

LABORATORY TEST REPORT
RADIO PERFORMANCE MEASUREMENTS

for the

TBCC0E Base Station Transceiver

Tested in accordance with:

FCC 47 CFR Parts 80 and 90

RSS-119 Issue 12
RSS-Gen Issue 4

Report Revision: 1
Issue Date: 27 February 2017

PREPARED BY: L. M. White


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CHECKED & APPROVED BY: M. C. James


Laboratory Technical Manager



IANZ
ACCREDITED LABORATORY

OATS FCC LISTING REGISTRATION: 837095
OATS IC LISTING REGISTRATION: SITE# 737A-1

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation.

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REVISION

Date	Revision	Comments
27 February 2017	1	Initial test report

INTRODUCTION

Type approval testing of the TBCC0E, 100 Watt, Base Station transceiver in order to demonstrate compliance with FCC 47 Parts 80 & 90, and RSS-119 Issue 12 & RSS-Gen Issue 4. This radio supports analogue, digital FFSK and Digital Mobile Radio (DMR) modulations.

Type Approval Testing of the TBCC0E
Frequency range 216 → 222 MHz

in accordance with:

FCC 47 CFR Parts 80 and 90
RSS-119 Issue 12 & RSS-Gen Issue 4

REPORT PREPARED FOR

Tait Ltd
245 Wooldridge Road
Harewood
Christchurch 8051
New Zealand

DESCRIPTION OF SAMPLE

Manufacturer Tait Limited
Equipment: Base Station Transceiver
Type: TBCC0E
Quantity: 1

Modulation		Channel Spacing	Speech Channels	Symbol Rate (symbols/sec)	Data Rate (bps)
Analogue FM		12.5 kHz	1	-	-
FFSK	Fast Frequency Shift Keying	12.5 kHz	-	1200	1200
Digital Mobile Radio (DMR)	4 Level FSK (2 slot TDMA) (ETSI TS102 361-1)	12.5 kHz	2	4800	9600

HARDWARE & SOFTWARE

Module	Product Code	Serial Number	Firmware	Hardware
Front Panel	T01-01110-CCAA	18181404	1.09.00.0002	00.04
Reciter	T01-01105-FACA	18253013	dmr-2.25.00.0003	1.00
PA	T01-01136-EBAA	18252708	0314	1.00
PMU	TBA30A0-0100	18181802	0316	0.03

TEST CONDITIONS

All testing was performed between 13 → 25 February 2017, and under the following conditions:

Ambient temperature: 15°C → 30°C
Relative Humidity: 20% → 75%
Standard Test Voltage 120 V_{AC}

STATEMENT OF COMPLIANCE

We, TELTEST LABORATORIES of 558 Wairakei Road, Christchurch, New Zealand, declare under our sole responsibility that the product:

Equipment: Base Station Transceiver
Type: TBCC0E
Quantity: 1

Module	Product Code	Serial Number	Firmware	Hardware
Front Panel	T01-01110-CCAA	18181404	1.09.00.0002	00.04
Reciter	T01-01105-FACA	18253013	dmr-2.25.00.0003	1.00
PA	T01-01136-EBAA	18252708	0314	1.00
PMU	TBA30A0-0100	18181802	0316	0.03

to which this declaration relates, is in conformity with the following standards:

FCC 47 CFR Parts 80 and 90

RSS-119 Issue 12 & RSS-Gen Issue 4

Signature: 

Mike James
Technical Manager

Date: 28 February 2017

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

F3E	FM Analogue Voice	-	-
F2D	Fast Frequency Shift Keying	1200 symbols/sec	1200 bps
FXD	Digital Data	4800 symbols/sec	9600 bps
FXW	Digital Voice / Data	4800 symbols/sec	9600 bps

CHANNEL SPACINGS: 12.5 kHz

EMISSION DESIGNATORS:

Analogue Voice	11K0F3E
FFSK	7K60F2D
DMR Digital Voice / Data	7K60FXW
DMR Digital Data	7K60FXD

Equation: $B_n = 2M + 2Dk$

(M is highest modulating frequency; D is peak allowable deviation; k is a constant of 1 for FM)

Analogue Voice 12.5 kHz Channel Spacing

Necessary bandwidth	Emission Designator
M = 3.0 kHz	11K0F3E
D = 2.5 kHz	F3E represents an FM voice transmission
$B_n = (2 \times 3.0) + (2 \times 2.5) \times 1$	
= 11.0 kHz	

Fast Frequency Shift Keying (FFSK – 1200 bps) 12.5 kHz Channel Spacing

Necessary bandwidth	Emission Designator
M = 1.8 kHz	7K60F2D
D = 2.0 kHz	F2D represents a FM data transmission with the use of a modulating sub carrier
$B_n = (2 \times 1.8) + (2 \times 2.0) \times 1$	
= 7.6 kHz	

Digital Mobile Radio (DMR) 4 level FSK (as per ETSI TS 102 361-1)
4800 symbols/sec 9600 bps

Digital Data 12.5 kHz Channel Spacing – 7K60FXW

99% bandwidth = 7.6 kHz	Emission Designator 7K60FXW FXW represents FM combination of data and telephony.
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Digital Data 12.5 kHz Channel Spacing – 7K60FXD

99% bandwidth = 7.6 kHz	Emission Designator 7K60FXD FXD represents FM data only
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TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046
RSS-119 5.4

GUIDE: TIA-102.CAAA-C 2.2.1

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The coaxial attenuator has an impedance of 50 Ohms.
3. The unmodulated output power was measured with an RF Power meter.

MEASUREMENT RESULTS:

Manufacturer's Rated Output Power:

Switchable: 100 W and 10 W

Nominal 100 W	217.5 MHz	219.5 MHz	220.975 MHz	221.975 MHz
Measured	107.1	108.0	105.4	109.1
Variation (%)	7.1	8.0	5.4	9.1
Variation (dB)	0.3	0.3	0.2	0.4
Nominal 10 W	217.5 MHz	219.5 MHz	220.975 MHz	221.975 MHz
Measured	10.6	10.7	10.6	10.8
Variation (%)	6.2	7.1	6.0	8.1
Variation (dB)	0.3	0.3	0.3	0.3
Measurement Uncertainty	± 0.6 dB			

LIMIT CLAUSES:

FCC 47 CFR 90.205 (s)

The output power shall not exceed by more than 20%... the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

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The output power shall be within ±1.0 dB of the manufacturer's rated power.

TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603E 2.2.6

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000 Hz was measured.

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing tested at 100 W transmit power.

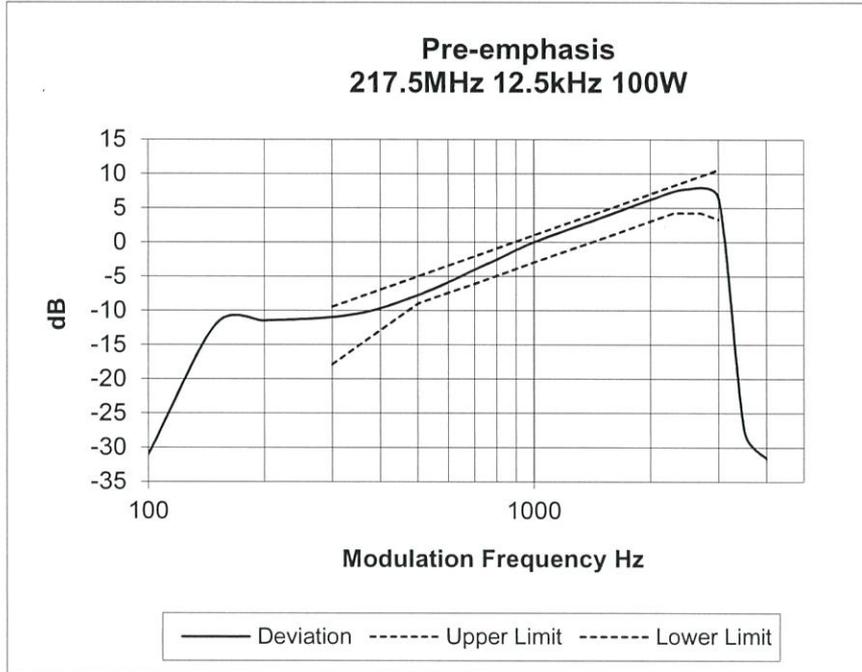
LIMIT CLAUSE: TIA/EIA-603E 3.2.6

MEASUREMENT UNCERTAINTY: $\pm 1.5 \%$

Transmitter Audio Frequency Response – Pre-emphasis

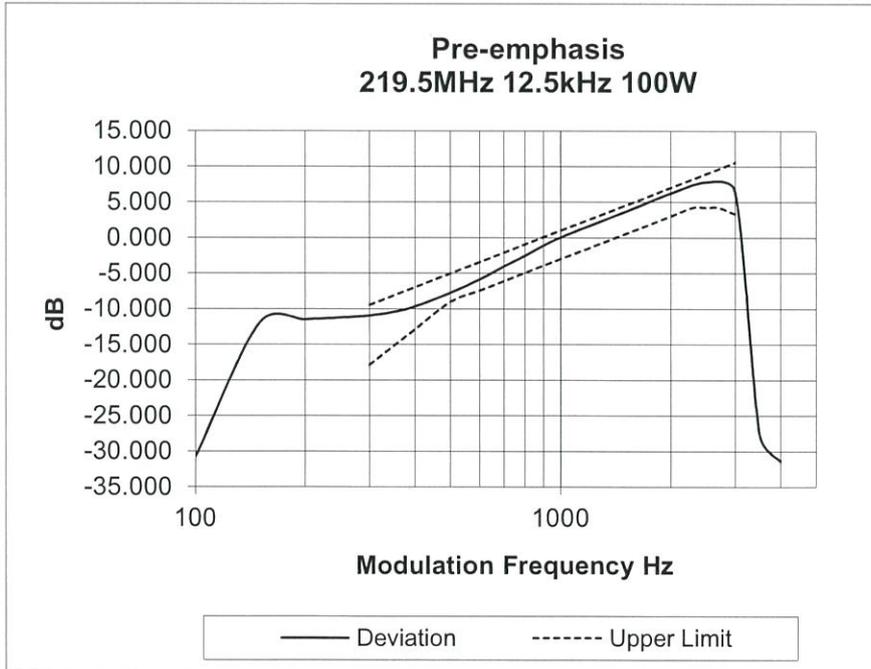
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 217.5 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

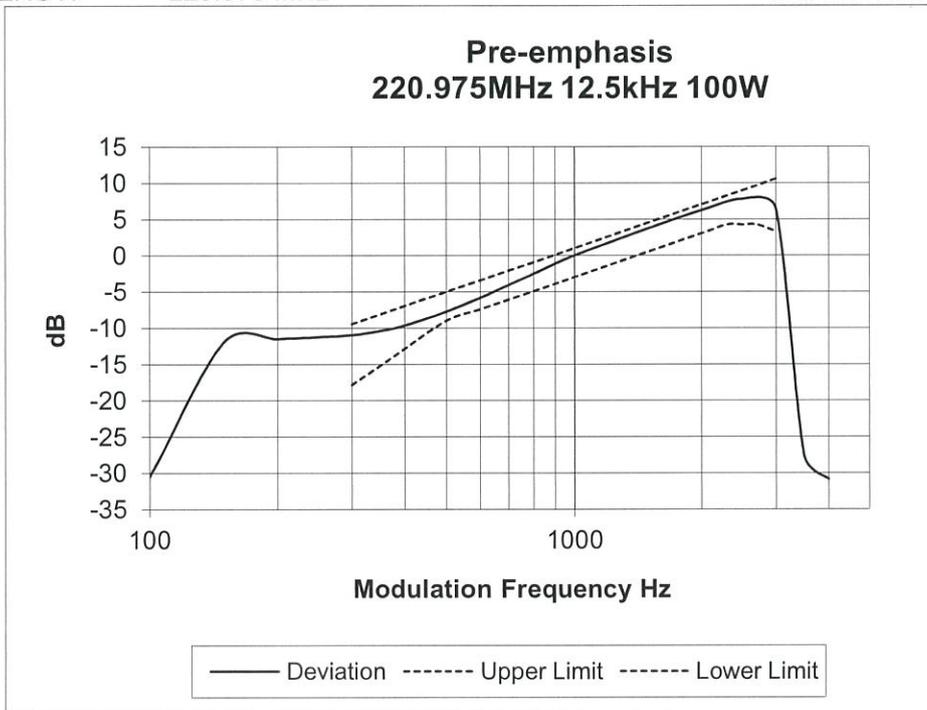
Tx FREQUENCY: 219.5 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

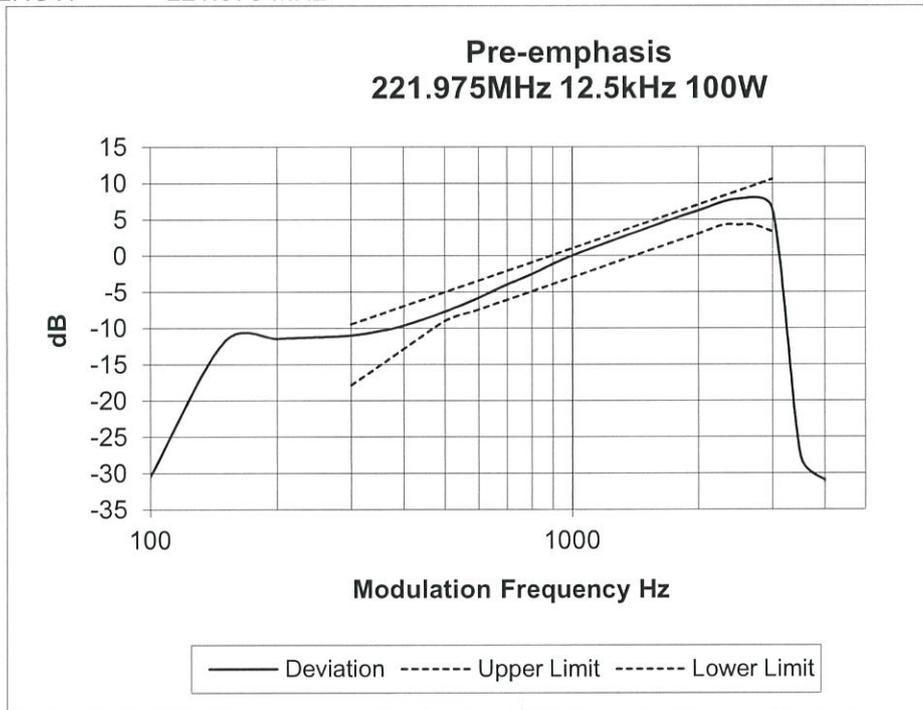
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 220.975 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 221.975 MHz 12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603E 2.2.3

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing.

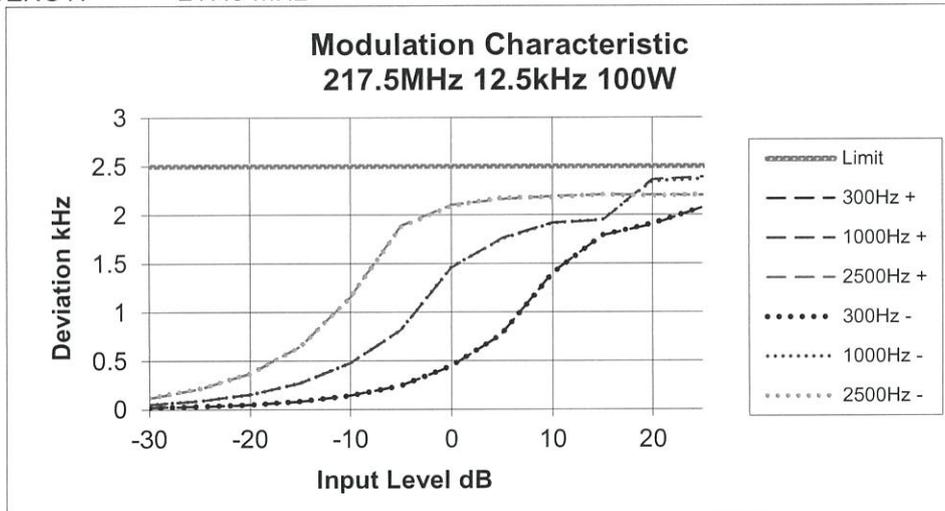
LIMIT CLAUSE: TIA/EIA-603E 1.3.4.4

SPECIFICATION: FCC CFR 2.1047 (b)

MEASUREMENT UNCERTAINTY: $\pm 1.5\%$

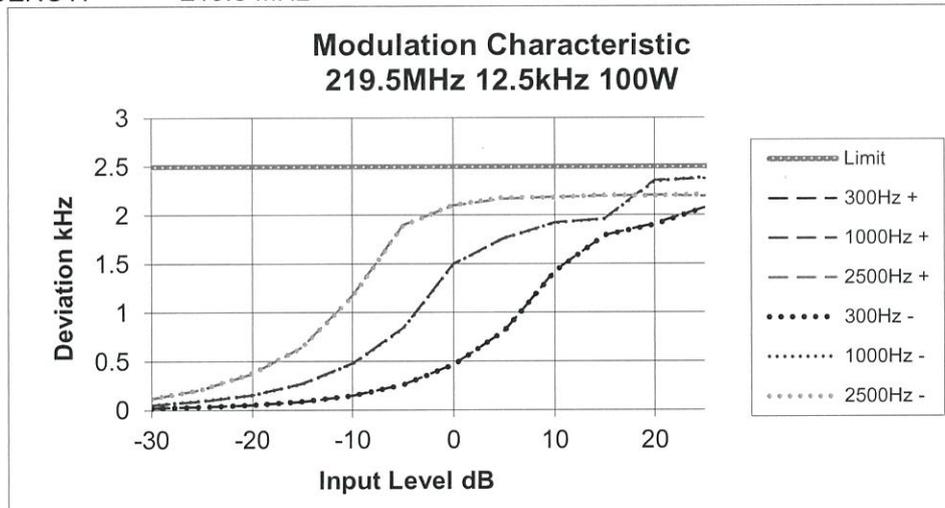
Tx FREQUENCY: 217.5 MHz

12.5 kHz Channel Spacing



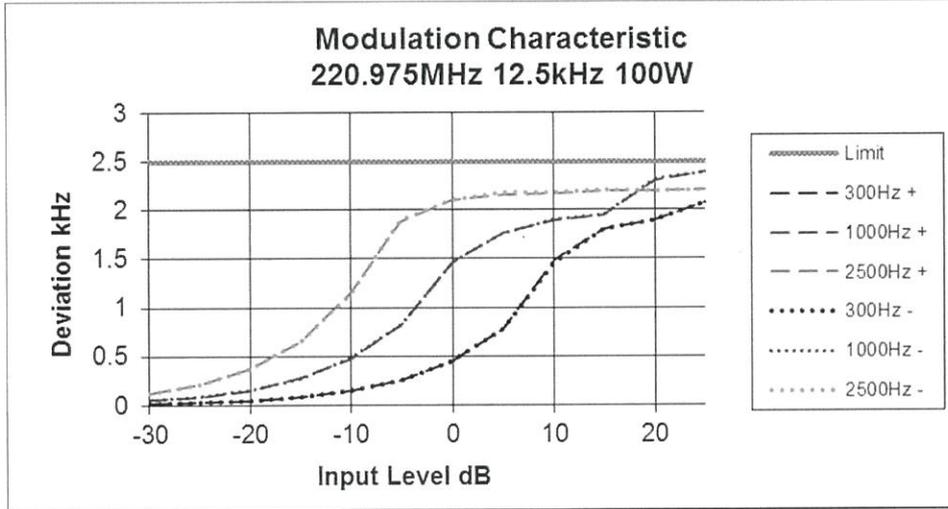
Tx FREQUENCY: 219.5 MHz

12.5 kHz Channel Spacing

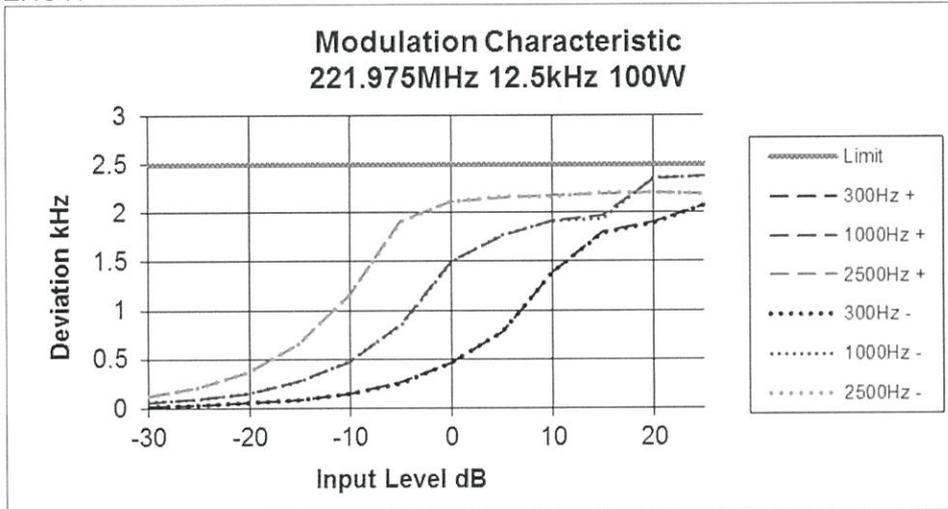


Transmitter Modulation Limiting

Tx FREQUENCY: 220.975 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 221.975 MHz 12.5 kHz Channel Spacing



TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c) RSS-119 5.5

GUIDE: TIA/EIA-603E 2.2.11 (Analog)
TIA-102.CAAA-C 2.2.5 (Digital)

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.
2. Analog: The EUT was modulated with an externally generated 2.5 kHz audio signal at a level 16 dB above 50% of the maximum rated deviation.
FFSK and DMR: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
3. The Occupied Bandwidth was measured on the Spectrum Analyser, with bandwidth settings as follows.
Emission Mask D – Resolution Bandwidth = 100 Hz, Video Bandwidth = 1 kHz
Emission Mask F (4 contiguous channels) – Resolution Bandwidth = 300 Hz, Video Bandwidth = 3 kHz
Emission Mask 80.211 (f) – Resolution Bandwidth = 100 Hz, Video Bandwidth = 1 kHz

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: FCC 47 CFR 80.211 & 90.210 RSS-119 5.5

DATA SPEED

Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps (DMR)
1200 bps (FFSK)

MEASUREMENT UNCERTAINTY 95% ±0.65dB

EMISSION MASKS

Transmit Frequency	FCC Part	Analog Mask	FFSK & DMR Mask
216-220	80	80.211 (f)	80.211 (f)
220-222	90	F (4 contiguous channels)	F (4 contiguous channels)

Transmit Frequency	IC Document	Analog Mask	FFSK & DMR Mask
217-218 & 219-220	RSS-119 5.5	D	D
220-222	SRSP-512 & RSS-119 5.5	F (4 contiguous channels)	F (4 contiguous channels)

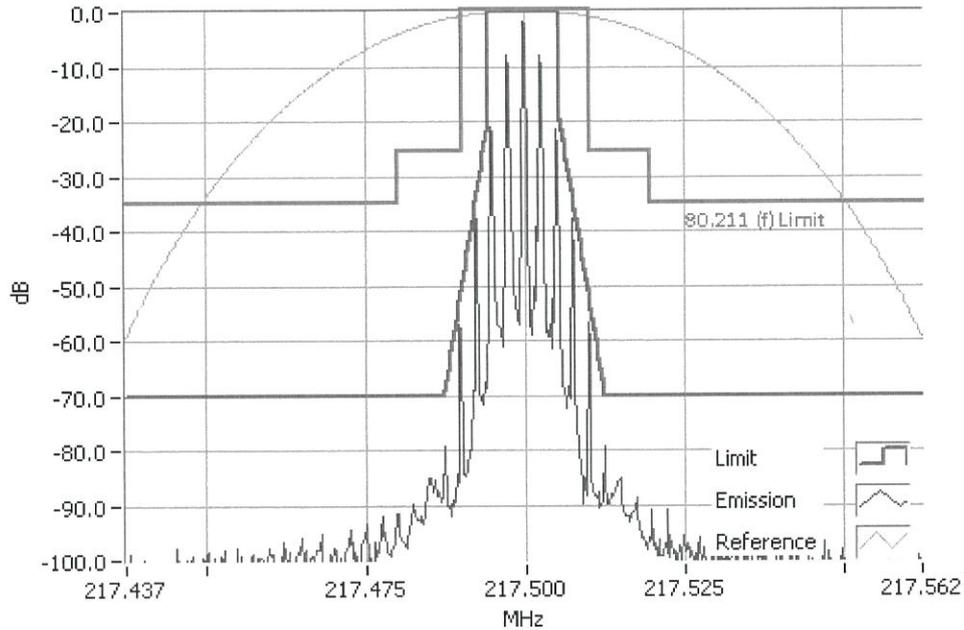
Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

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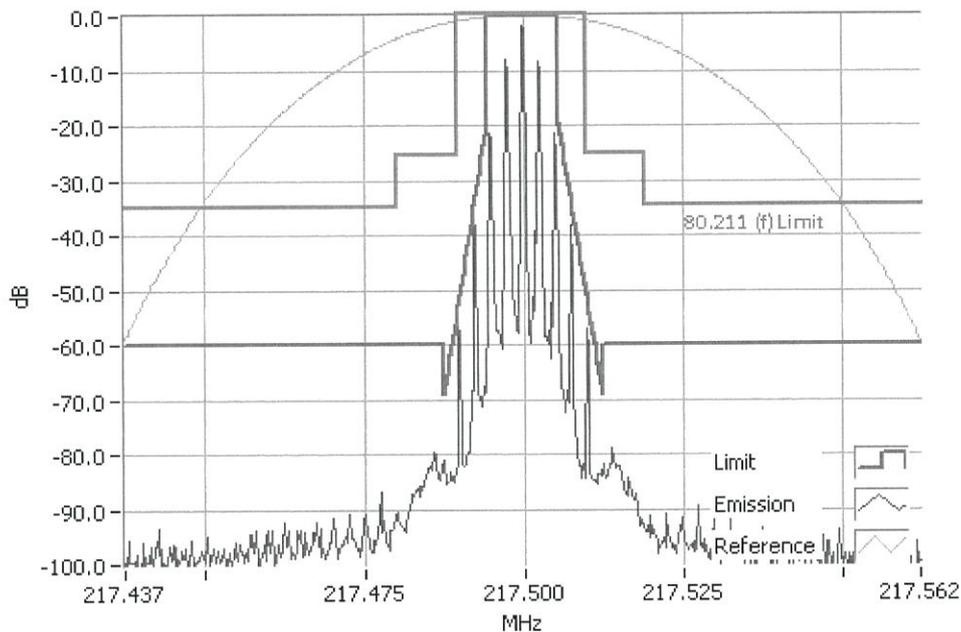
Analog Modulation

Tx FREQUENCY: 217.5 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 217.5000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 217.5 MHz 10 W 12.5 kHz Channel Spacing



Analogue Modulation 217.5000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

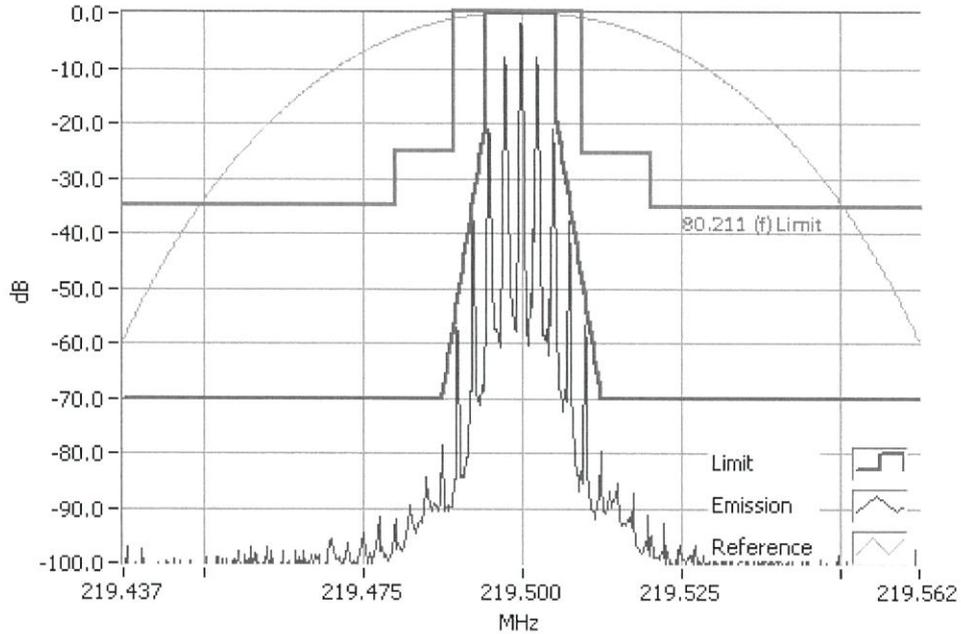
Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

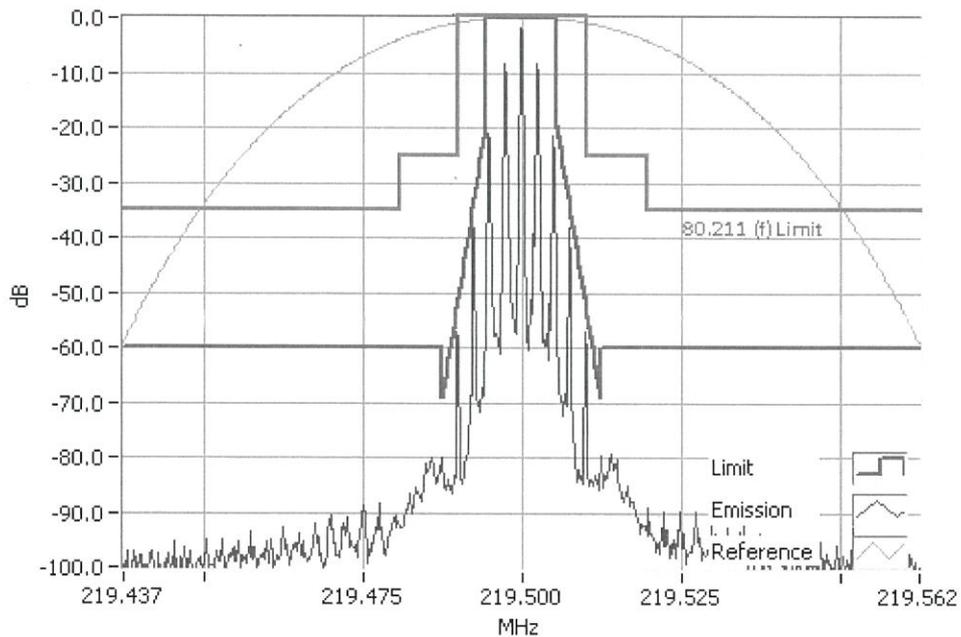
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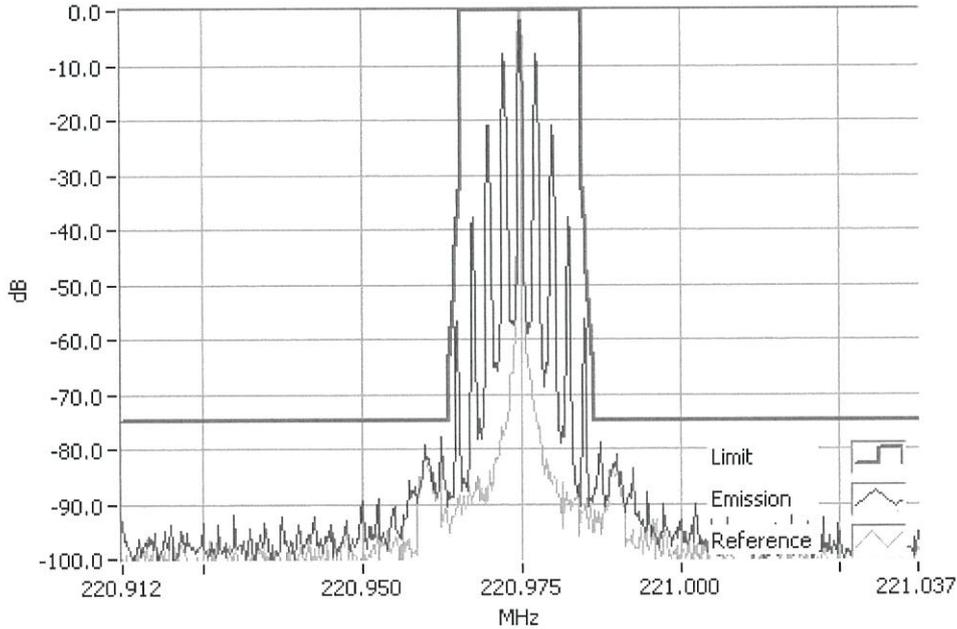
Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

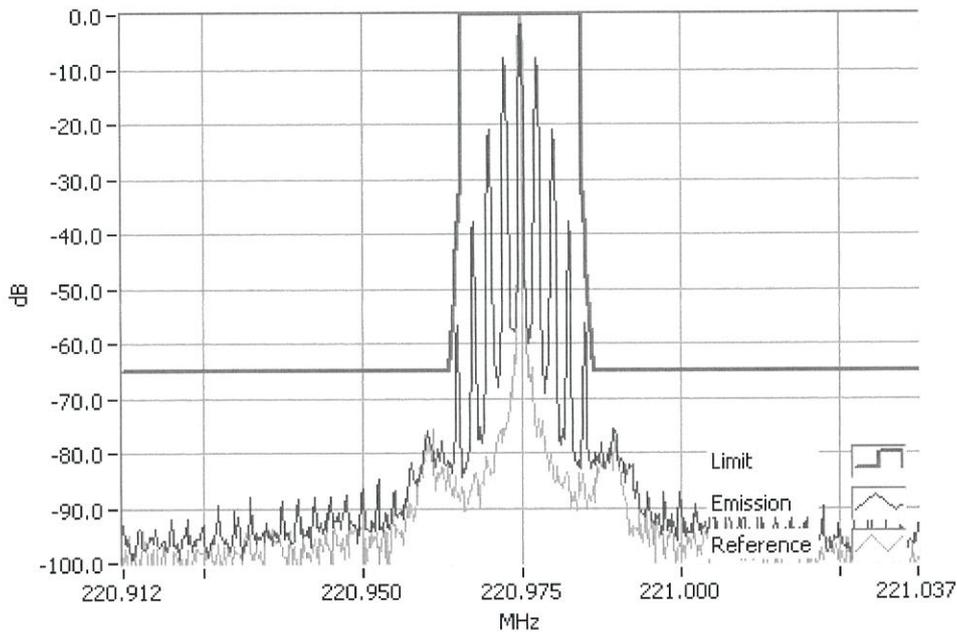
Analog Modulation

Tx FREQUENCY: 220.975 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 220.9750MHz Mask Fx4 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 220.975 MHz 10 W 12.5 kHz Channel Spacing



Analogue Modulation 220.9750MHz Mask Fx4 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

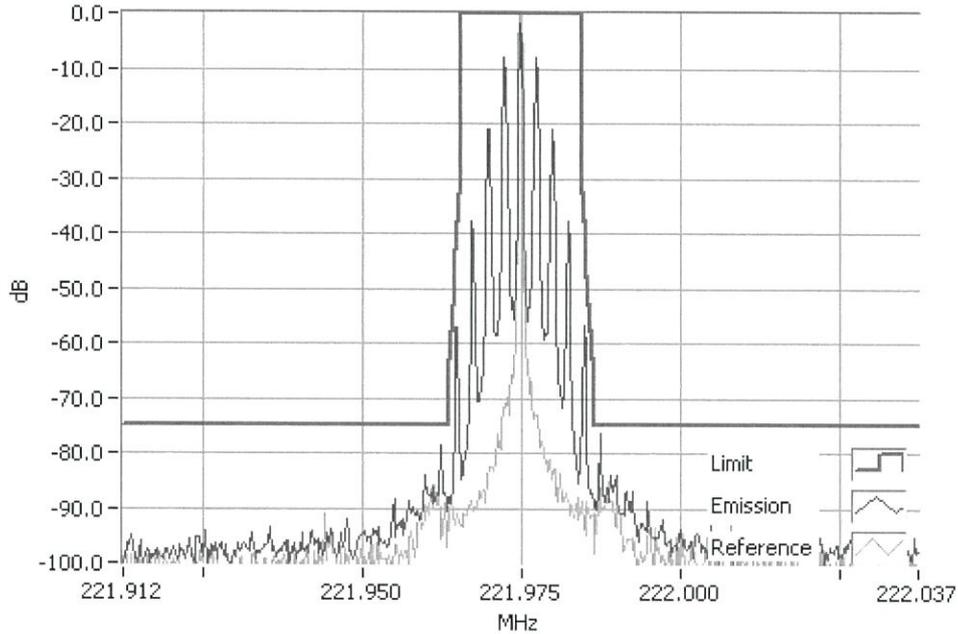
Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

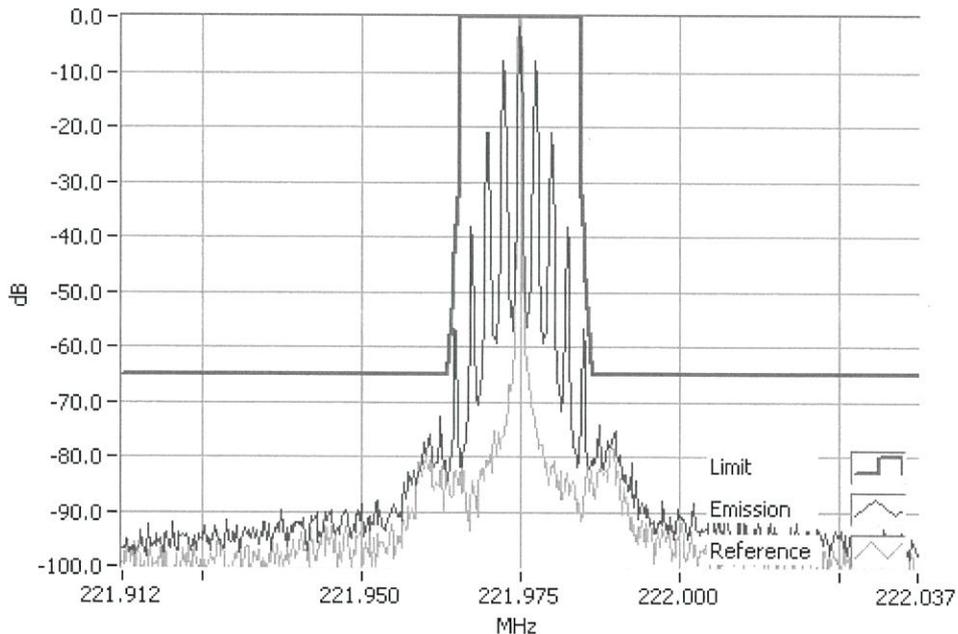
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Analogue Modulation 221.9750MHz Mask Fx4 100W
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Analogue Modulation 221.9750MHz Mask Fx4 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

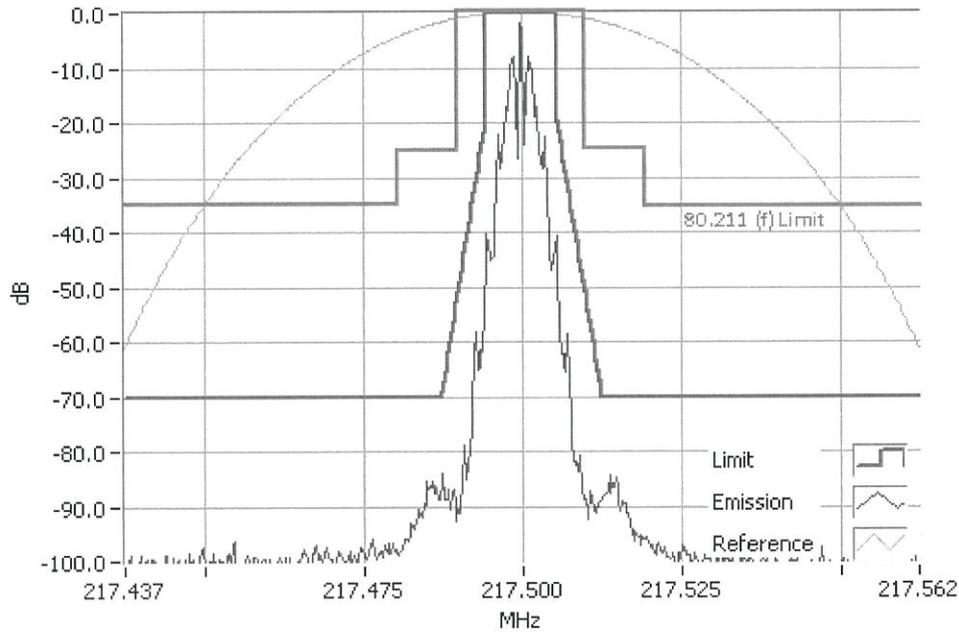
Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

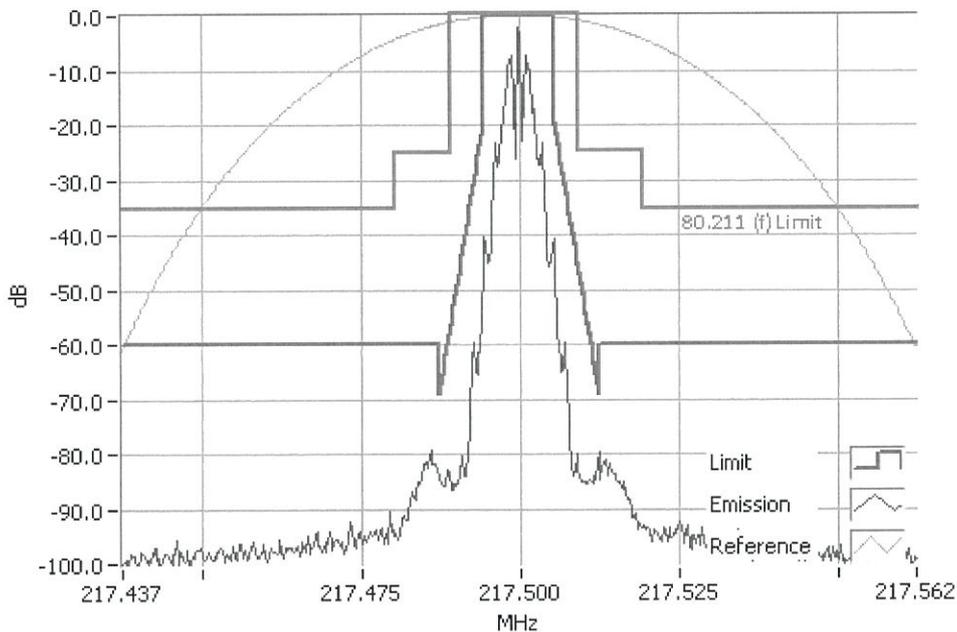
FFSK Modulation

Tx FREQUENCY: 217.5 MHz 100 W 12.5 kHz Channel Spacing



FFSK 1200 217.5000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 217.5 MHz 10 W 12.5 kHz Channel Spacing



FFSK 1200 217.5000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

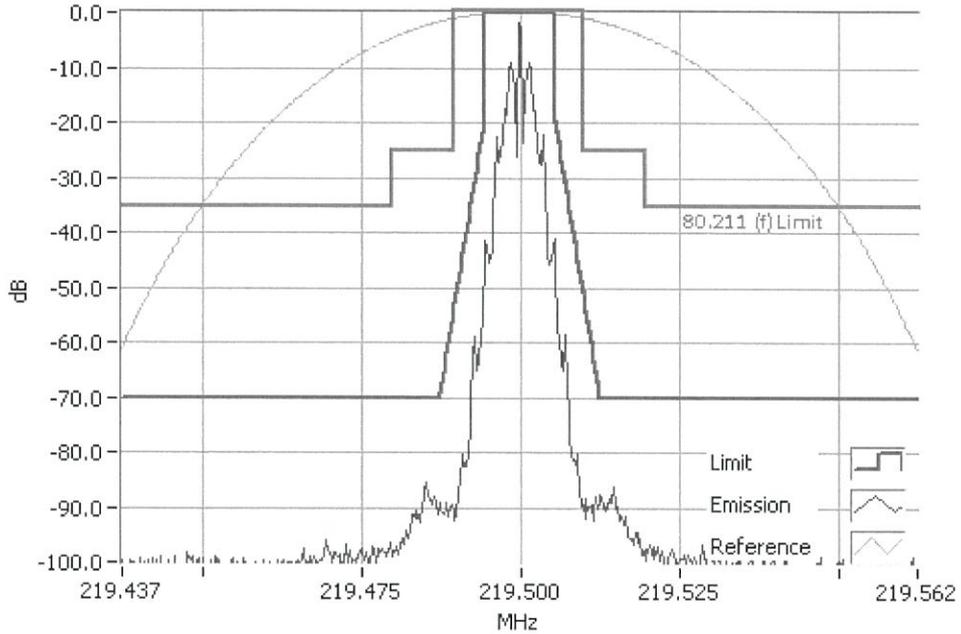
Occupied Bandwidth and Spectrum Masks

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RSS-119 5.5

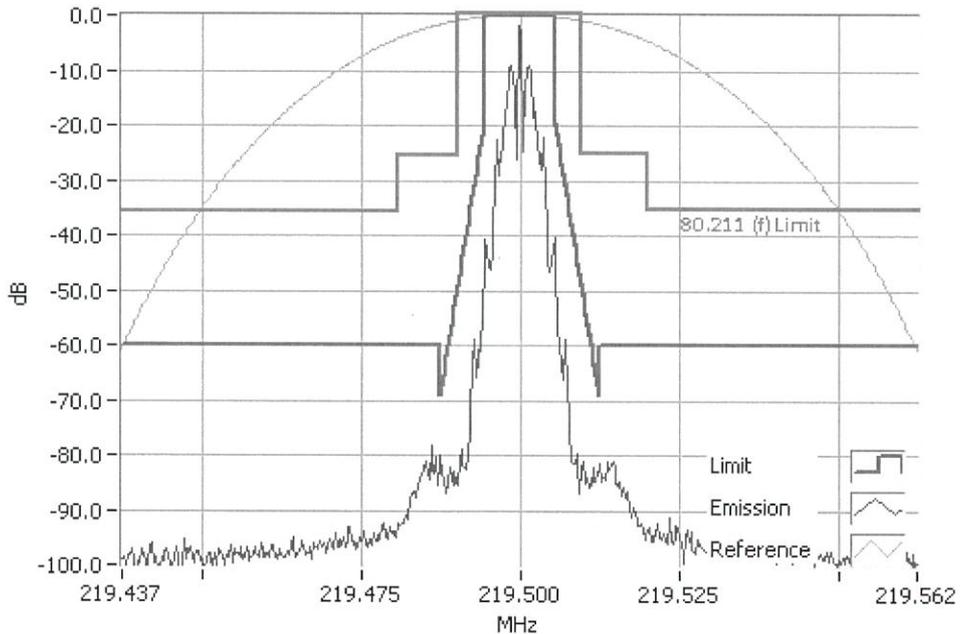
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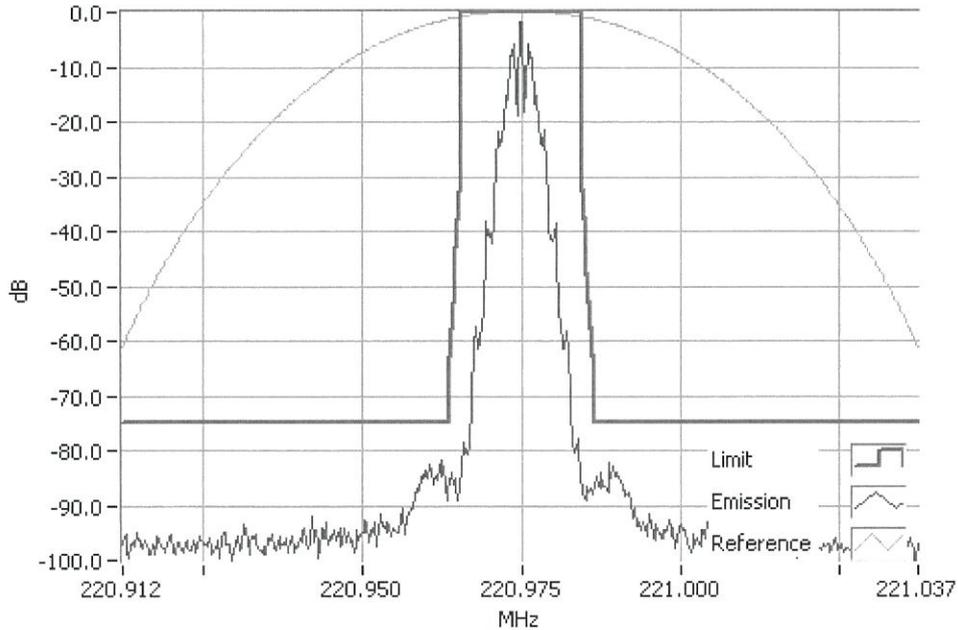
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RSS-119 5.5

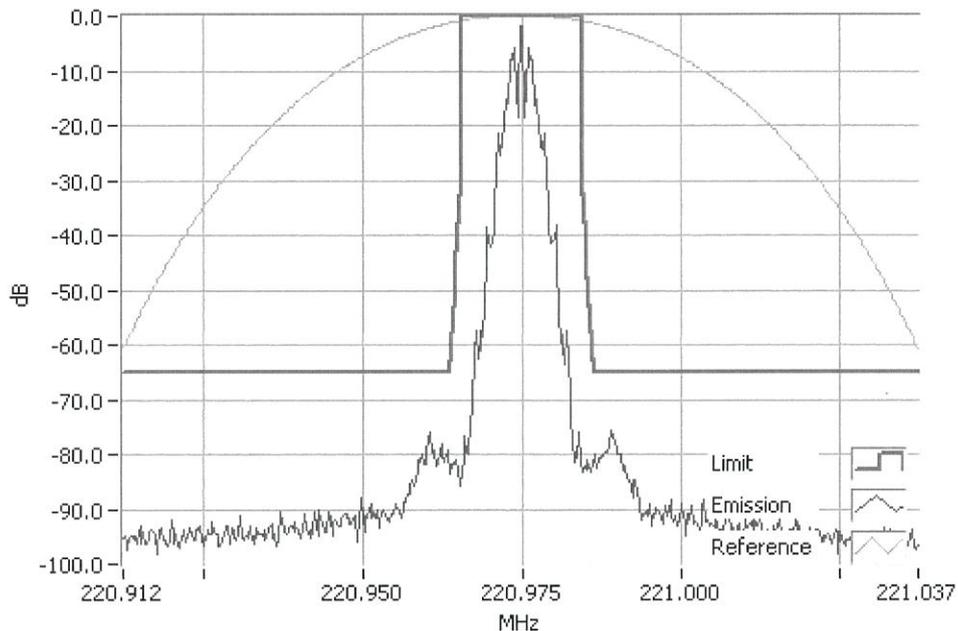
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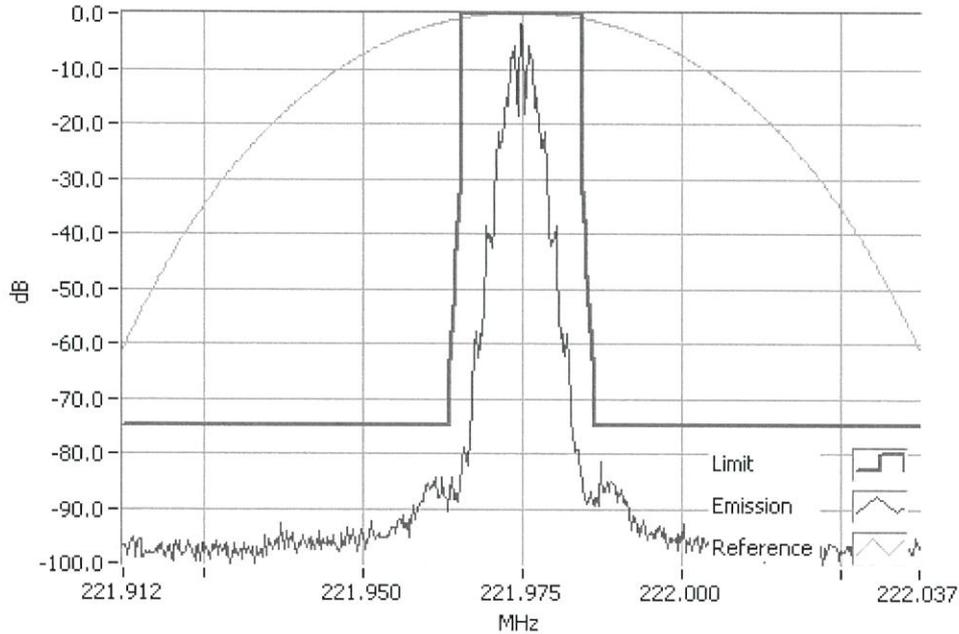
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RSS-119 5.5

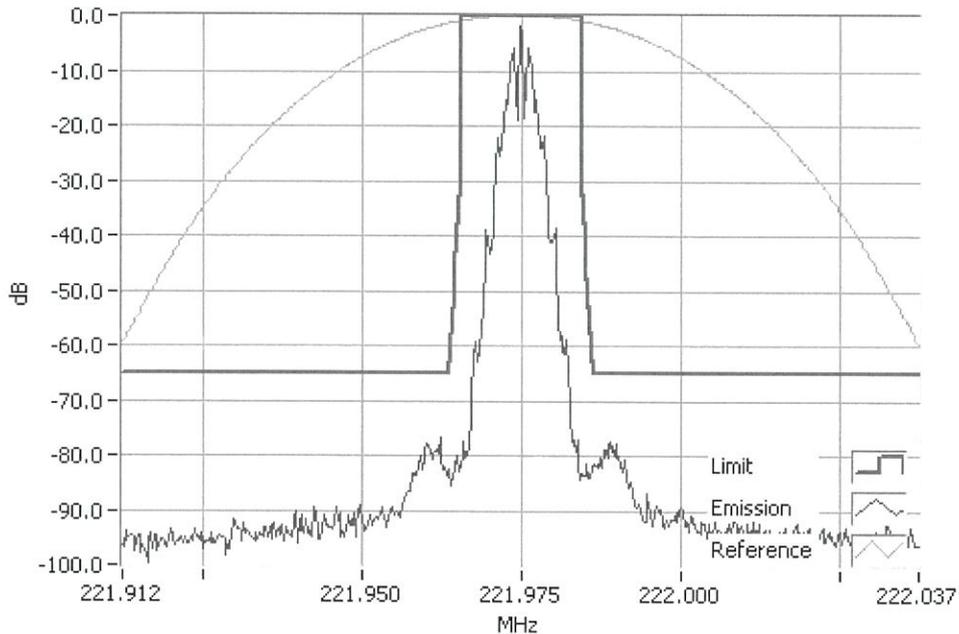
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