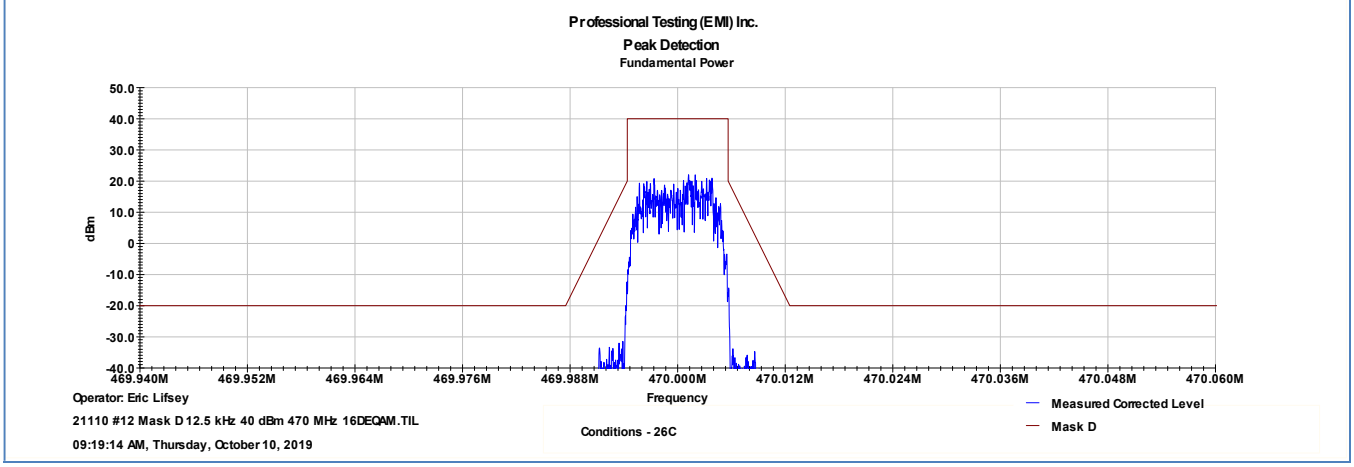

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #07 Mask D 12.5 kHz 40 dBm 400 MHz D8PSK TIL
03:43:35 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

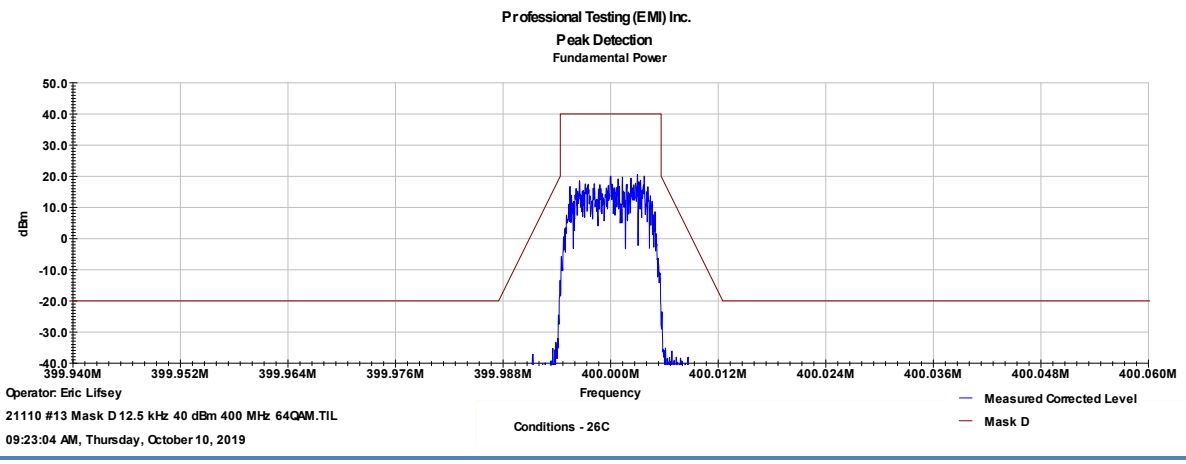

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #08 Mask D 12.5 kHz 40 dBm 435 MHz D8PSK TIL
03:46:00 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

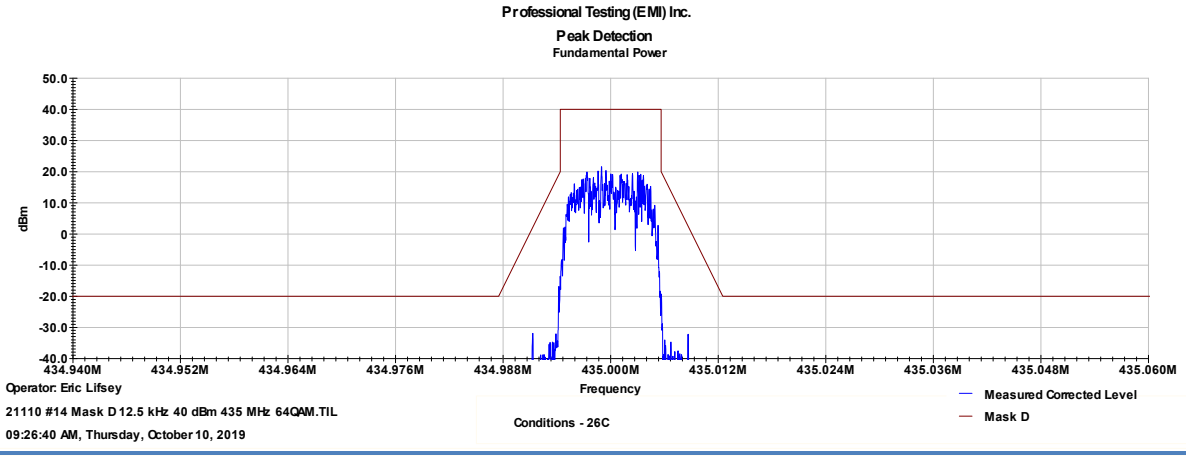

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #09 Mask D 12.5 kHz 40 dBm 470 MHz D8PSK TIL
03:59:51 PM, Wednesday, October 09, 2019
Conditions - 26C
Measured Corrected Level
Mask D

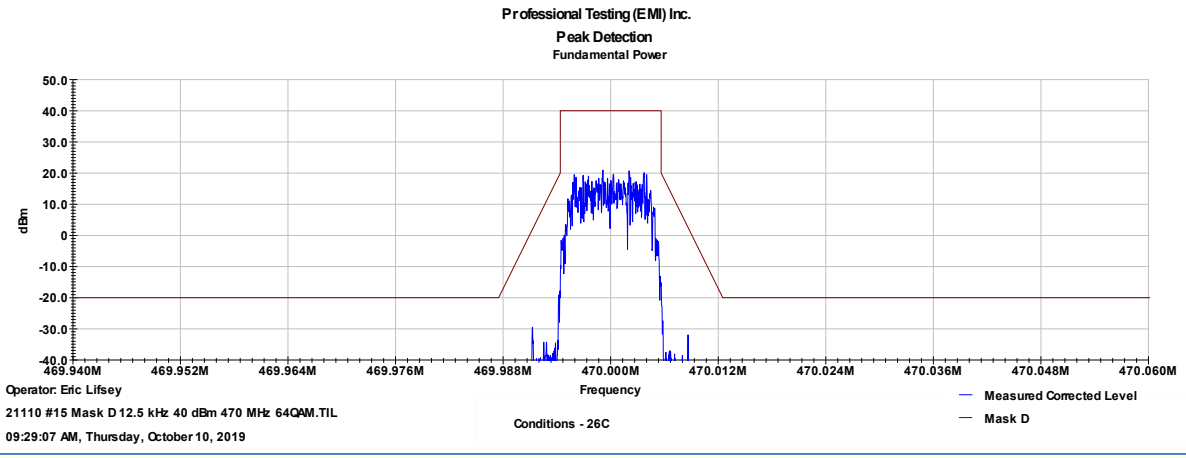

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #10 Mask D 12.5 kHz 40 dBm 400 MHz 16DEQAM.TIL
09:14:08 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

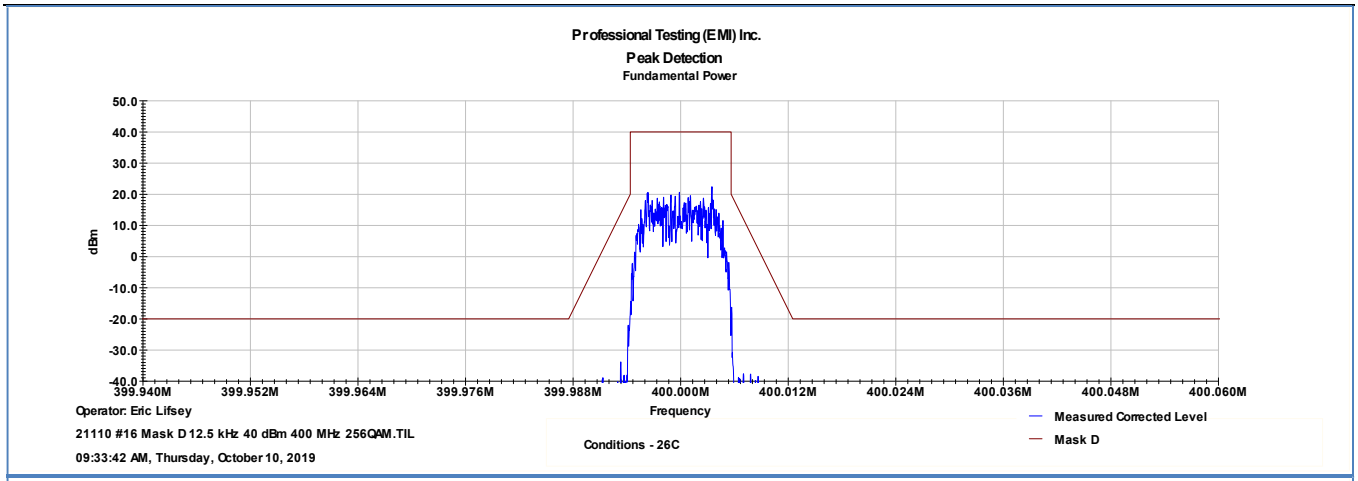

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #11 Mask D 12.5 kHz 40 dBm 435 MHz 16DEQAM.TIL
09:16:40 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

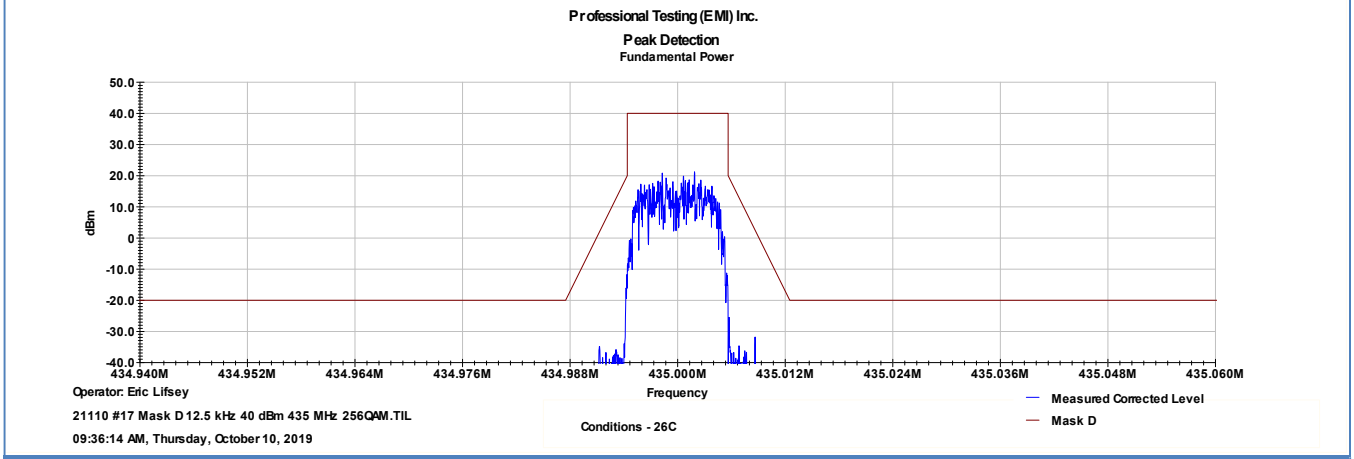

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #12 Mask D 12.5 kHz 40 dBm 470 MHz 16DEQAM.TIL
09:19:14 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

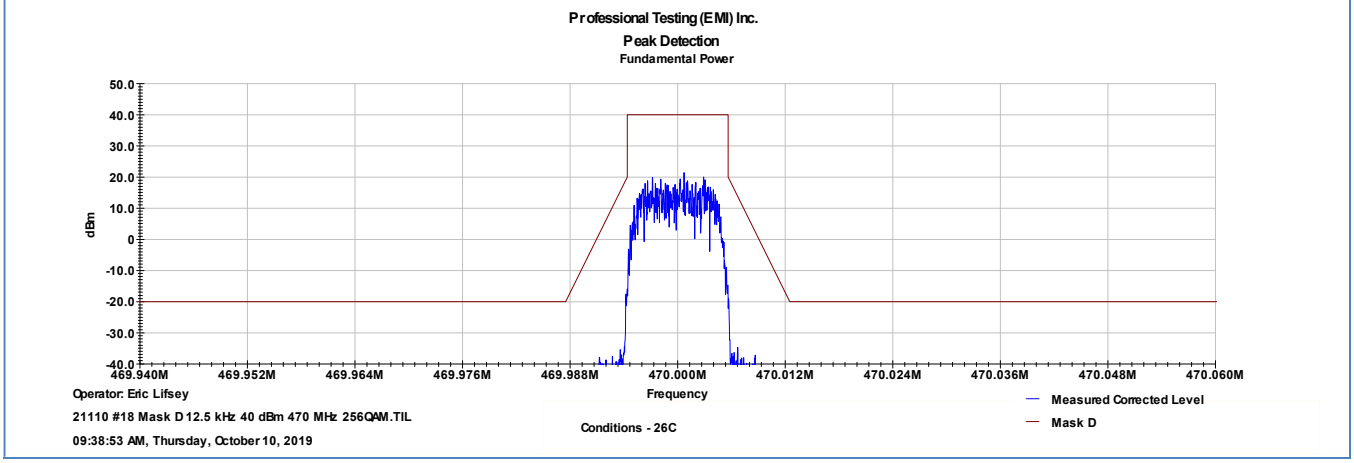

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #13 Mask D 12.5 kHz 40 dBm 400 MHz 64QAM.TIL
09:23:04 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #14 Mask D 12.5 kHz 40 dBm 435 MHz 64QAM.TIL
09:26:40 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

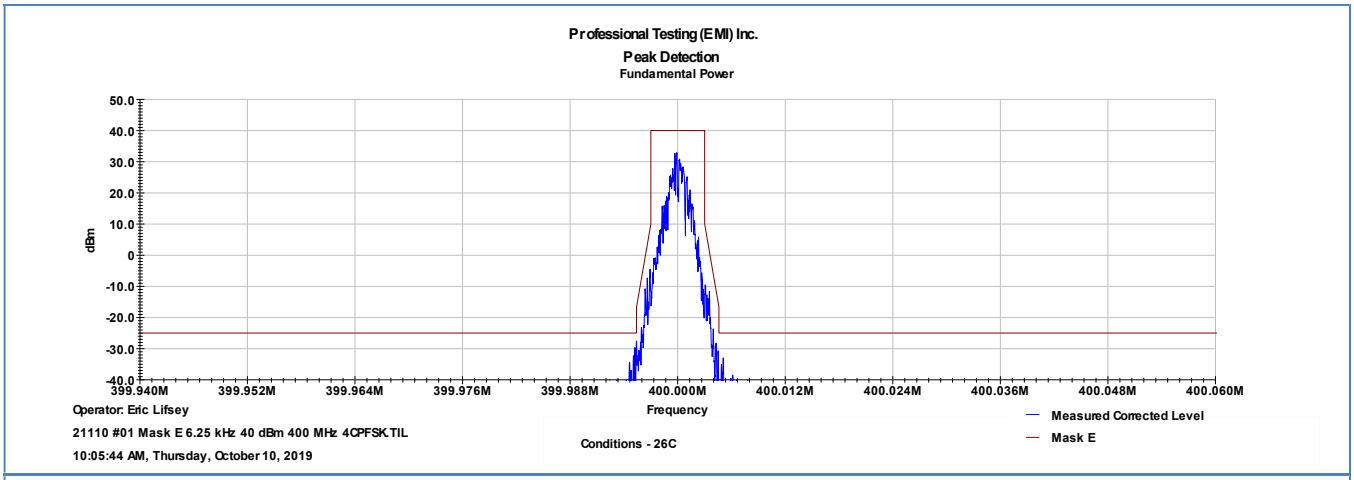

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #15 Mask D 12.5 kHz 40 dBm 470 MHz 64QAM.TIL
09:29:07 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

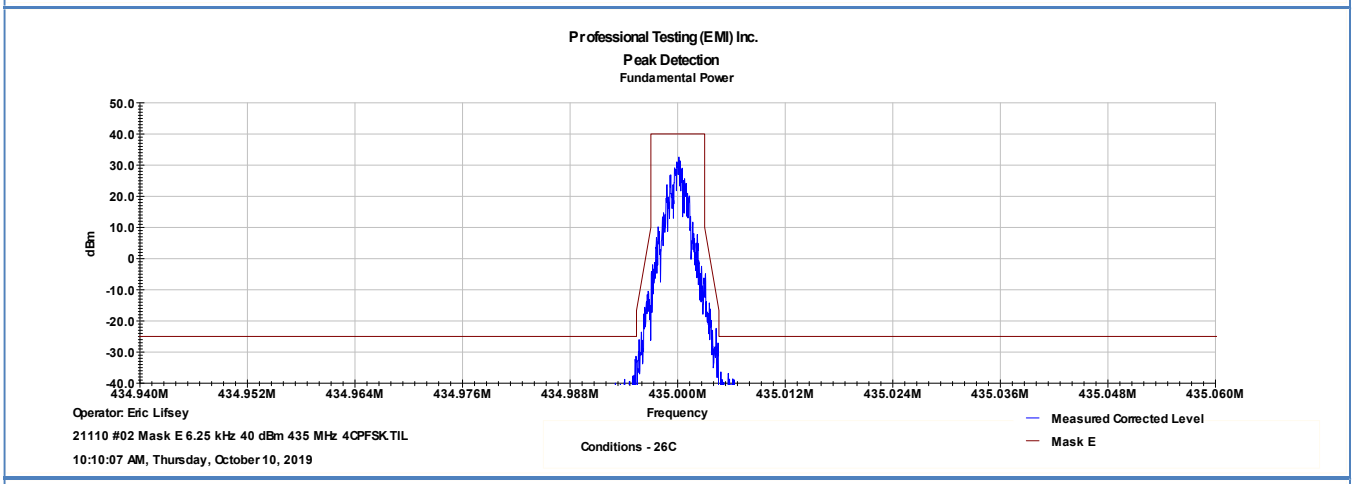

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #16 Mask D 12.5 kHz 40 dBm 400 MHz 256QAM.TIL
09:33:42 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

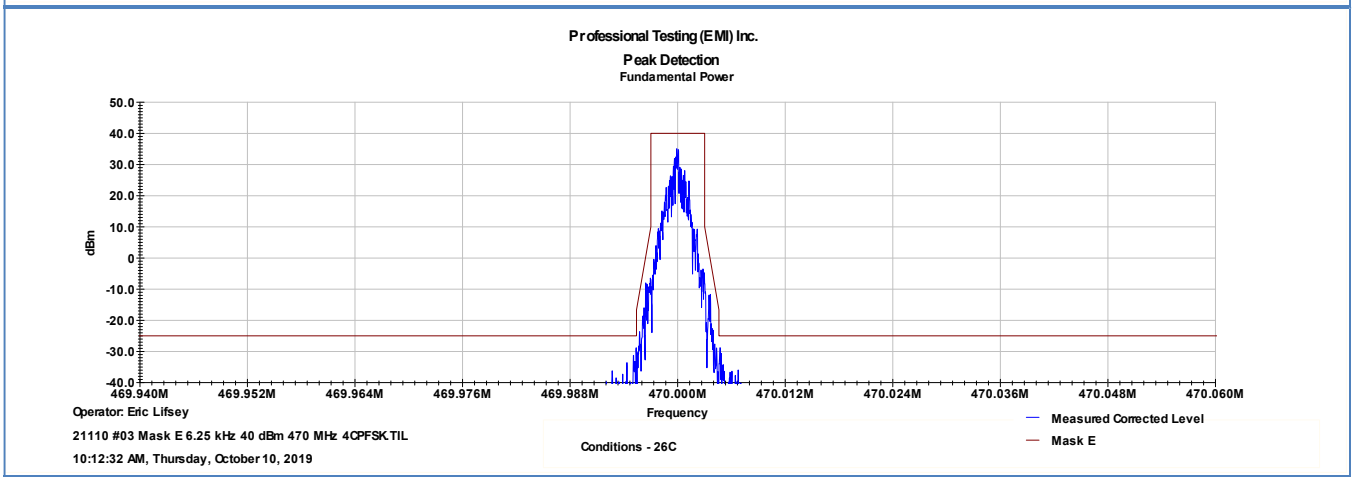

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #17 Mask D 12.5 kHz 40 dBm 435 MHz 256QAM.TIL
09:36:14 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

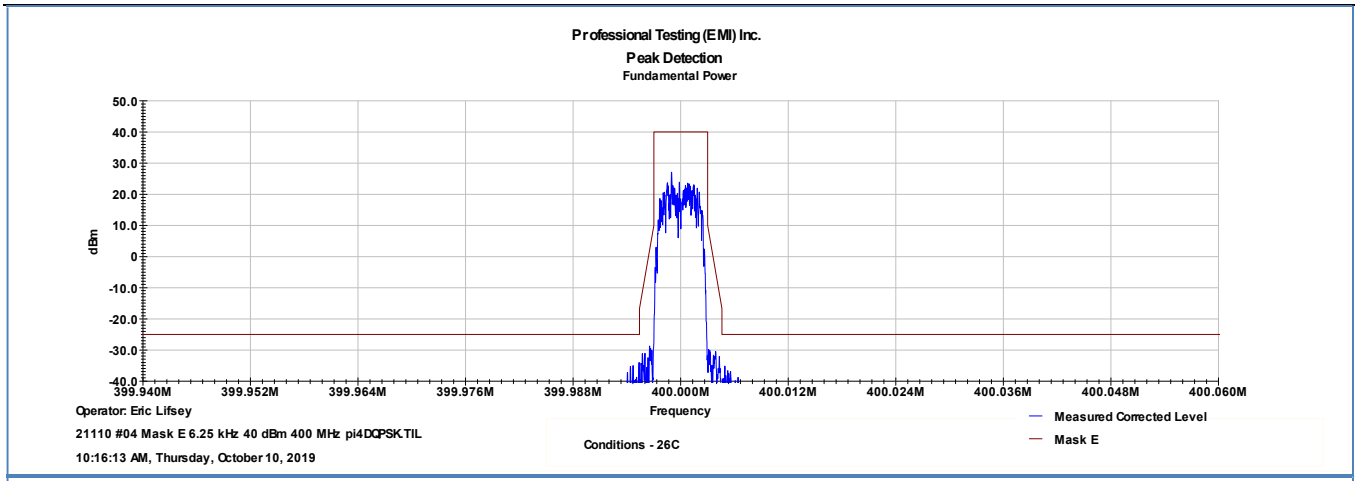

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #18 Mask D 12.5 kHz 40 dBm 470 MHz 256QAM.TIL
09:38:53 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask D

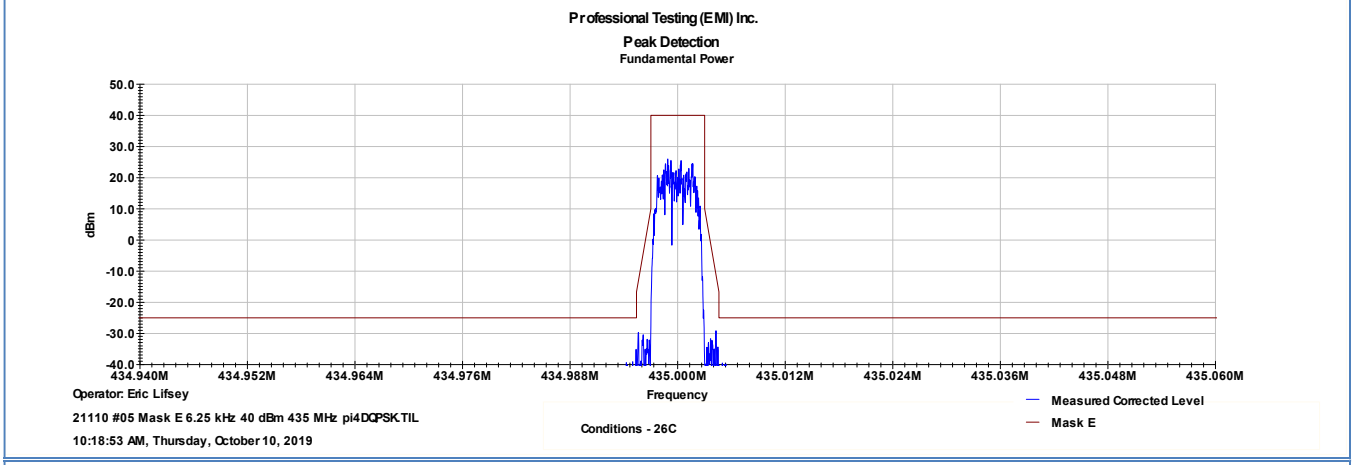
3.3.3 Mask E

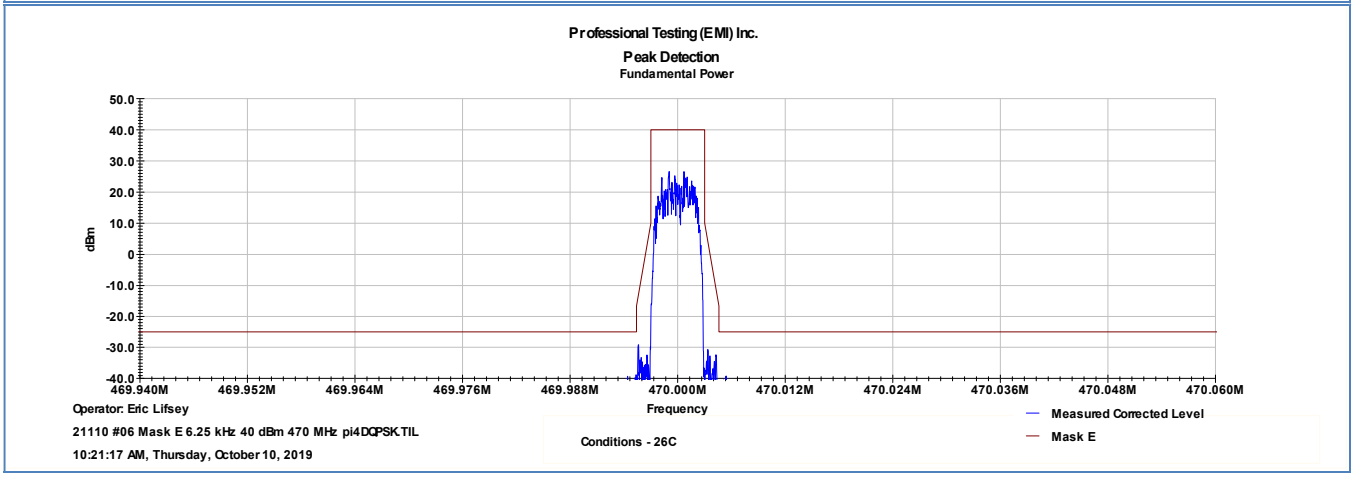

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #01 Mask E 6.25 kHz 40 dBm 400 MHz 4CPFSK.TIL
10:05:44 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

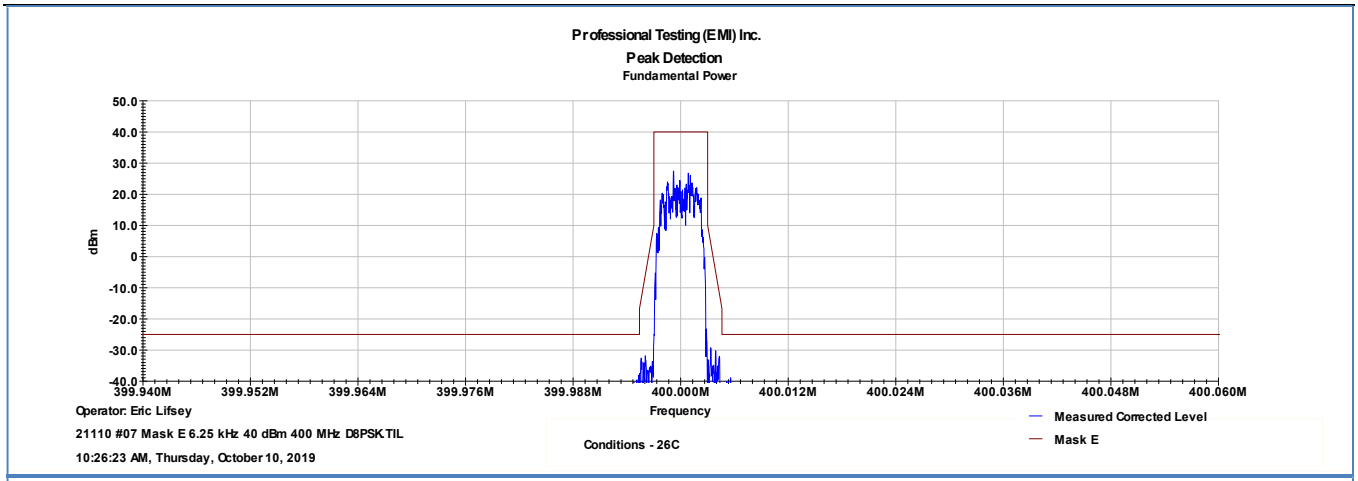

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #02 Mask E 6.25 kHz 40 dBm 435 MHz 4CPFSK.TIL
10:10:07 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

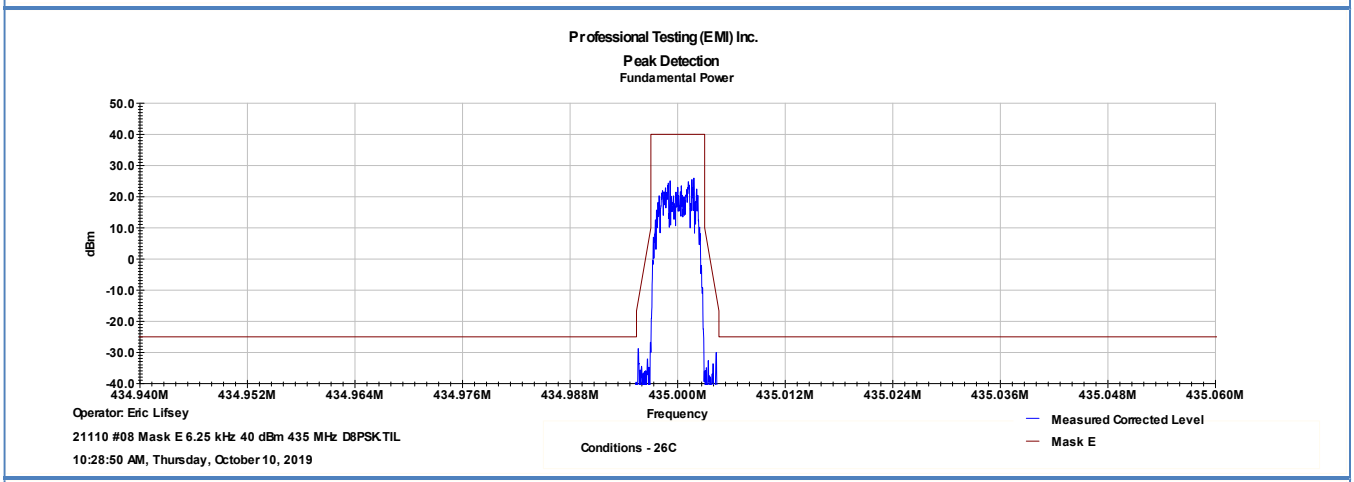

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #03 Mask E 6.25 kHz 40 dBm 470 MHz 4CPFSK.TIL
10:12:32 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

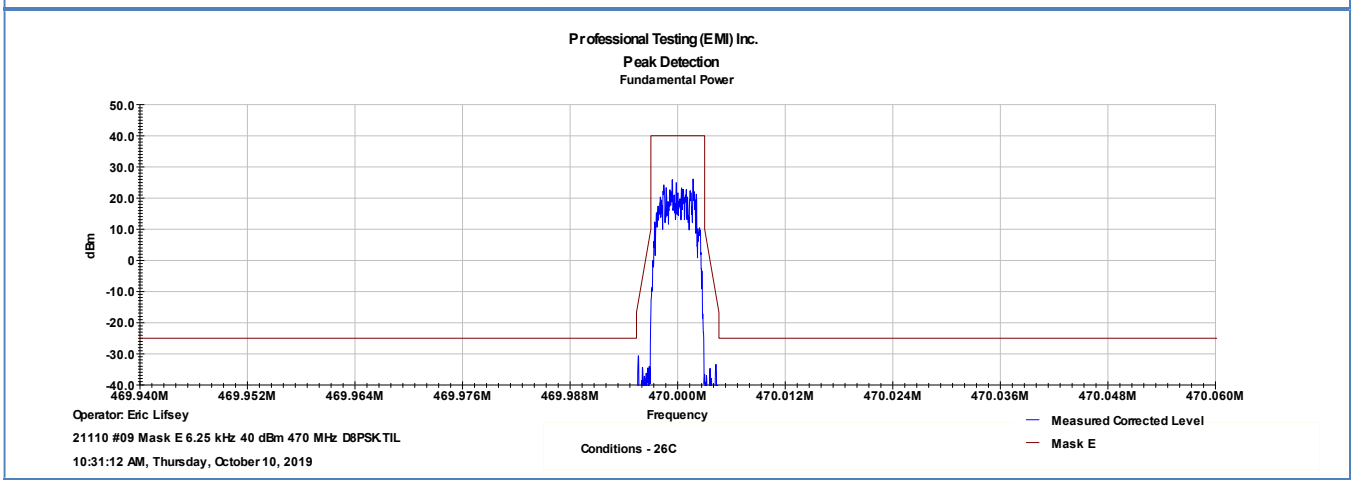

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #04 Mask E 6.25 kHz 40 dBm 400 MHz pi4DQPSK.TIL
10:16:13 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

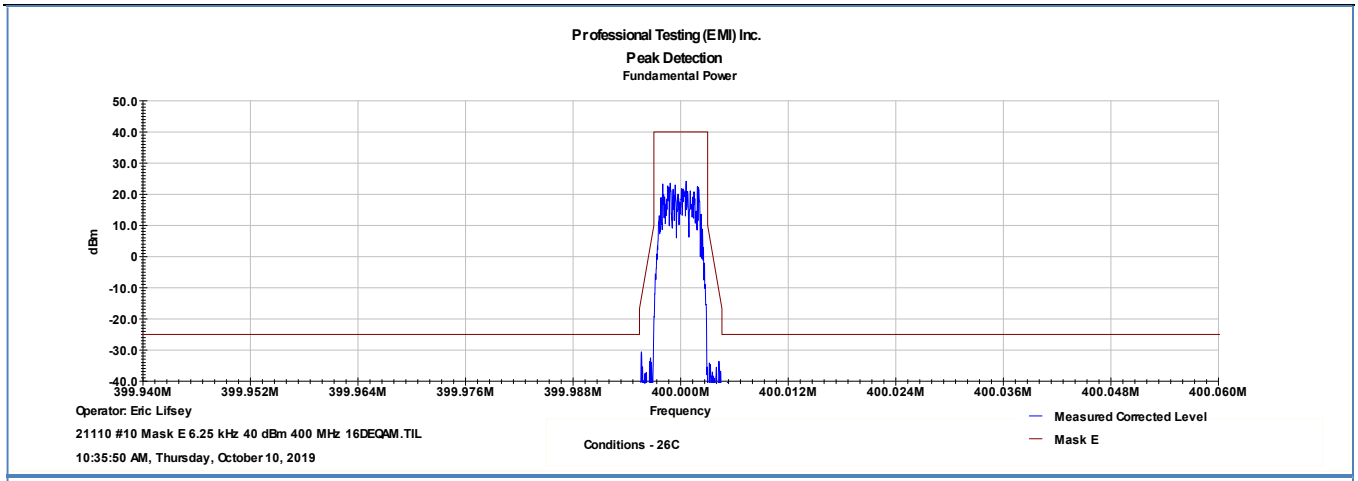

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #05 Mask E 6.25 kHz 40 dBm 435 MHz pi4DQPSK.TIL
10:18:53 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

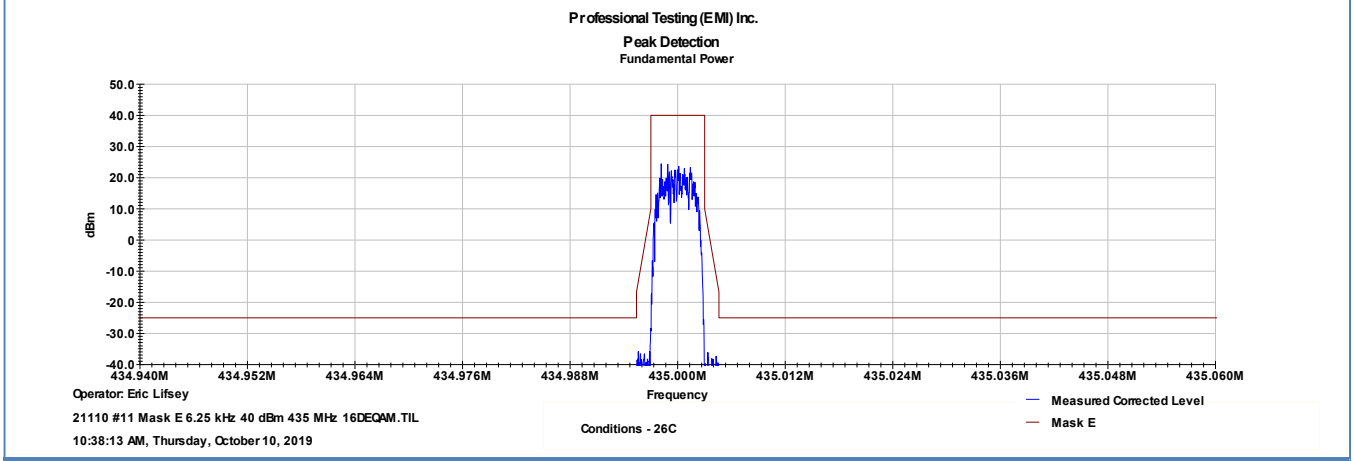

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #06 Mask E 6.25 kHz 40 dBm 470 MHz pi4DQPSK.TIL
10:21:17 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

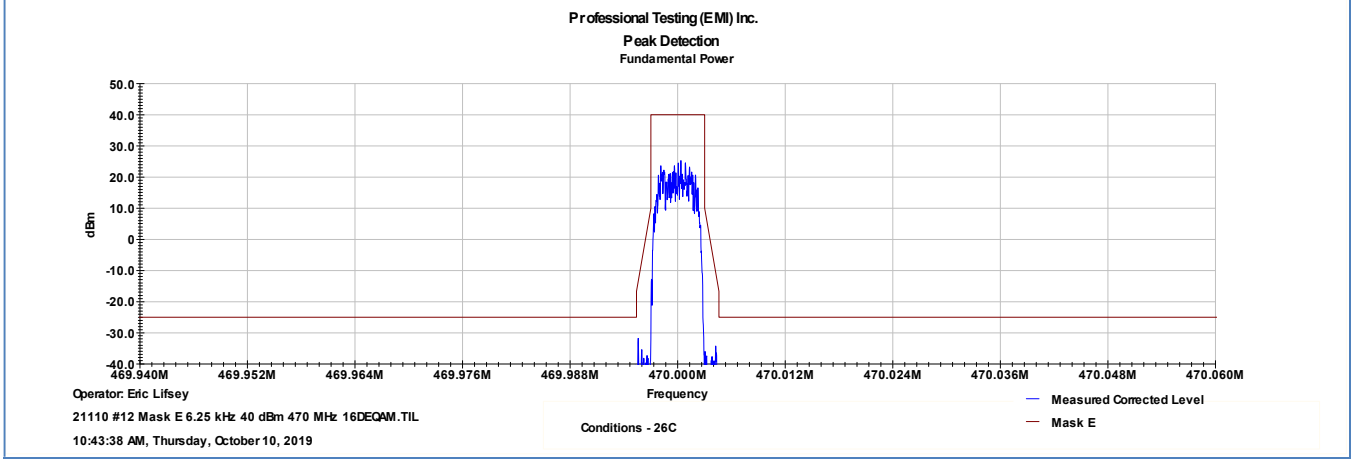

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #07 Mask E 6.25 kHz 40 dBm 400 MHz D8PSK TIL
10:26:23 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

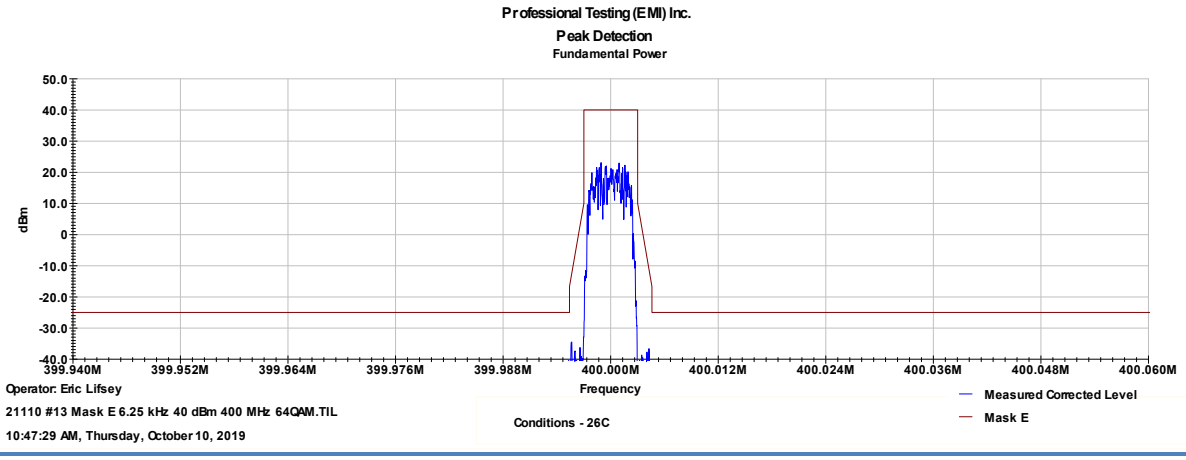

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #08 Mask E 6.25 kHz 40 dBm 435 MHz D8PSK TIL
10:28:50 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

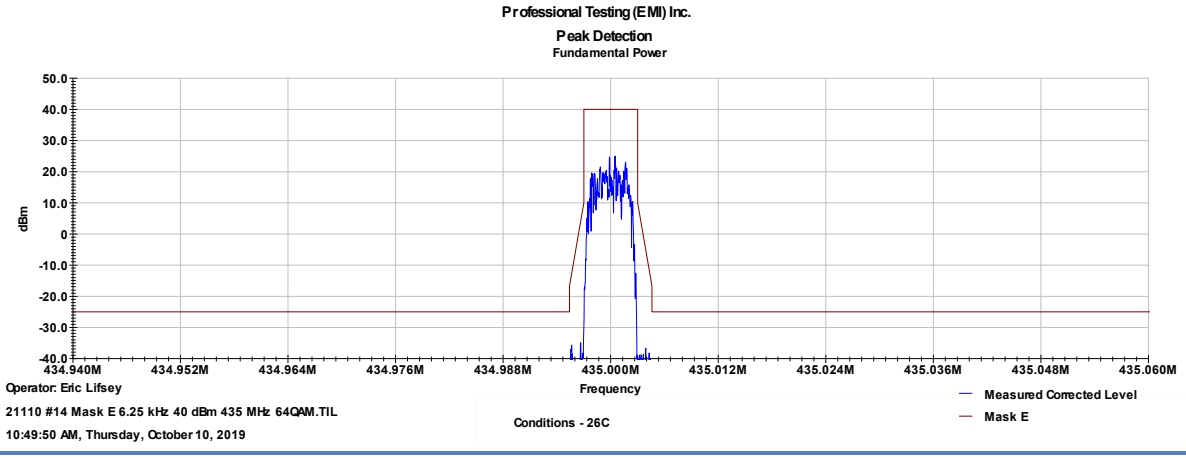

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #09 Mask E 6.25 kHz 40 dBm 470 MHz D8PSK TIL
10:31:12 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

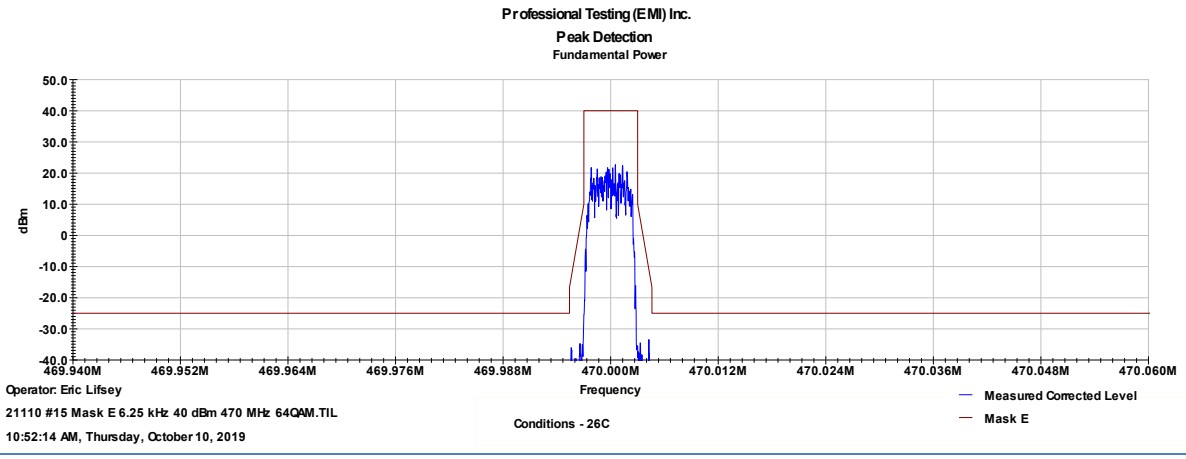

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #10 Mask E 6.25 kHz 40 dBm 400 MHz 16DEQAM.TIL
10:35:50 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

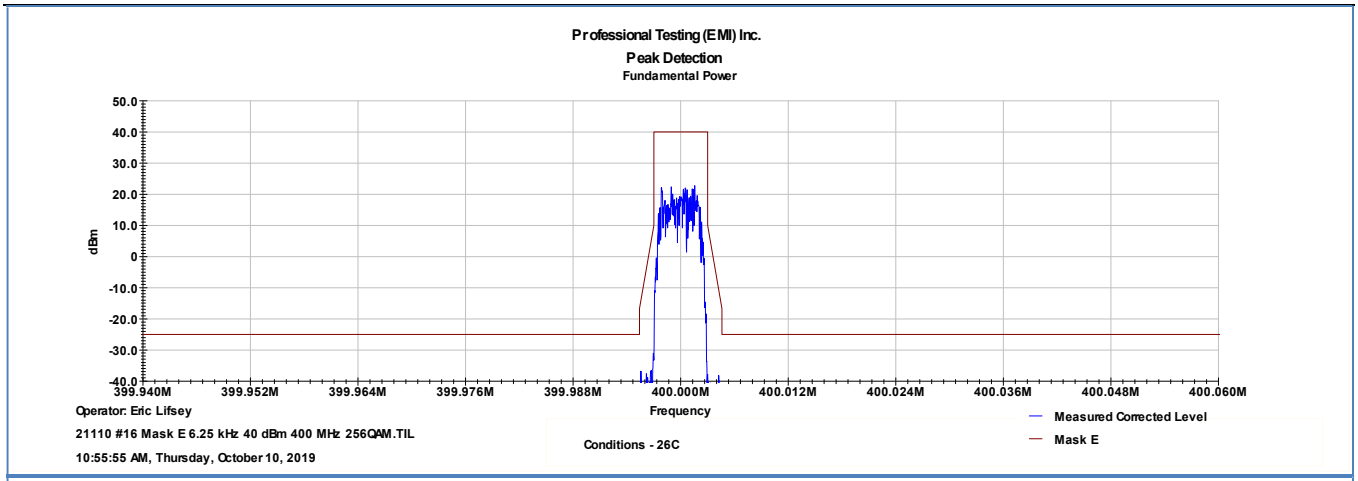

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #11 Mask E 6.25 kHz 40 dBm 435 MHz 16DEQAM.TIL
10:38:13 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

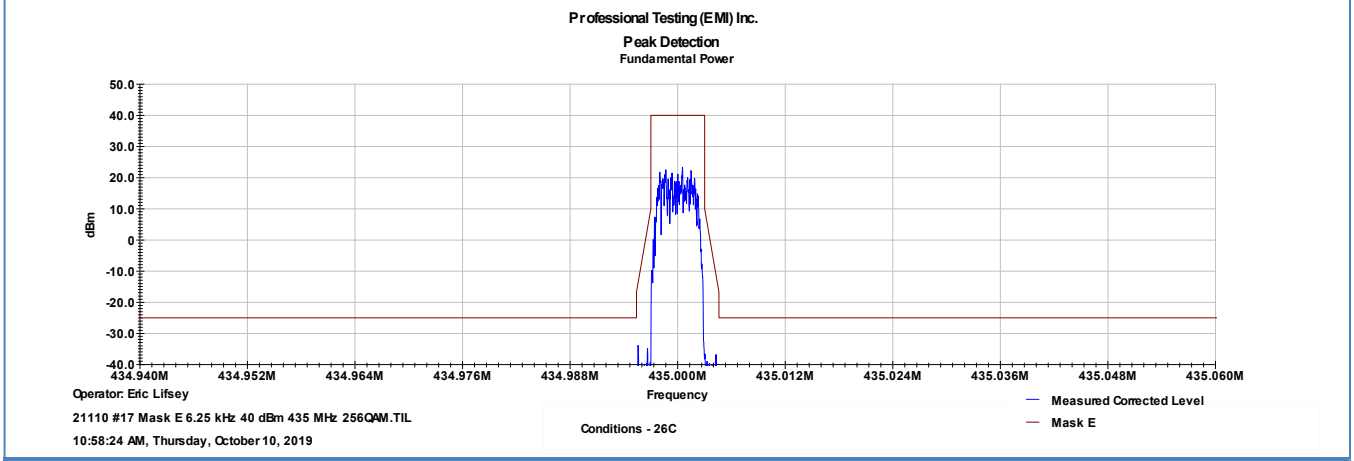

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #12 Mask E 6.25 kHz 40 dBm 470 MHz 16DEQAM.TIL
10:43:38 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

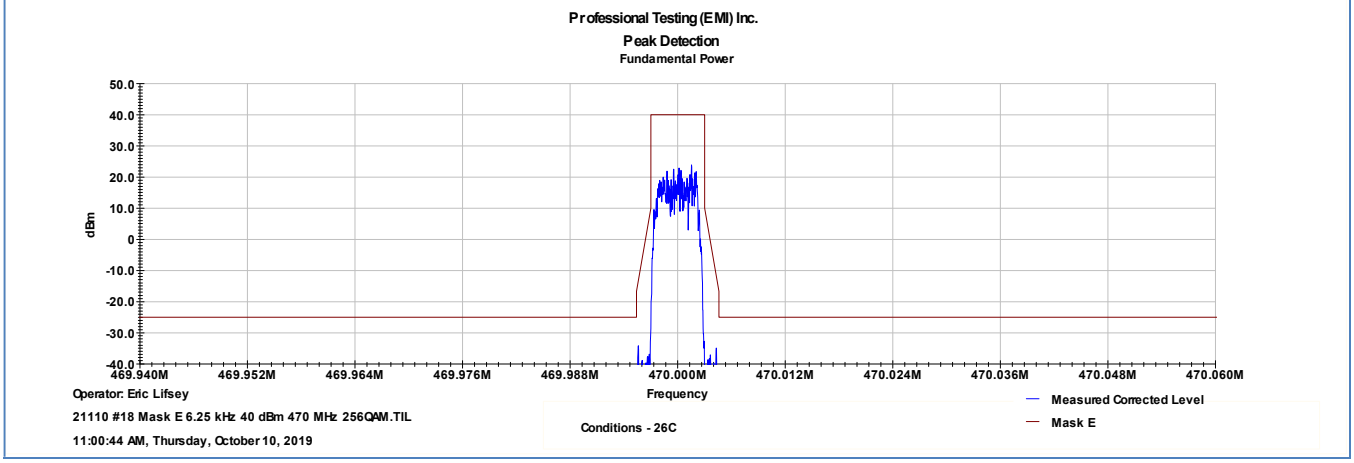

Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #13 Mask E 6.25 kHz 40 dBm 400 MHz 64QAM.TIL
10:47:29 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #14 Mask E 6.25 kHz 40 dBm 435 MHz 64QAM.TIL
10:49:50 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
dBm
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #15 Mask E 6.25 kHz 40 dBm 470 MHz 64QAM.TIL
10:52:14 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
399.940M
399.952M
399.964M
399.976M
399.988M
400.000M
400.012M
400.024M
400.036M
400.048M
400.060M
Frequency
Operator: Eric Lifsey
21110 #16 Mask E 6.25 kHz 40 dBm 400 MHz 256QAM.TIL
10:55:55 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
434.940M
434.952M
434.964M
434.976M
434.988M
435.000M
435.012M
435.024M
435.036M
435.048M
435.060M
Frequency
Operator: Eric Lifsey
21110 #17 Mask E 6.25 kHz 40 dBm 435 MHz 256QAM.TIL
10:58:24 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E


Professional Testing (EMI) Inc.
Peak Detection
Fundamental Power
dBm
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
469.940M
469.952M
469.964M
469.976M
469.988M
470.000M
470.012M
470.024M
470.036M
470.048M
470.060M
Frequency
Operator: Eric Lifsey
21110 #18 Mask E 6.25 kHz 40 dBm 470 MHz 256QAM.TIL
11:00:44 AM, Thursday, October 10, 2019
Conditions - 26C
Measured Corrected Level
Mask E

4.0 Spurious Emissions at Antenna Terminals

4.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode. The connection is otherwise direct and no cables are used. Spurious signals are then measured directly with attenuator loss applied. Emissions are measured with a peak detector from 9 kHz to 5 GHz to include the tenth harmonic.

4.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals	90.210, 2.1047| RSS-119 Issue 12, 5.8	18 Aug 2017

Limit is determined in section 2.4 for emissions beyond the authorized bandwidth.

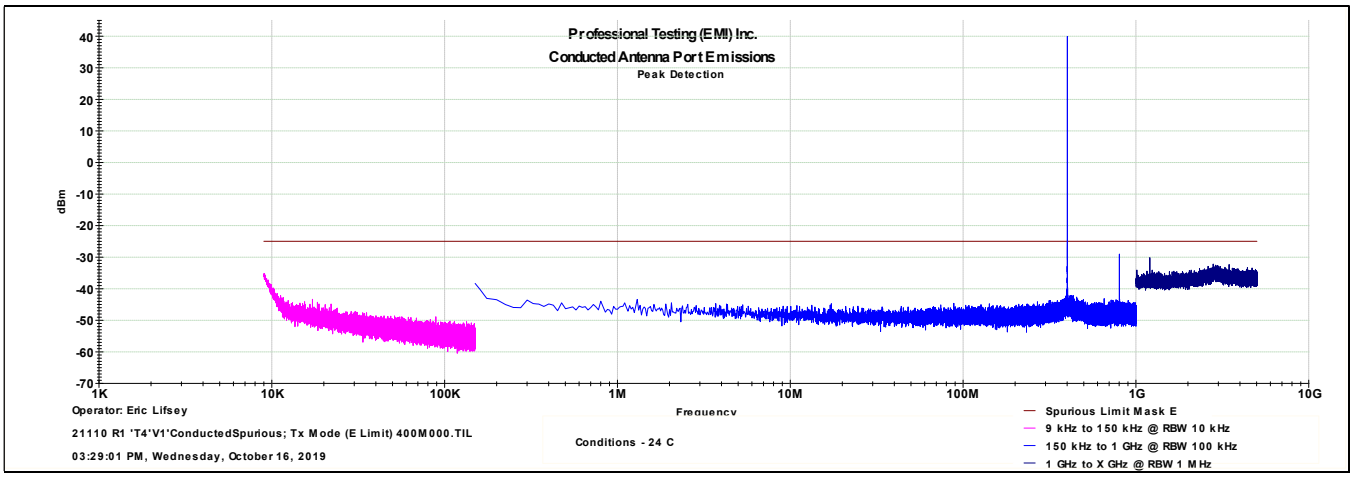
4.3 Results

Setup per section 1.7.

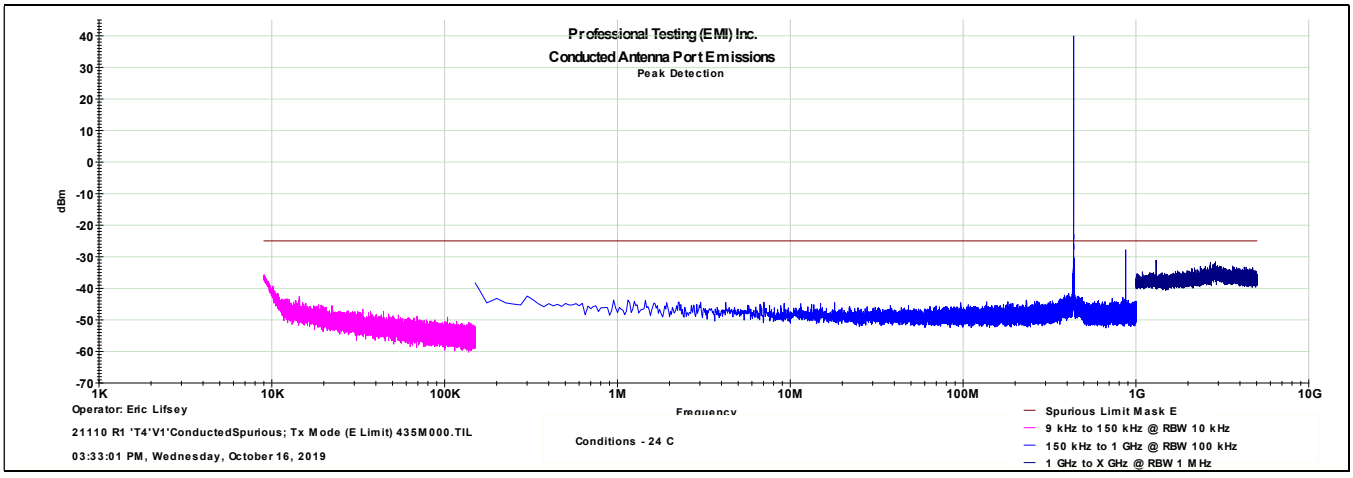
Highest recorded spurious emission: -27.9 dBm at 869.995 MHz.

The EUT satisfied the requirement.

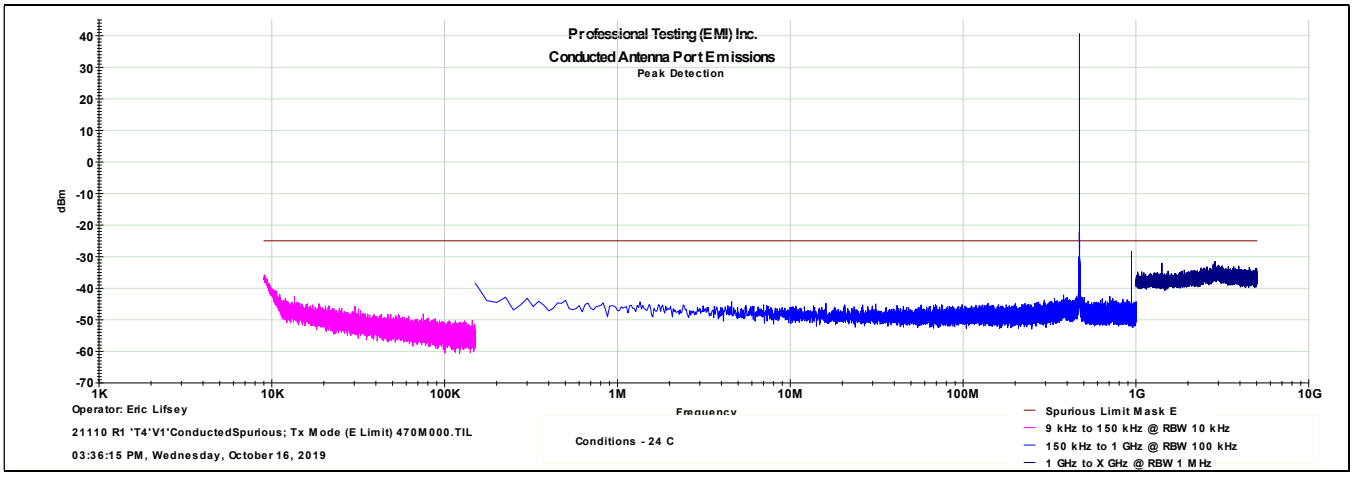
4.3.1 Transmit Mode, Bottom Channel



4.3.2 Transmit Mode, Middle Channel



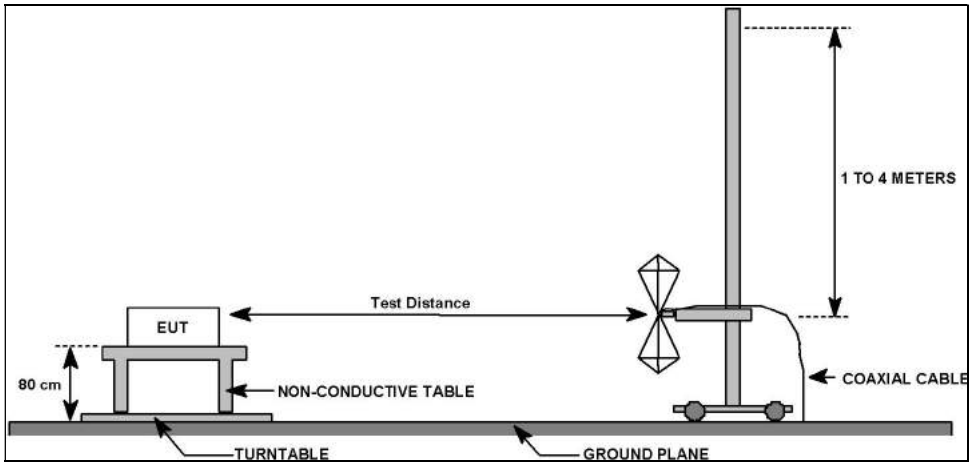
4.3.3 Transmit Mode, Top Channel



5.0 Field Strength of Radiated Spurious Emissions

5.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna. The EUT was placed into transmit mode with the antenna removed and a resistive terminator substituted.



Field Strength of Radiated Emissions Test Setup

5.2 Criteria

Parameter	Section Number	Date
Field Strength of Radiated Emissions 30 MHz to 5 GHz	90.210, 15.209, 2.1053| RSS-119 Issue 12, 5.8; RSS-Gen Issue 4	28 Oct 2019

5.3 Results

Conducted limit for Part 90.210(e) is -25 dBm. This appears on the graphs below as a magenta color line.

The lower Part 15 general emissions limit (in red) is also displayed and the EUT satisfied those limits.

Highest recorded spurious emission: 48.4 dBµV/m @ 3 m on 2666.93 MHz.

The middle channel emissions were measured with all peripheral cables attached to include recording of unintentional emissions.

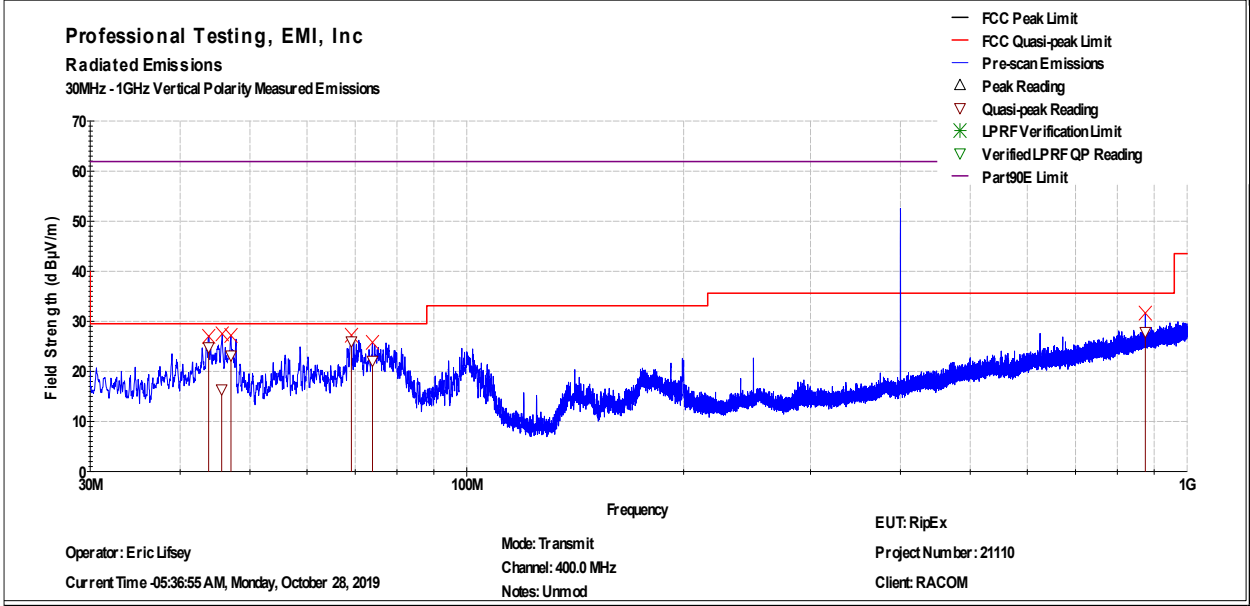
The EUT satisfied the requirement.

5.3.1 Transmit Mode, Below 1 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	EUT Serial #:	1901665515
Customer:	RACOM s. r. o.	EUT Part #:	None
Project Number:	21110-10	Test Technician:	Eric Lifsey
Purchase Order #:	2019-RAC-0546	Supervisor:	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	Witness' Name:	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit 400 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
43.805	10	212	1.29	Quasi-peak	24.861	29.5	-4.6	Pass
45.677	10	355	3.74	Quasi-peak	16.443	29.5	-13.1	Pass
47.053	10	112	1.28	Quasi-peak	23.217	29.5	-6.3	Pass
69.148	10	342	1.55	Quasi-peak	26.023	29.5	-3.5	Pass
73.978	10	355	2.25	Quasi-peak	22.148	29.5	-7.4	Pass
874.971	10	158	3.58	Quasi-peak	27.909	35.6	-7.7	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

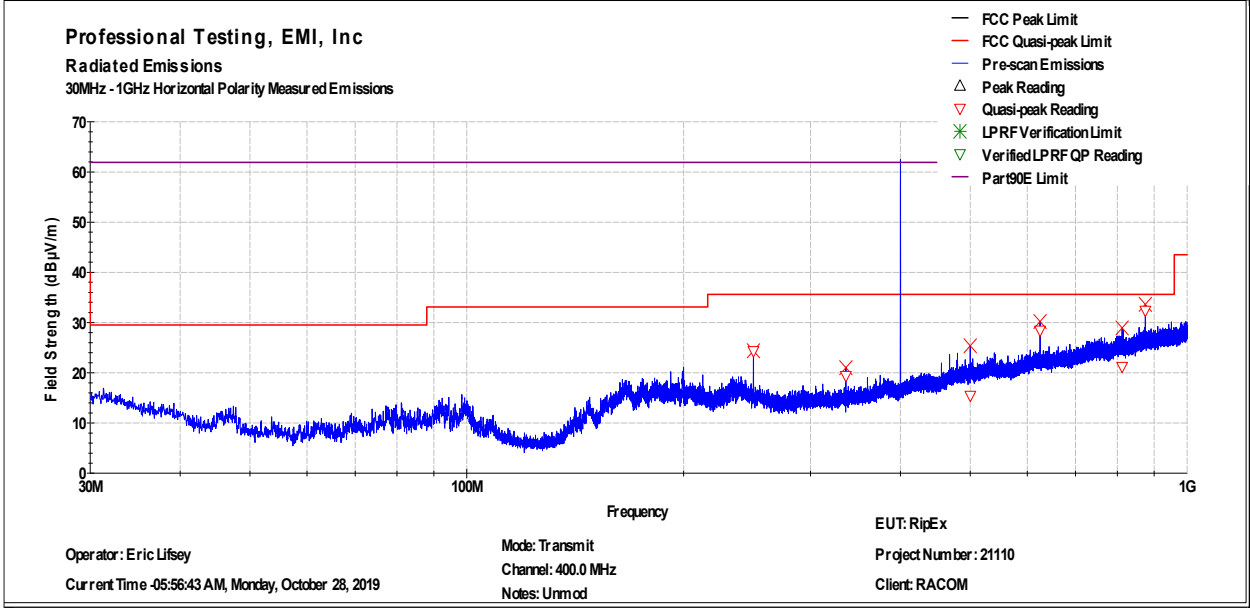
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665515
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Eric Lifsey
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit 400 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
250.008	10	272	3.75	Quasi-peak	24.337	35.6	-11.3	Pass
335.986	10	193	1.6	Quasi-peak	19.383	35.6	-16.2	Pass
500.108	10	357	1.01	Quasi-peak	15.431	35.6	-20.2	Pass
625.022	10	234	1.26	Quasi-peak	28.43	35.6	-7.2	Pass
812.381	10	357	3.23	Quasi-peak	21.206	35.6	-14.4	Pass
875.001	10	217	1.26	Quasi-peak	32.375	35.6	-3.2	Pass



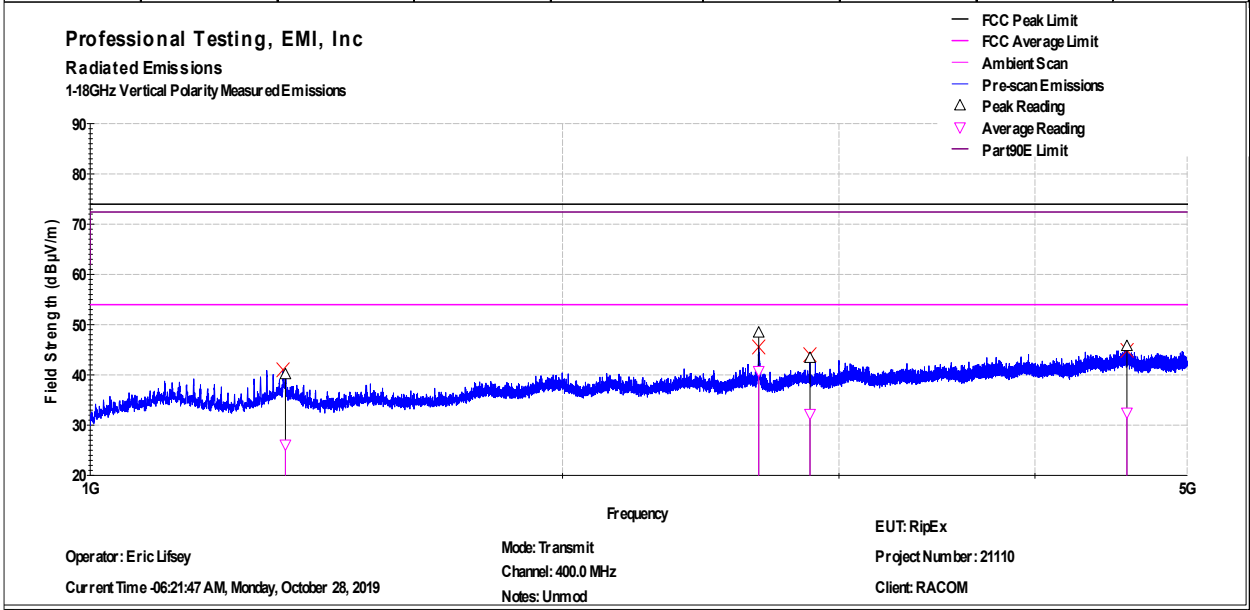
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.2 Transmit Mode, Above 1 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	EUT Serial #:	1901665515
Customer:	RACOM s. r. o.	EUT Part #:	None
Project Number:	21110-10	Test Technician:	Eric Lifsey
Purchase Order #:	2019-RAC-0546	Supervisor:	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	Witness' Name:	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit 400 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1331.81	3	332	1.79	Peak	40.096	74.0	-33.9	Pass
2666.93	3	73	1.37	Peak	48.383	74.0	-25.6	Pass
2875.22	3	89	2.95	Peak	43.338	74.0	-30.6	Pass
4577.49	3	312	1.02	Peak	45.688	74.0	-28.3	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

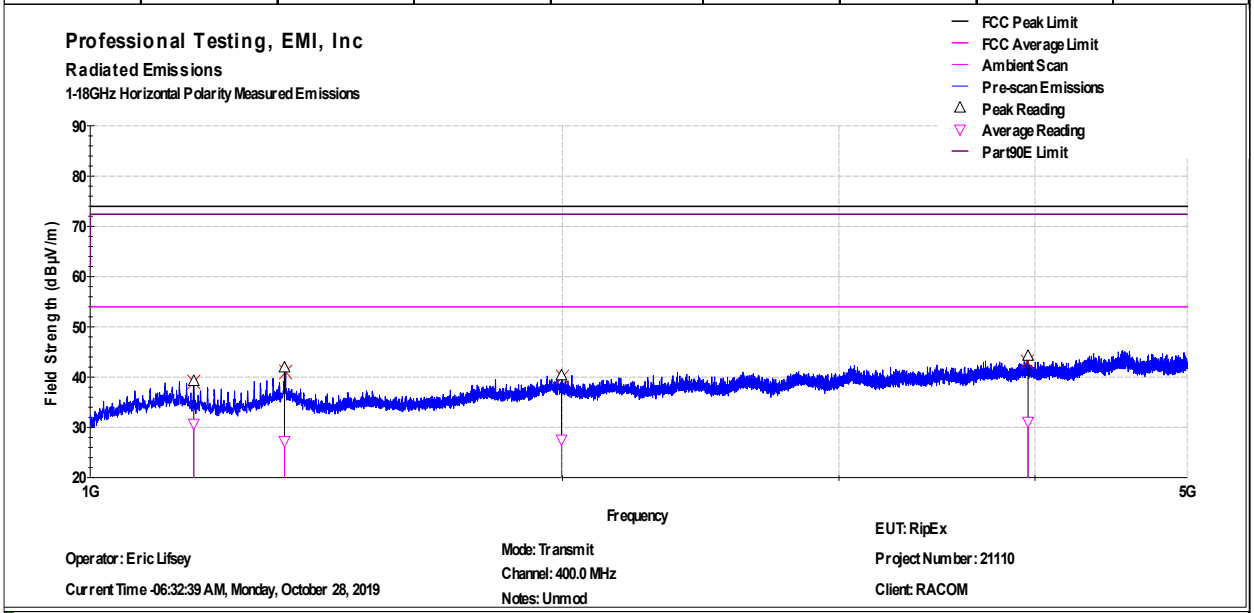
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665515
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Eric Lifsey
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit 400 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1164.12	3	357	2.49	Peak	39.182	74.0	-34.8	Pass
1329.93	3	357	1.73	Peak	41.892	74.0	-32.1	Pass
1996.89	3	27	2.9	Peak	40.309	74.0	-33.6	Pass
3959.42	3	328	2.73	Peak	44.209	74.0	-29.7	Pass



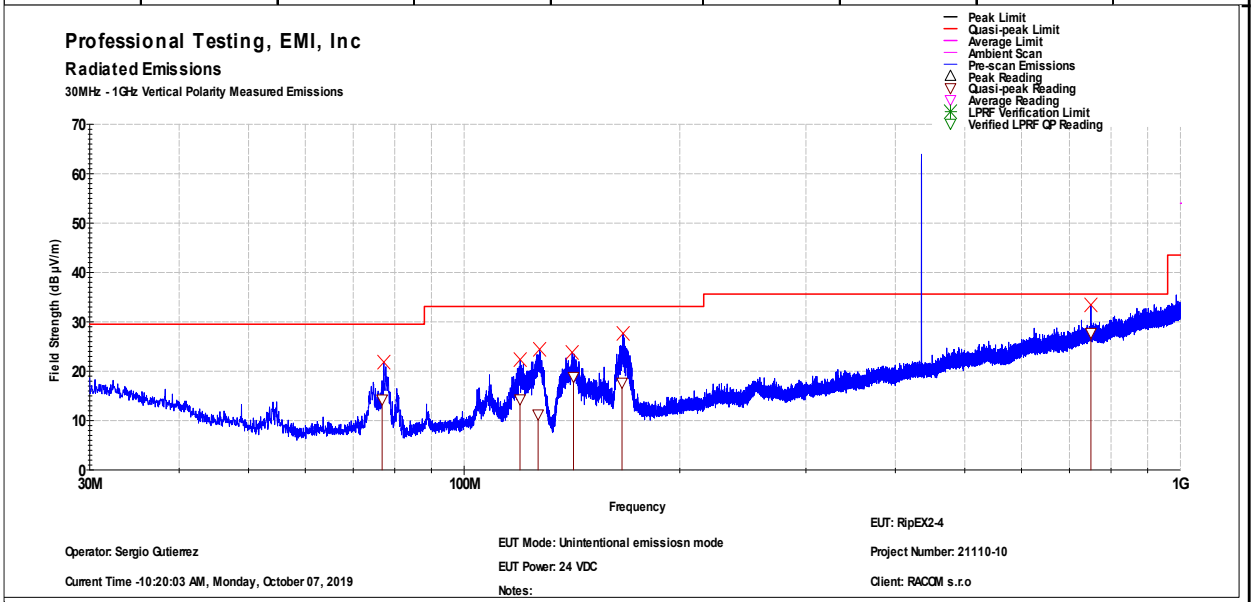
> 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.3 Transmit Mode, Below 1 GHz, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	EUT Serial #:	1901665415
Customer:	RACOM s. r. o.	EUT Part #:	None
Project Number:	21110-10	Test Technician:	Sergio Gutierrez
Purchase Order #:	2019-RAC-0546	Supervisor:	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	Witness' Name:	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit 435 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
76.812	10	22	1.98	Quasi-peak	14.307	29.5	-15.2	Pass
119.675	10	158	1.67	Quasi-peak	14.325	33.1	-18.8	Pass
126.829	10	247	1.63	Quasi-peak	11.293	33.1	-21.8	Pass
142.105	10	274	1.28	Quasi-peak	18.87	33.1	-14.2	Pass
166.13	10	327	2.41	Quasi-peak	17.709	33.1	-15.4	Pass
750.032	10	263	2.62	Quasi-peak	27.797	35.6	-7.8	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

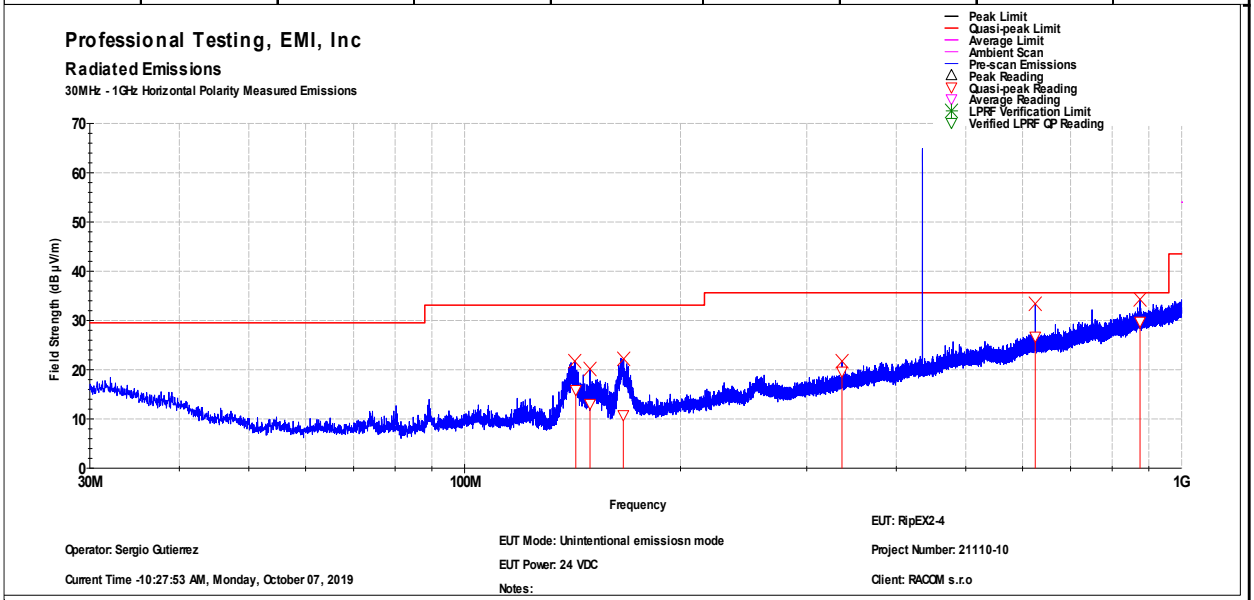
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665415
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Sergio Gutierrez
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit 435 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
142.919	10	249	3.3	Quasi-peak	15.924	33.1	-17.2	Pass
149.596	10	286	3.53	Quasi-peak	13.097	33.1	-20.0	Pass
166.451	10	227	3.64	Quasi-peak	10.818	33.1	-22.3	Pass
336.009	10	285	2.6	Quasi-peak	19.661	35.6	-15.9	Pass
625.009	10	254	1.49	Quasi-peak	26.754	35.6	-8.8	Pass
875.006	10	22	1.07	Quasi-peak	29.787	35.6	-5.8	Pass



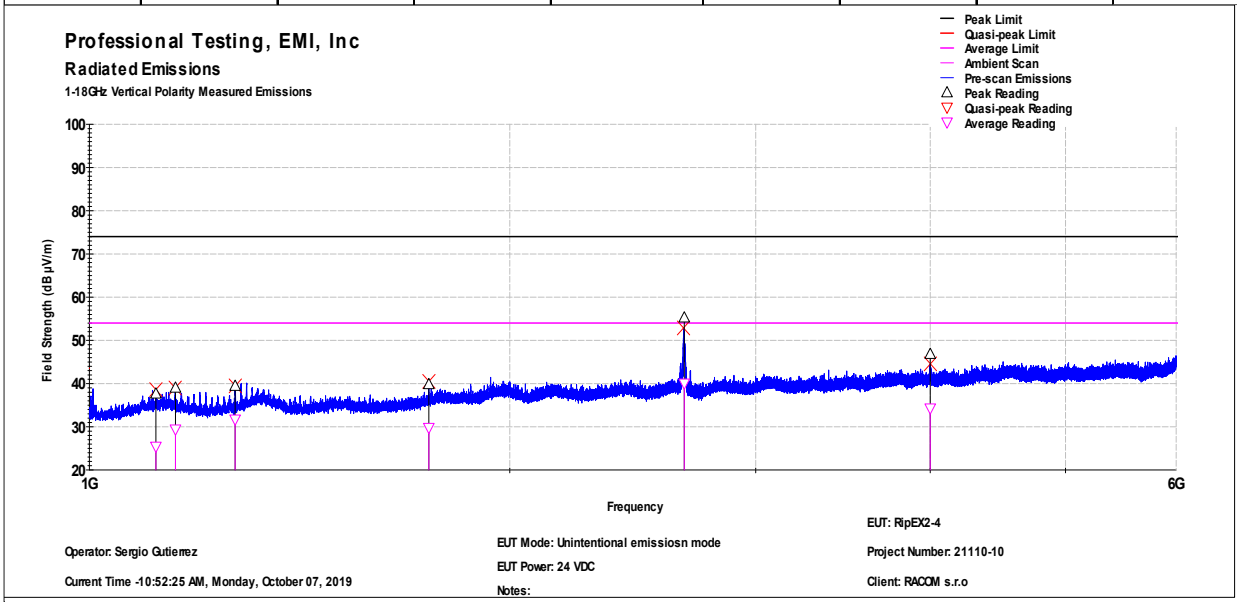
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.4 Transmit Mode, Above 1 GHz, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665415
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Sergio Gutierrez
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit 435 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1115.96	3	156	2.98	Average	25.424	54.0	-28.5	Pass
1152.56	3	61	2.57	Average	29.4	54.0	-24.6	Pass
1271.75	3	9	1.18	Average	31.719	54.0	-22.2	Pass
1750.18	3	42	3.02	Average	29.771	54.0	-24.2	Pass
2666.66	3	85	1.08	Average	40.05	54.0	-13.9	Pass
4000.25	3	69	2.66	Average	34.292	54.0	-19.7	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

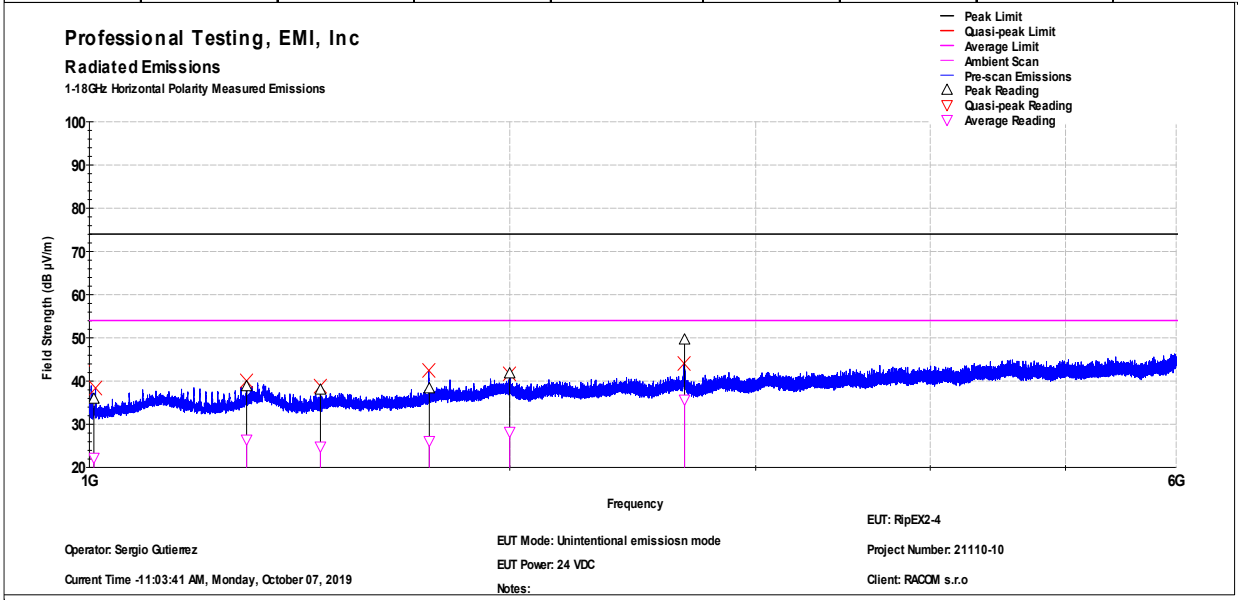
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665415
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Sergio Gutierrez
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:	Transmit 435 MHz		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1007.47	3	70	2.57	Average	22.28	54.0	-31.7	Pass
1295.98	3	32	3.97	Average	26.498	54.0	-27.5	Pass
1463.8	3	241	2.59	Average	24.885	54.0	-29.1	Pass
1751.63	3	66	3.97	Average	26.173	54.0	-27.8	Pass
1999.63	3	71	2.59	Average	28.291	54.0	-25.7	Pass
2667.91	3	66	3.85	Average	35.75	54.0	-18.2	Pass



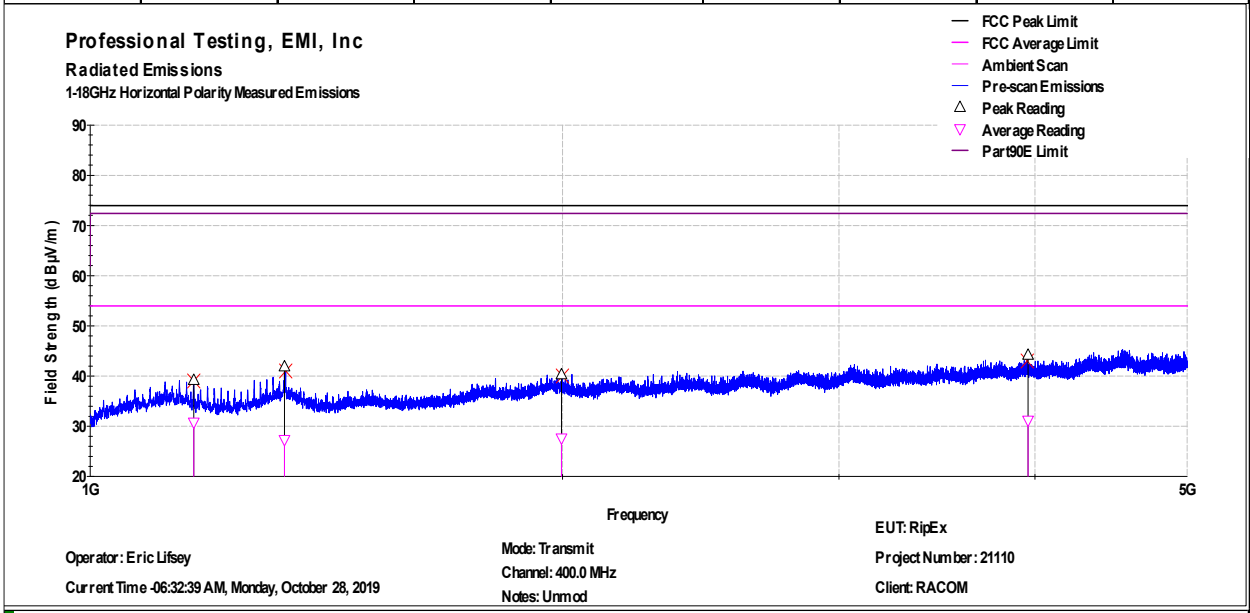
> 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.5 Transmit Mode, Below 1 GHz, Top Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	EUT Serial #:	1901665515
Customer:	RACOM s. r. o.	EUT Part #:	None
Project Number:	21110-10	Test Technician:	Eric Lifsey
Purchase Order #:	2019-RAC-0546	Supervisor:	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	Witness' Name:	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit 400 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1164.12	3	357	2.49	Peak	39.182	74.0	-34.8	Pass
1329.93	3	357	1.73	Peak	41.892	74.0	-32.1	Pass
1996.89	3	27	2.9	Peak	40.309	74.0	-33.6	Pass
3959.42	3	328	2.73	Peak	44.209	74.0	-29.7	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

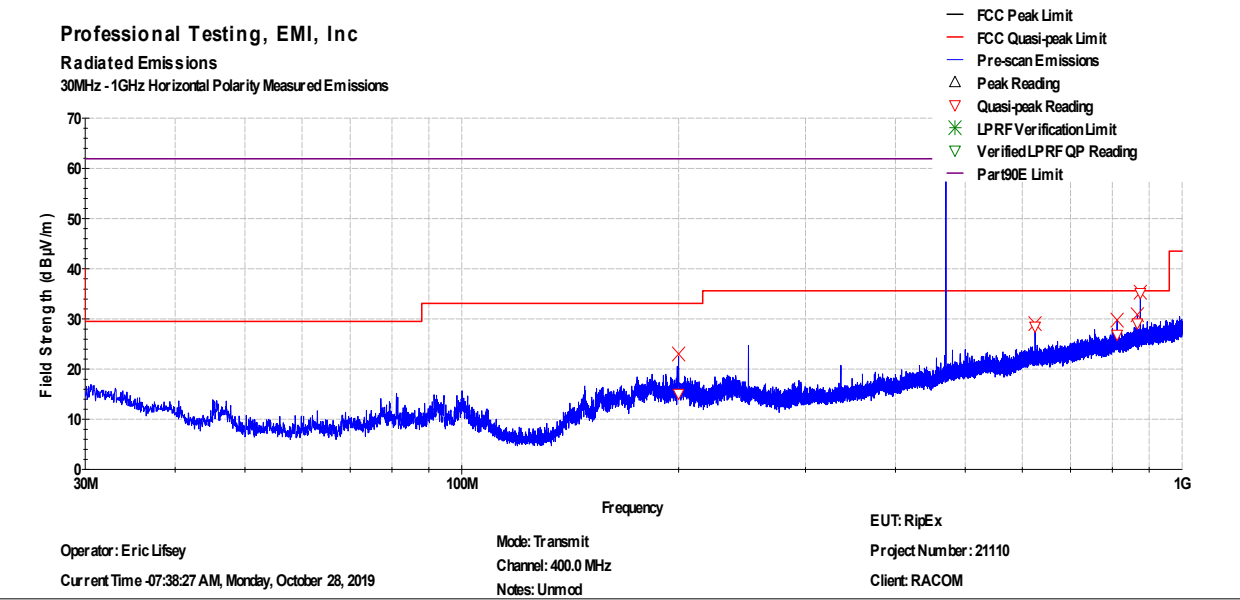
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665515
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Eric Lifsey
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit 470 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
199.952	10	141	3.77	Quasi-peak	15.103	33.1	-18.0	Pass
624.991	10	230	1.27	Quasi-peak	28.477	35.6	-7.1	Pass
812.493	10	246	1.24	Quasi-peak	26.868	35.6	-8.7	Pass
866.659	10	221	1.03	Quasi-peak	29.121	35.6	-6.5	Pass
875.005	10	231	1.03	Quasi-peak	35.17	35.6	-0.4	Pass



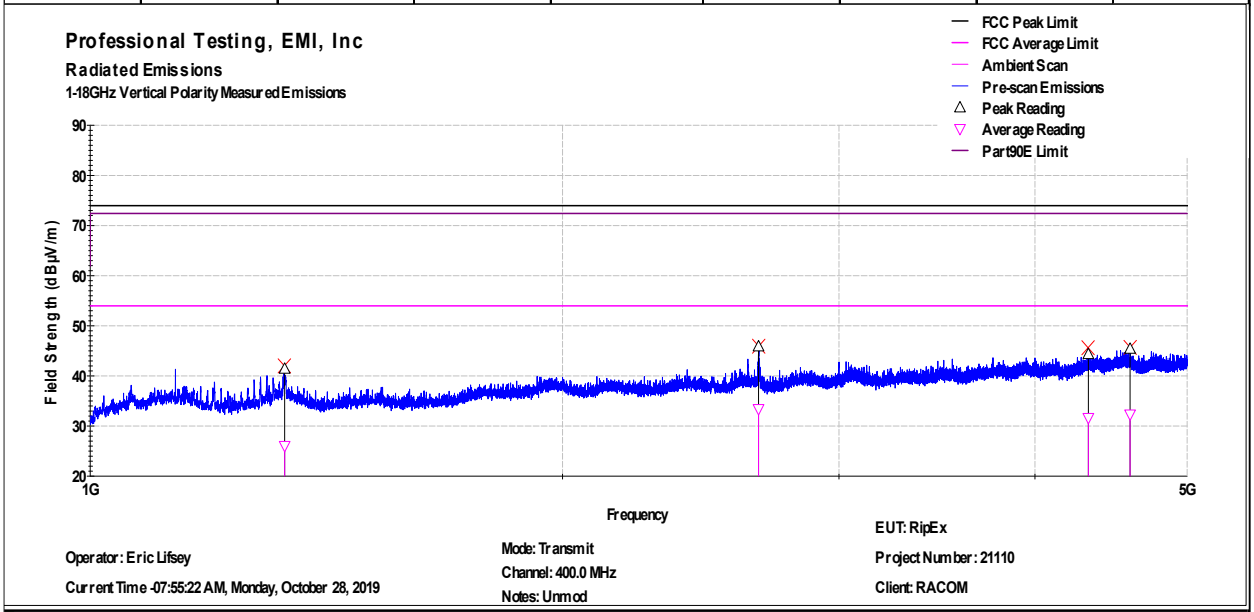
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.6 Transmit Mode, Above 1 GHz, Top Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	EUT Serial #:	1901665515
Customer:	RACOM s. r. o.	EUT Part #:	None
Project Number:	21110-10	Test Technician:	Eric Lifsey
Purchase Order #:	2019-RAC-0546	Supervisor:	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	Witness' Name:	N/A

Radiated Emissions Test Results Data Sheet			
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit 470 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1330.28	3	66	1.89	Peak	41.396	74.0	-32.6	Pass
2666.13	3	99	1.01	Peak	45.838	74.0	-28.1	Pass
4325.76	3	275	2.89	Peak	44.311	74.0	-29.6	Pass
4598.82	3	291	2.58	Peak	45.372	74.0	-28.6	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

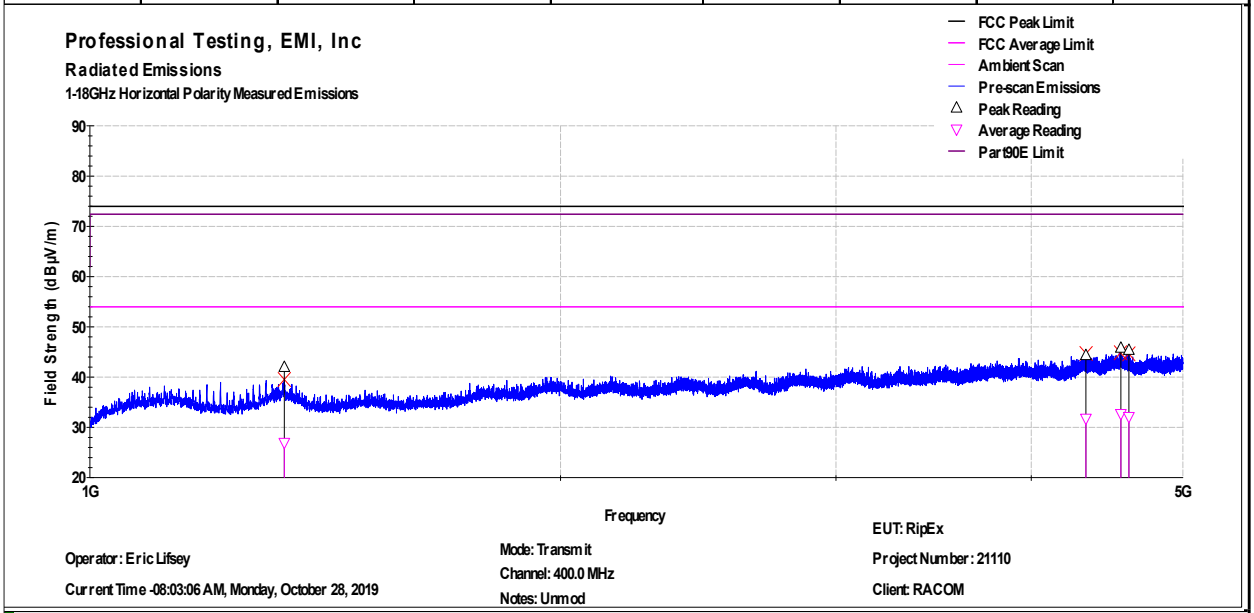
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	10/28/2019	**EUT Serial #:**	1901665515
Customer:	RACOM s. r. o.	**EUT Part #:**	None
Project Number:	21110-10	**Test Technician:**	Eric Lifsey
Purchase Order #:	2019-RAC-0546	**Supervisor:**	Shakil Murad
Equip. Under Test:	Type: RipEX2-4	**Witness' Name:**	N/A

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	24 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit 470 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1331.59	3	185	2.15	Peak	41.972	74.0	-32.0	Pass
4334.98	3	230	2.93	Peak	44.331	74.0	-29.6	Pass
4564.04	3	95	1.9	Peak	45.808	74.0	-28.1	Pass
4618.06	3	275	3.51	Peak	45.365	74.0	-28.6	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

6.0 Frequency Stability

6.1 Procedure

The EUT is placed into a temperature chamber with a cable coupling the transmitted signal to a spectrum analyzer. On reaching each set point temperature, the EUT is allowed to soak at least 10 minutes without power applied. After soak time was satisfied, the EUT is powered on in transmit mode and the frequency is observed until it becomes stable; then the measurement of frequency is taken.

6.2 Criteria

Parameter	Section Number	Date
Frequency Stability	90.213 | RSS-119 Issue 12, 5.3	15 Oct 2019

Table 6.2.1 Frequency Tolerance
0.5 ppm (Base station criteria.): 400 MHz * 0.5 = +/- 200.0 Hz 435 MHz * 0.5 = +/- 217.5 Hz 470 MHz * 0.5 = +/- 235.0 Hz

Table 6.2.2 Operating Voltages		
Low	Nominal	High
10	24	30

The operating frequency shall remain within the required tolerance.

6.3 Results

Setup per section 1.7 with a cable added to reach the EUT in the chamber. As this is a frequency measurement the cable losses were ignored. Frequency was read directly from spectrum analyzer using RBW 30 Hz in span of 2 kHz. EUT was in unmodulated mode.

The widest deviation from frequency observed was -102 Hz on highest channel.

The EUT satisfied the requirement.

6.3.1 Bottom Channel, Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	400.000000	400.000004	4
-20	400.000000	400.000083	83
-10	400.000000	400.000022	22
0	400.000000	400.000022	22
10	400.000000	400.000040	40
20	400.000000	400.000000	0
30	400.000000	399.999978	-22
40	400.000000	399.999946	-54
50	400.000000	399.999918	-82
Upper Deviation (Hz)			83
Lower Deviation (Hz)			-82

6.3.2 Bottom Channel, Operating Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.0	400.000000	399.999983	-17
Nominal	24.0	400.000000	399.999962	-38
High	30.0	400.000000	399.999968	-32

6.3.3 Middle Channel, Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	435.000000	435.000008	8
-20	435.000000	435.000093	93
-10	435.000000	435.000020	20
0	435.000000	435.000025	25
10	435.000000	435.000000	0
20	435.000000	434.999999	-1
30	435.000000	434.999978	-22
40	435.000000	434.999939	-61
50	435.000000	434.999908	-92
Upper Deviation (Hz)			93
Lower Deviation (Hz)			-92

6.3.4 Middle Channel, Operating Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.0	435.000000	434.999978	-22
Nominal	24.0	435.000000	434.999960	-40
High	30.0	435.000000	434.999970	-30

6.3.5 Top Channel, Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	470.000000	470.000011	11
-20	470.000000	470.000098	98
-10	470.000000	470.000019	19
0	470.000000	470.000027	27
10	470.000000	470.000047	47
20	470.000000	470.000000	0
30	470.000000	469.999966	-34
40	470.000000	469.999927	-73
50	470.000000	469.999898	-102
Upper Deviation (Hz)			98
Lower Deviation (Hz)			-102

6.3.6 Top Channel, Operating Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.0	470.000000	469.999970	-30
Nominal	24.0	470.000000	469.999957	-43
High	30.0	470.000000	469.999969	-31

7.0 Transient Frequency Behavior

The EUT was tested for transient frequency behavior using the test method outlined in TIA/EIA-603-E paragraph 2.2.19.3 Alternate Method of Measurement (Using a Test Receiver).

The EUT is terminated with a suitable resistive attenuator with the output connected to a forward power coupler. The coupler forward output (-10 dB) is run through a detector diode then to the trigger input port of a digital oscilloscope. The RF pass-through output of the coupler is then run to a 3 port resistive power combining network; the #2 port of the combiner is connected to the output of a RF signal generator, the #3 port is used as output and connected to a test receiver (modulation analyzer). The detected output of the modulation analyzer is connected to the vertical input of the digital oscilloscope.

The RF generator is set to the fundamental operating frequency, set to modulate with a 1 kHz tone at +/- 25 kHz FM deviation, and at a relatively low but usable level where the modulation analyzer is able to demodulate the signal. The modulation analyzer is configured to use the high and low pass filter settings as called out in the TIA-603-C procedure. The modulation analyzer is then dialed via front panel keypad to the fundamental operating frequency for best sensitivity.

The transmitter is keyed as needed and adjustments are made to the instruments to trigger appropriately and render the measurement as required by the TIA-603-C standard. The essential technique is the signal generator provides a reference frequency captured by the modulation analyzer. When the EUT is keyed, at many dB above the signal generator level, the modulation analyzer locks to the EUT signal and deviation from center frequency can be observed and recorded on the digital oscilloscope.

7.1 Criteria

Parameter	Section Reference	Date
Transient Frequency Behavior	90.214 | RSS-119 Issue 12, 5.9 Procedure: TIA-603-E	24 Oct 2019

Table 7.1.1 Transient Frequency Limits

Time intervals[1,2]	Maximum frequency difference[3]	Frequency Range	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1 is the time period immediately following t_{on}.

t_2 is the time period immediately following t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

t_{off} is the instant when the 1 kHz test signal starts to rise.

[2]During the time from the end of $t_2$to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.

[3]Difference between the actual transmitter frequency and the assigned transmitter frequency.

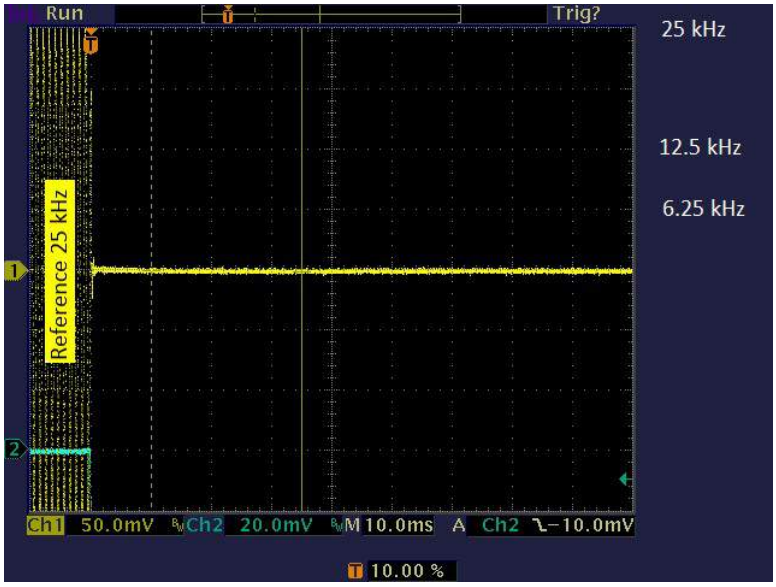
[4]If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

The measurement is performed for the lowest, middle, and highest operating frequency.

7.2 Results

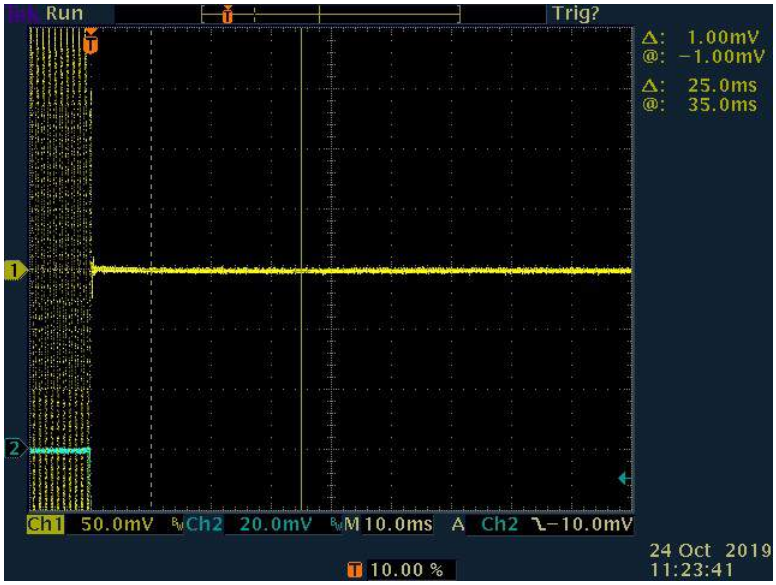
The frequency synthesis circuitry is identical for all channel spacing modes so the worst-case mode was measured to show compliance for all modes.

The EUT satisfied the requirement. The limits were not superimposed on the plots as the transmitter performance was clearly in compliance for all of the supported channel schemes.

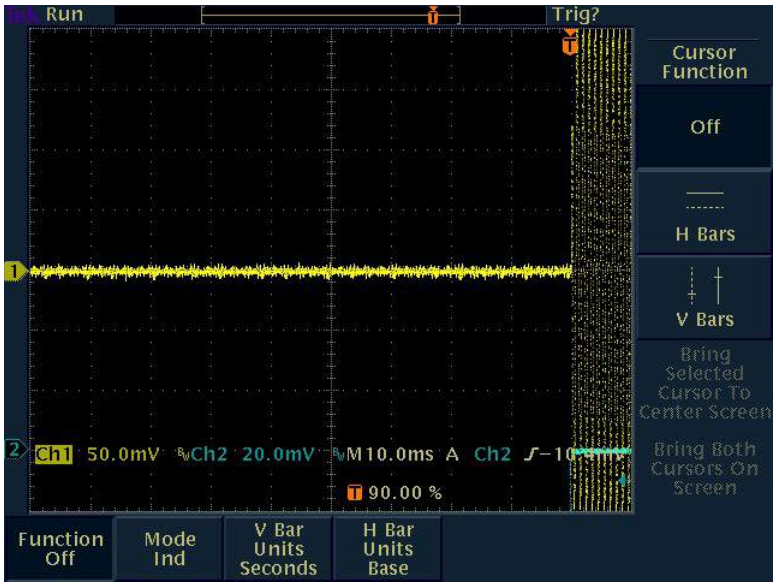


Annotated Calibration

7.2.1 Bottom Channel

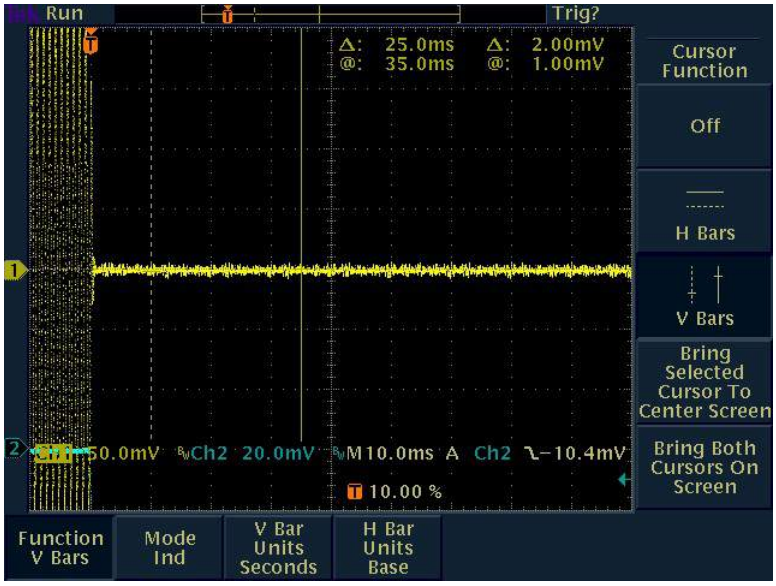


Start

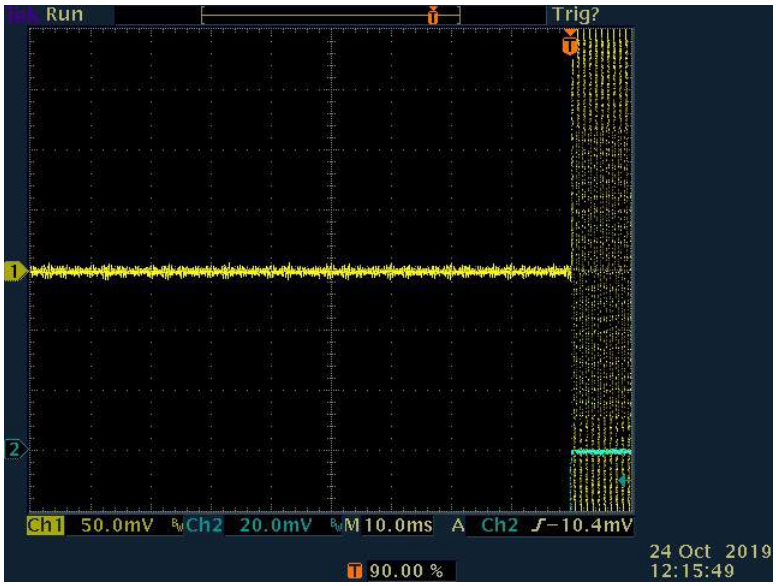


Stop

7.2.2 Middle Channel

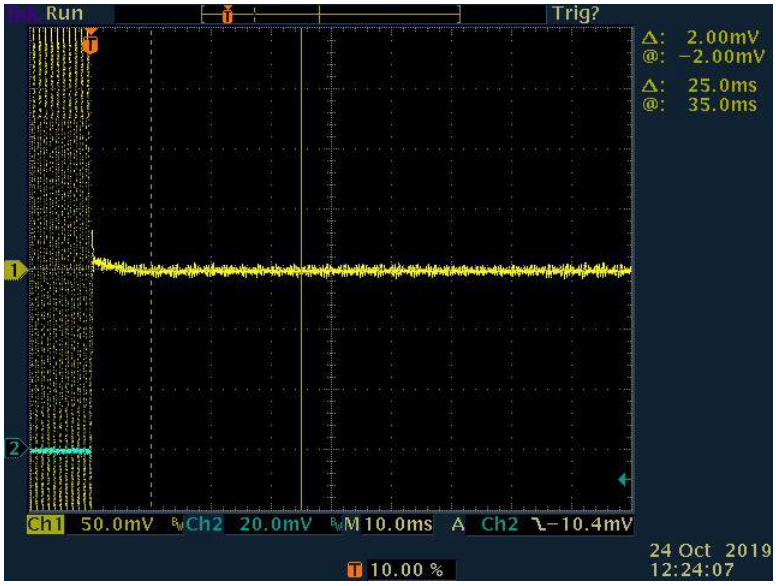


Start

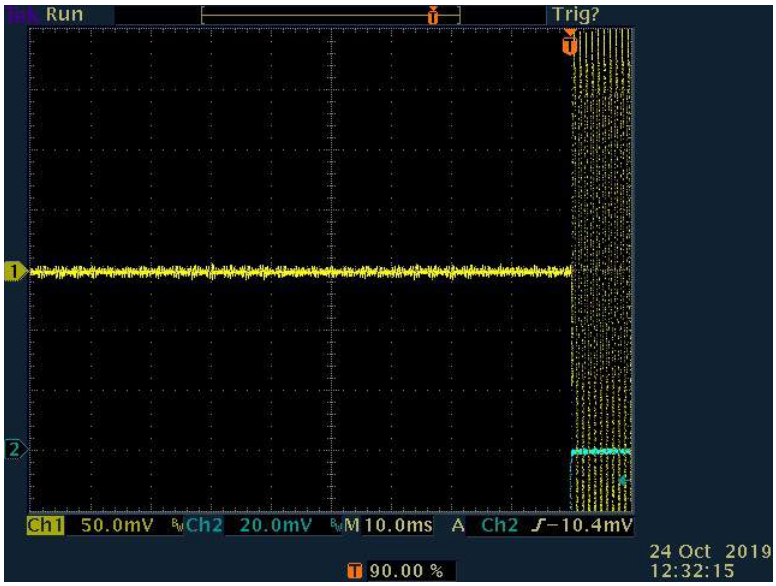


Stop

7.2.3 Top Channel



Start



Stop

8.0 Emission Bandwidth

8.1 Procedure

The EUT antenna port is coupled to a spectrum analyzer for measurement.

8.2 Criteria

Parameter	Section Number	Date
99% Bandwidth for Reporting	90.210, 90.203(j)(3), 2.1049 | RSS-119 Issue 12, 5.5	24 Oct 2019

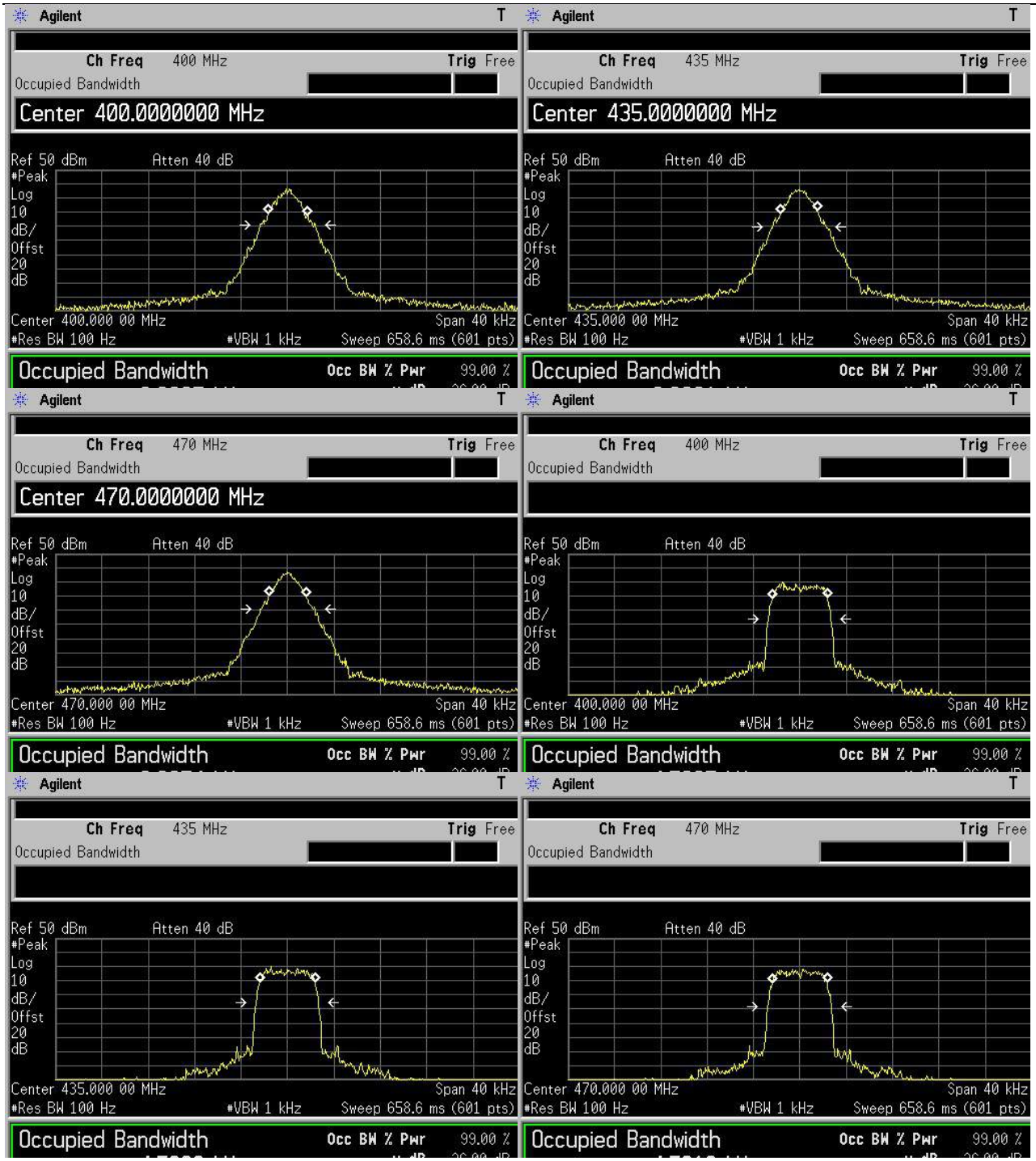
8.3 Results

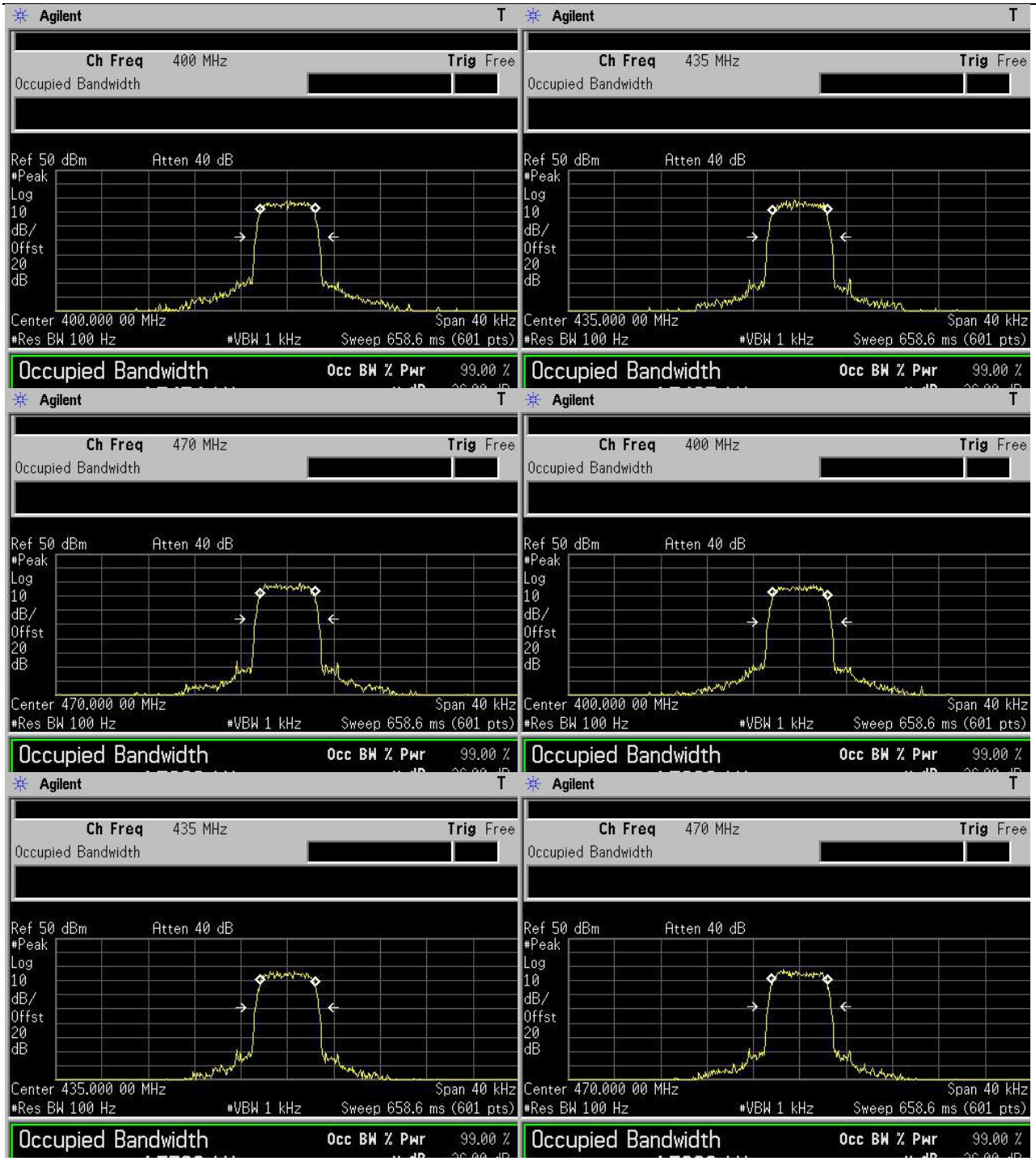
Setup is per section 1.7.

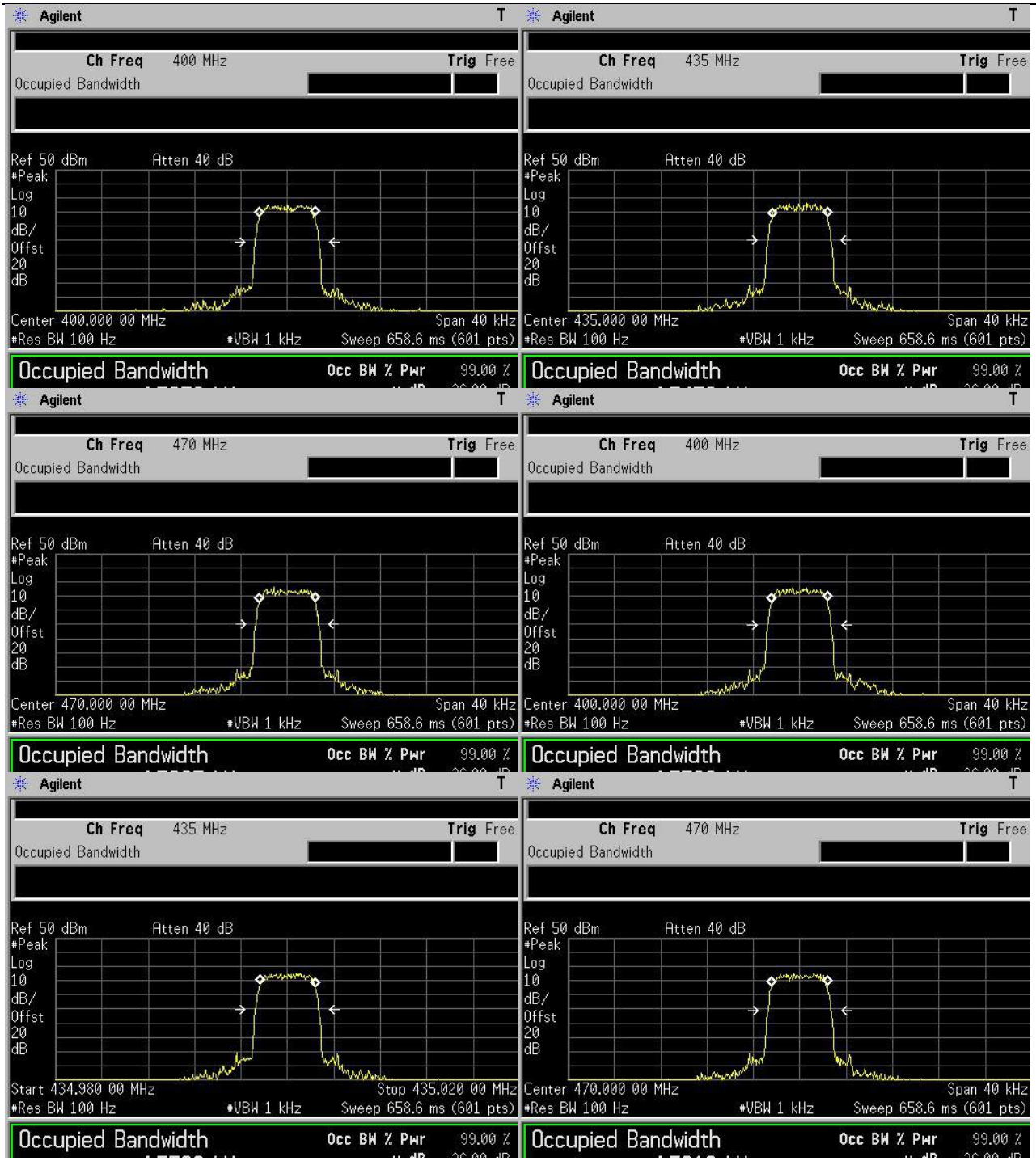
Video bandwidth is 1 kHz in all cases. Resolution bandwidth as noted in tabular data and plots. Measurement rounded to 3 significant digits in tables.

8.3.1 Channel Width 6.25 kHz

Table 8.3.1.1 Bandwidth Measurement, 6.25 kHz using 100 Hz RBW		
Channel Frequency MHz	**Modulation Method**	**Measured OBW 99% kHz**
400	4CPFSK	3.33
435	4CPFSK	3.21
470	4CPFSK	3.21
400	pi/4DQPSK	4.73
435	pi/4DQPSK	4.73
470	pi/4DQPSK	4.73
400	D8PSK	4.75
435	D8PSK	4.75
470	D8PSK	4.76
400	16DEQAM	4.73
435	16DEQAM	4.76
470	16DEQAM	4.77
400	64QAM	4.80
435	64QAM	4.75
470	64QAM	4.80
400	256QAM	4.75
435	256QAM	4.78
470	256QAM	4.79

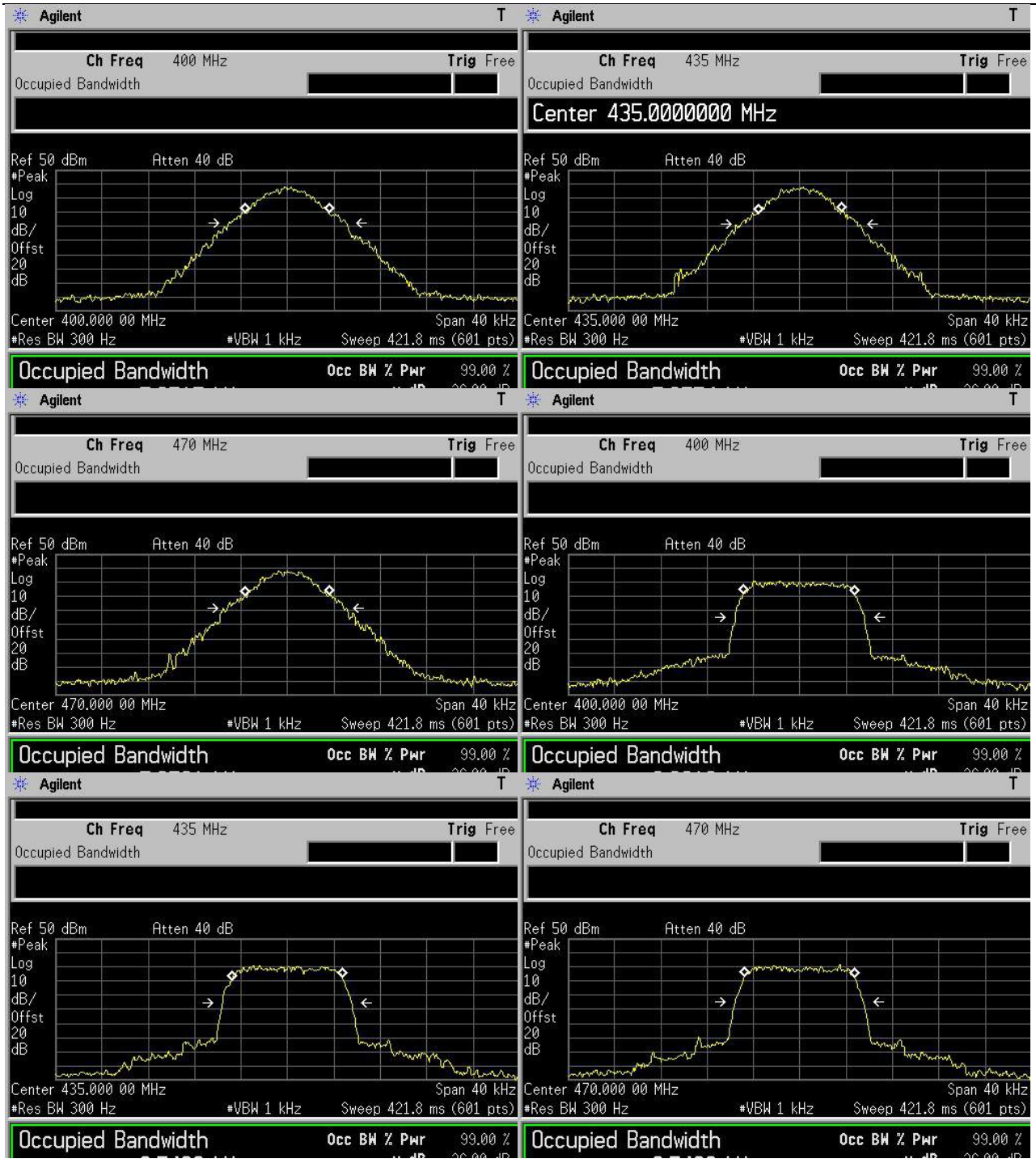

Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Center 400.0000000 MHz
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Center 435.0000000 MHz
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Center 470.0000000 MHz
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

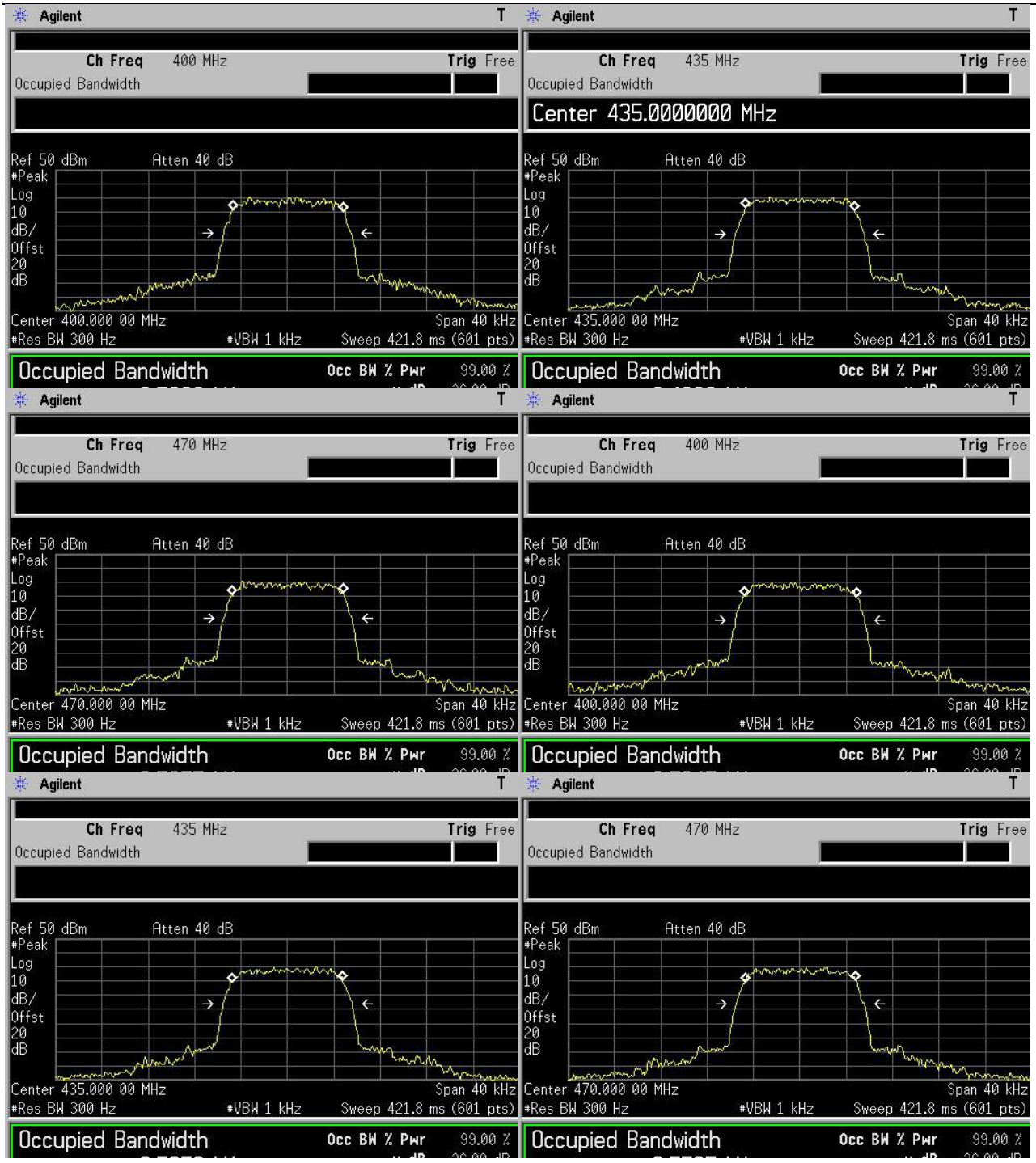

Agilent
T
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

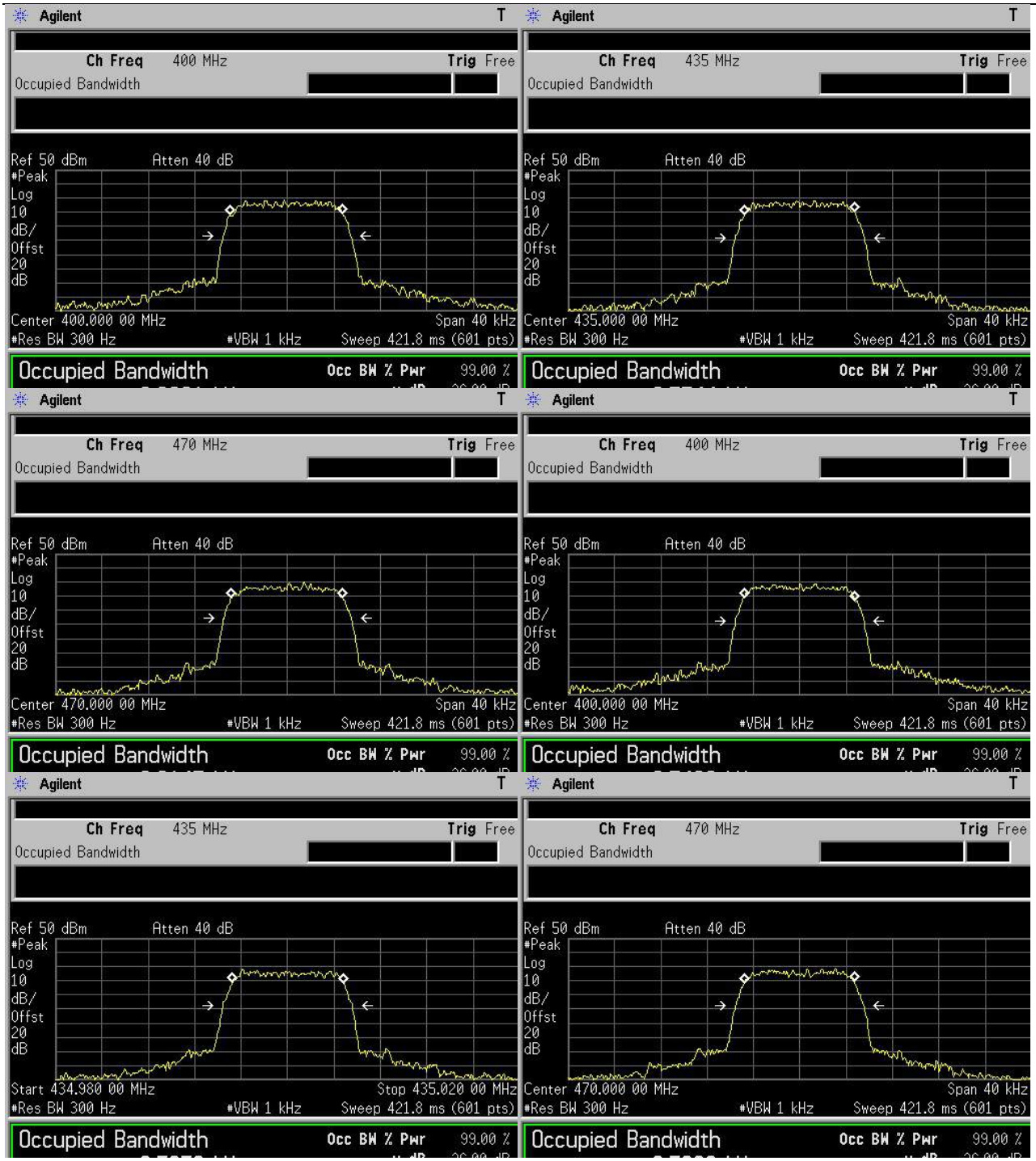

Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Start 434.980 00 MHz
Stop 435.020 00 MHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 658.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

8.3.2 Channel Width 12.5 kHz

Table 8.3.2.1 Bandwidth Measurement, 12.5 kHz using 300 Hz RBW		
Channel Frequency MHz	**Modulation Method**	**Measured OBW 99% kHz**
400	4CPFSK	7.27
435	4CPFSK	7.26
470	4CPFSK	7.25
400	pi/4DQPSK	9.62
435	pi/4DQPSK	9.55
470	pi/4DQPSK	9.54
400	D8PSK	9.57
435	D8PSK	9.50
470	D8PSK	9.59
400	16DEQAM	9.71
435	16DEQAM	9.54
470	16DEQAM	9.55
400	64QAM	9.69
435	64QAM	9.55
470	64QAM	9.62
400	256QAM	9.55
435	256QAM	9.60
470	256QAM	9.51

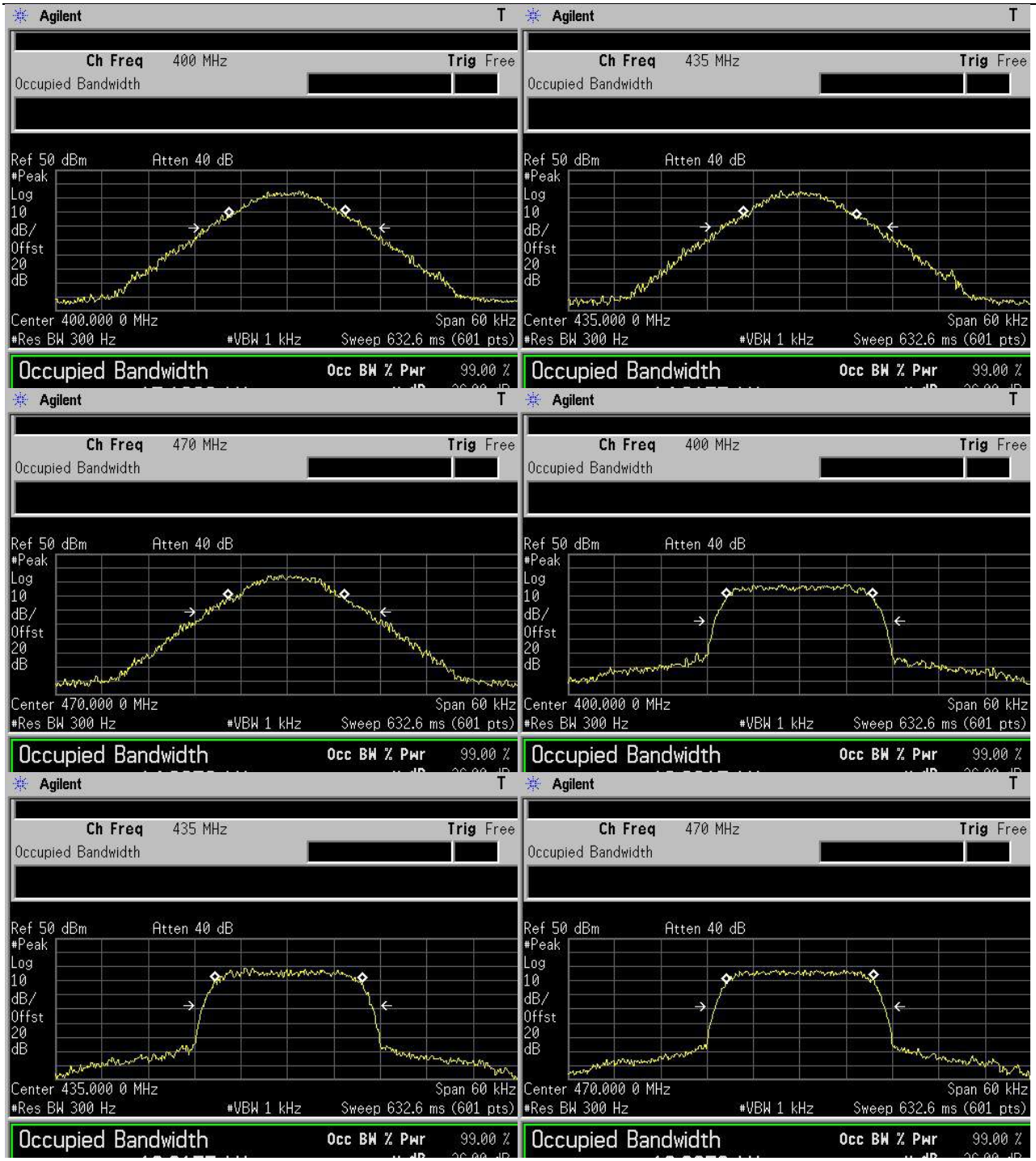

Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Center 435.0000000 MHz
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

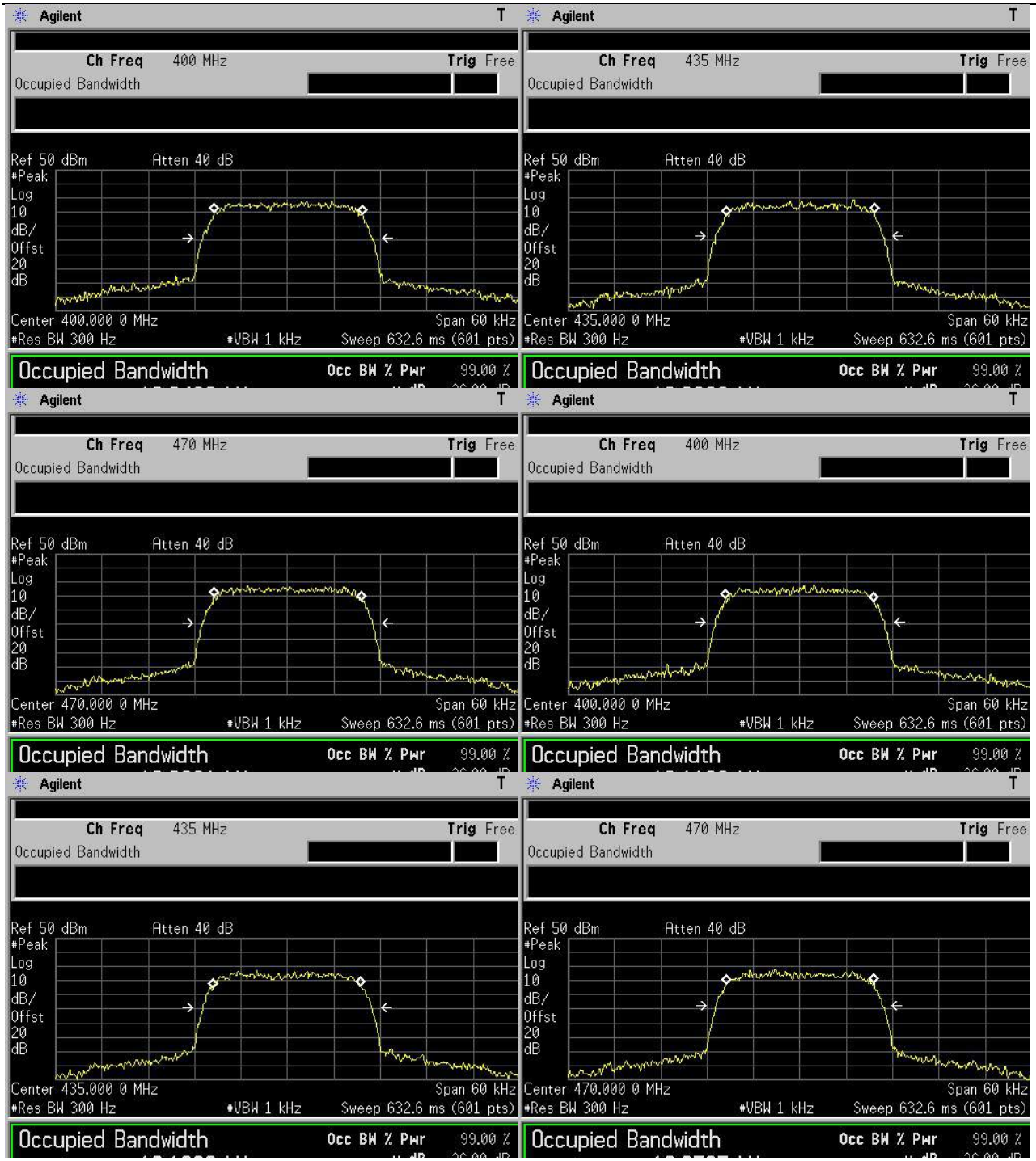

Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Center 435.0000000 MHz
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

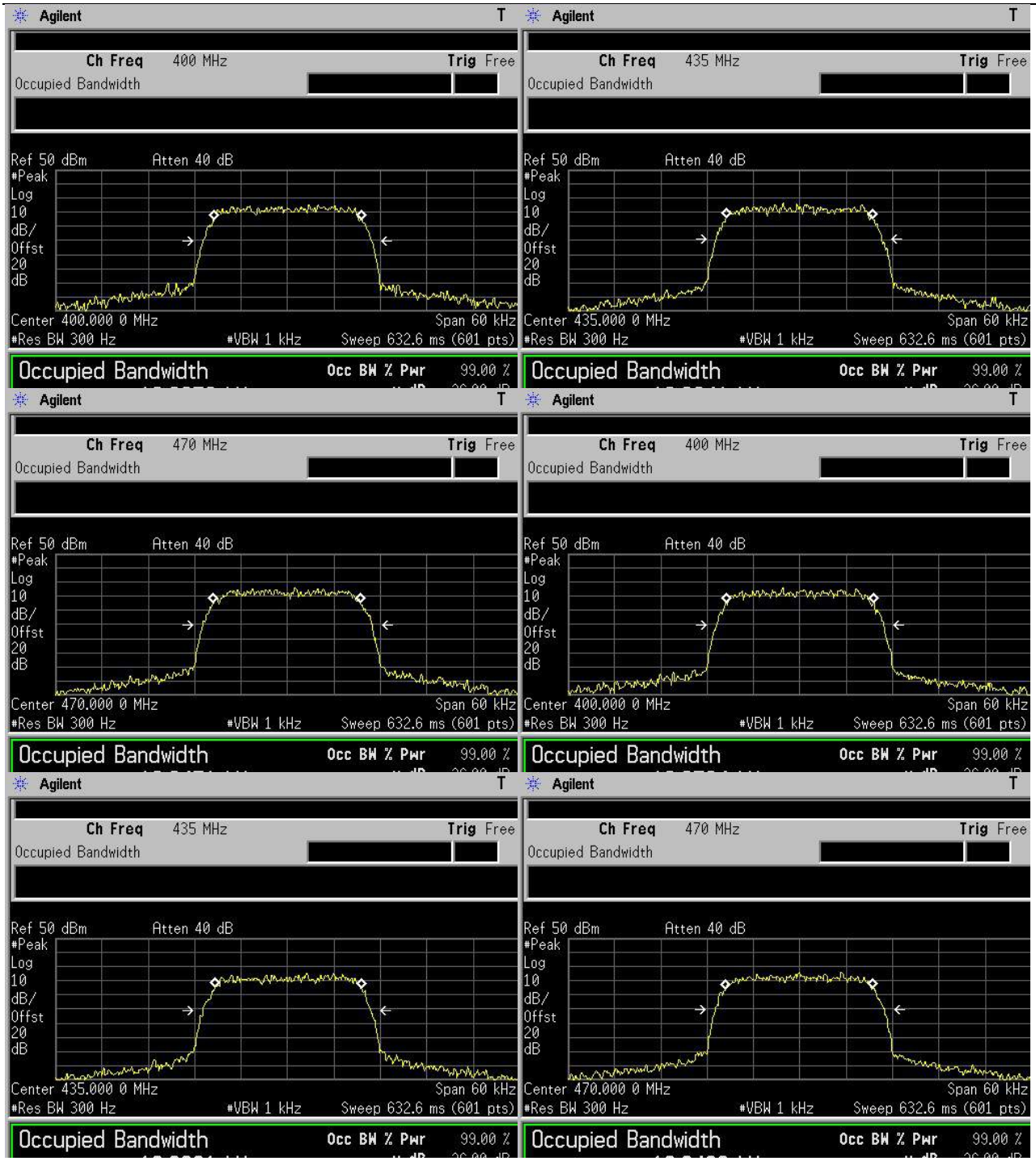

Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Start 434.980 00 MHz
Stop 435.020 00 MHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 00 MHz
Span 40 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 421.8 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

8.3.3 Channel Width 25.0 kHz

Table 8.3.3.1 Bandwidth Measurement, 25.0 kHz using 300 Hz RBW		
Channel Frequency MHz	**Modulation Method**	**Measured OBW 99% kHz**
400	4CPFSK	15.1
435	4CPFSK	14.6
470	4CPFSK	15.0
400	pi/4DQPSK	18.9
435	pi/4DQPSK	19.0
470	pi/4DQPSK	19.0
400	D8PSK	19.0
435	D8PSK	19.1
470	D8PSK	19.1
400	16DEQAM	19.1
435	16DEQAM	19.1
470	16DEQAM	19.1
400	64QAM	19.1
435	64QAM	19.0
470	64QAM	19.0
400	256QAM	19.0
435	256QAM	18.9
470	256QAM	19.1


Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %


Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %


Agilent
T
Ch Freq 400 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 400.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 435 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
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20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
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Sweep 632.6 ms (601 pts)
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Agilent
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Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
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dB
Center 435.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %
Agilent
T
Ch Freq 470 MHz
Trig Free
Occupied Bandwidth
Ref 50 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
20
dB
Center 470.000 0 MHz
Span 60 kHz
#Res BW 300 Hz
#VBW 1 kHz
Sweep 632.6 ms (601 pts)
Occupied Bandwidth
Occ BW % Pwr 99.00 %

9.0 Equipment Lists

9.1 Conducted Power, Conducted Spurious, Mask, and Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	6 Nov 2019
A105	Narda	768A-20	20 dB Attenuator, 20 Watt	23 Mar 2020
C355	Pasternack	RG type	Coaxial Cable, Low Loss, ~5m	30 May 2020
0467	Fluke	077A	DMM	10 Nov 2020
2205	Astron	VS-35M	Power Supply, Linear Regulated	CIU

9.2 Frequency Stability

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	6 Nov 2019
A105	Narda	768A-20	20 dB Attenuator, 20 Watt	23 Mar 2020
2134	Tenny	TPS T2C	Temperature Chamber	8 Oct 2020
C355	Pasternack	RG type	Coaxial Cable, double shielded	CNR
0467	Fluke	077A	DMM	10 Nov 2020
1831	HP	6622A	DC Power Supply	CIU
2205	Astron	VS-35M	Power Supply, Linear Regulated	CIU

9.3 Frequency Behavior

Asset #	Manufacturer	Model #	Description	Calibration Due
0836	Narda	3293-1	Broadband Directional Coupler	CNR
2228	Tektronix	TDS3034	Oscilloscope, Digital	10 Jul 2020
1816	Agilent	N5181A	Signal Generator	8 Nov 2019
0742	HP	355C	Step Attenuator	CNR
0637	HP	8901A	Modulation Analyzer	7 Nov 2019
None	Mini-Circuits	ZFRSC-43	3 Port Resistive Divider/Combiner SMA	CNR
A100	Narda	94455-1	Diode Detector	CNR
2201	Agilent	E3632A	Adjustable DC Power Supply	CIU
None	Various	None	RG Type coaxial cables	CNR
None	Various	Unknown	SMA-SMA attenuators, 1 each of: 20 dB, 10 dB, 3 dB, 1.2 dB	CNR

9.4 Radiated Emissions

Radiated Emissions Test Equipment List					
Tile! Software Version:		**Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM**			
Test Profile:		**2019_May_Unintentional RE_TILE7_v2.5.til**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	9/17/2021
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/10/2020
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/8/2019
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/11/2021
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/9/2020
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	TDK 10M	TDK 10M Chamber,sVSWR > 1 GHz	DAC-012915-005	9/21/2021
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/10/2020
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/9/2020
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/11/2021

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report