## LABORATORY TEST REPORT

#### RADIO PERFORMANCE MEASUREMENTS

for the

TBDH5F Transportable Base Station Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22 and 90

Report Revision:

1

Issue Date:

18 October 2019

PREPARED BY:

A. Schinkelshoek

Test Technician

CHECKED & APPROVED BY: M. C. James

Laboratory Technical Manager



FCC REGISTRATION:

838288

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

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FCC ID: CASTBDH5F

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## **REVISION**

Date	Revision	Comments
18 October 2019	1	Initial test report

## INTRODUCTION

Type approval testing of the TBDH5F, 30 Watt, Transportable Base Station transceiver, in order to demonstrate compliance with FCC 47 Parts 22 & 90. This radio supports analogue, digital FFSK, Digital Mobile Radio (DMR), APCO P25 phase-1 modulations.

#### REPORT PREPARED FOR

Tait International Ltd 245 Wooldridge Road Harewood Christchurch 8051 New Zealand

#### **DESCRIPTION OF SAMPLE**

Manufacturer Tait International Limited

Equipment: Transportable Base Station Transceiver

Type: TBDH5F
Product Code: TB7304-H580
Serial Number(s): 18298071
Frequency range 400 → 470 MHz

Transmit Power 30 W

Quantity: 1

FCC ID: CASTBDH5F

Modulation		Channel Spacing	Speech Channels	Symbol Rate (symbols/sec)	Data Rate (bps)
Analogue FM		12.5 kHz	1	-	-
FFSK	Fast Frequency Shift	12.5 kHz	-	1200	1200
FISK	Keying		-	2400	2400
Digital Mobile Radio (DMR)	4 Level FSK (2 slot TDMA) (ETSI TS102 361-1)	12.5 kHz	2	4800	9600
APCO P25 Phase 1	C4FM (TIA 102)	12.5 kHz	1	4800	9600

#### HARDWARE & SOFTWARE

## Analog and DMR Tests:

Module	Product Code	Serial Number	Firmware Version	Hardware Version
Reciter	T01-01403-SBAA	18295659	dmr- trunk.20190903T1402 06	01.01
Power Amplifier	T01-01405-SCAA	18301518	< Not applicable >	00.01

#### P25 Tests:

Module	Product Code	Serial Number	Firmware Version	Hardware Version
Reciter	T01-01403-SBAA	18295659	p25- trunk.20190903T1121 22	1.01
Power Amplifier	T01-01405-SCAA	18301518	< Not applicable >	00.01

#### **TEST CONDITIONS**

FCC ID: CASTBDH5F

All testing was performed between 18 September 2019  $\rightarrow$  17 October 2019, and under the following conditions:

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Indoor Ambient temperature:  $15^{\circ}\text{C} \rightarrow 30^{\circ}\text{C}$ Indoor Relative Humidity:  $20\% \rightarrow 75\%$ Outdoor Ambient temperature:  $48\% \rightarrow 77\%$ Outdoor Relative Humidity:  $24\% \rightarrow 44\%$ 

All tests except Radiated emissions were done at 13.8  $V_{\text{DC}}.$  Radiated emissions were measured at 120  $V_{\text{AC}}$ 

## STATEMENT OF COMPLIANCE

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

Equipment:

Transportable Base Station Transceiver

Type:

TBDH5F

Product Code:

TB7304-H580

Serial Number(s):

18298071

( November 2014

Quantity:

1

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

FCC 47 CFR Parts 22 and 90

Signature

M. C. James

FCC ID: CASTBDH5F

Laboratory Technical Manager

Date:

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# MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

#### **MODULATION TYPES:**

F3E Analogue Frequency Modulation (FM)

F2D FFSK 1200 bps and 2400 bps

FXW DMR Digital Voice 9600 bps FXD DMR Digital Data 9600 bps F1E, F7E P25 phase 1 Digital Voice 9600 bps F1D, F7D P25 phase 1 Digital Data 9600 bps

CHANNEL SPACING: 12.5 kHz

## **EMISSION DESIGNATORS:**

	12.5 kHz
Analog FM	11K0F3E
FFSK Data 1200 bps	6K60F2D
FFSK Data 2400 bps	7K80F2D
Digital Voice DMR	7K60FXW
Digital Data DMR	7K60FXD
Digital Voice P25 phase 1	8K10F1E
Digital Data P25 phase 1	8K10F1D

#### **CALCULATIONS**

Equation: Bn = 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 Bandwidth

Necessary bandwidth Emission Designator

M = 3.0 kHz 11K0F3E

D = 2.5 kHz F3E represents an FM voice transmission

Bn = (2x3.0) + (2x2.5) x 1= 11.0 kHz

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

Necessary bandwidth Emission Designator

M = 1.8 kHz **6K60F2D** 

D = 1.5 kHz (60% of peak deviation) F2D represents a FM data transmission with

Bn =  $(2 \times 1.8) + (2 \times 1.5) \times 1$  the use of a modulating sub carrier

= 6.6 kHz

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## Emission Designators - Continued

Digital Voice 12.5 kHz Bandwidth DMR

99% bandwidth Emission Designator

= 7.6 kHz **7K60FXW** 

FXW represents a FM Time Division Multiple Access

(TDMA) combination of data and telephony

Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth Emission Designator

= 7.6 kHz **7K60FXD** 

FXD represents FM Time Division Multiple Access

(TDMA) data only

Digital Voice 12.5 kHz Bandwidth P25 phase 1

99% bandwidth Emission Designator

= 8.1 kHz **8K10F1E** 

F1E represents a digital FM voice transmission

Digital Data 12.5 kHz Bandwidth P25 phase 1

99% bandwidth Emission Designator

= 8.1 kHz **8K10F1D** 

F1D represents a digital FM data transmission

## **TEST RESULTS**

## TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046

GUIDE: ANSI C63.26 5.2.4.2

#### **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.

#### **EXAMPLE CALCULATION:**

#### Example calculation

Power in dBm = Measured power (dBm) + attenuator and cable loss (dB)

Chan 1 power (dBm)

12.77 dBm +31.05 dB

= 43.82dBm

Power in Watts =  $(10^{(43.82dBm)/10})/1000$ 

= 24.1W

Copy from TREVA sheet.

#### **MEASUREMENT RESULTS:**

Manufacturer's Rated Output Power: Switchable: 30 W and 2 W

Nominal 30 W	Measured (W)	Variation (%)	Variation (dB)
406.2 MHz	24.1	-19.6	-0.9
418.05 MHz	24.4	-18.8	-0.9
429.9 MHz	24.5	-18.2	-0.9
450.1 MHz	24.4	-18.5	-0.9
454.5 MHz	24.4	-18.6	-0.9
460.0 MHz	24.4	-18.7	-0.9
465.0 MHz	24.1	-19.7	-1.0
469.9 MHz	24.1	-19.5	-0.9
Measurement Uncertainty		± 0.	6 dB

## Transmitter Output Power (Conducted) - continued

Nominal 2 W	Measured (W)	Variation (%)	Variation (dB)
406.2 MHz	2.1	5.5	0.2
418.05 MHz	2.0	2.1	0.1
429.9 MHz	2.0	1.1	0.0
450.1 MHz	2.1	4.5	0.2
454.5 MHz	2.1	3.7	0.2
460.0 MHz	2.0	0.3	0.0
465.0 MHz	1.9	-5.6	-0.2
469.9 MHz	1.8	-8.2	-0.4
Measurement Uncertainty		± 0.6	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.

#### TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: ANSI C63.26 5.3.3.2

#### **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:**

FCC ID: CASTBDH5F

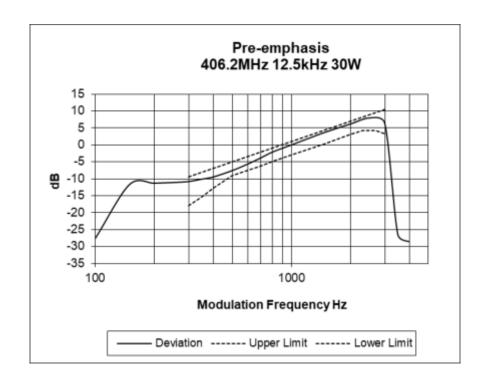
See the plots on the following pages for 12.5 kHz channel spacing tested at 30 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

MEASUREMENT UNCERTAINTY: ± 1.5 %

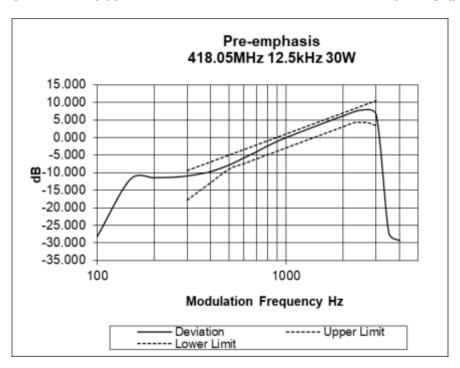
SPECIFICATION: FCC CFR 2.1047 (a

Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC 47 CFR 2.1047 (a)

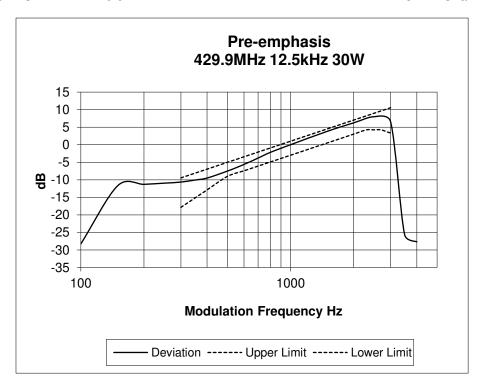
Tx FREQUENCY: 418.05 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC 47 CFR 2.1047 (a)

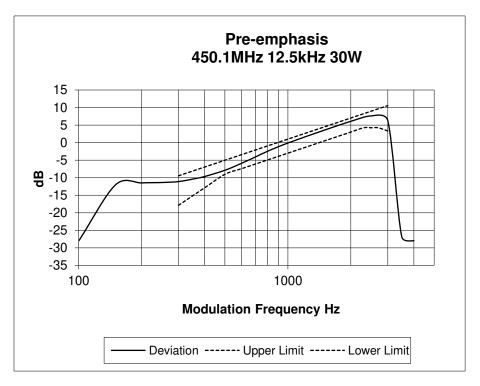
FCC ID: CASTBDH5F

Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing



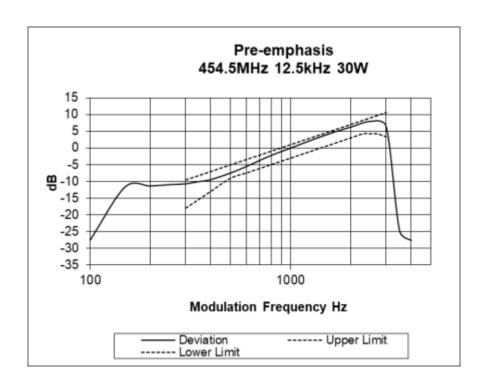
SPECIFICATION: FCC 47 CFR 2.1047 (a)

Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC 47 CFR 2.1047 (a)

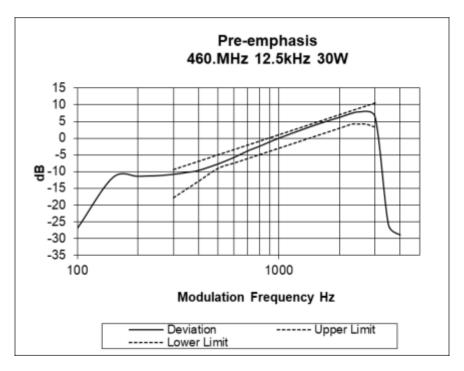
Tx FREQUENCY: 454.5 MHz 12.5 kHz Channel Spacing



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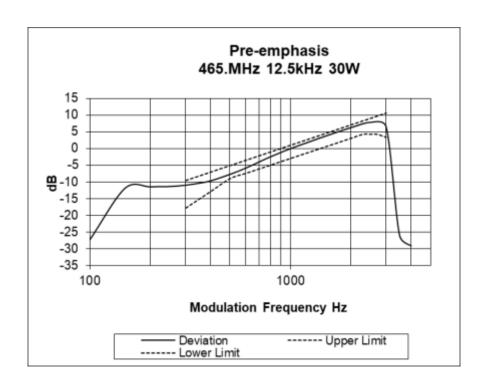
SPECIFICATION: FCC 47 CFR 2.1047 (a)

Tx FREQUENCY: 460.0 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC 47 CFR 2.1047 (a)

Tx FREQUENCY: 465.0 MHz 12.5 kHz Channel Spacing



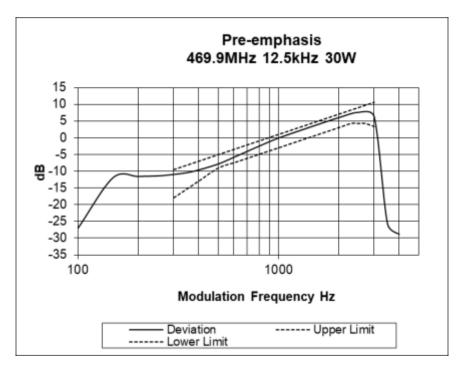
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SPECIFICATION: FCC 47 CFR 2.1047 (a)

FCC ID: CASTBDH5F

Tx FREQUENCY: 469.9 MHz 12.5 kHz Channel Spacing



#### TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: ANSI C63.26 5.3.2

#### **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 60% of maximum deviation. This was used as the 0-dB reference point.
- 3. The modulation response was measured at four audio frequencies while increasing the input level in 5dB steps.
- 4. Additionally the level used to measure sideband spectrum (occupied bandwidth) was included in the level sweep.
- 5. Measurements were made for both Positive and Negative Deviation.

#### **MEASUREMENT RESULTS:**

FCC ID: CASTBDH5F

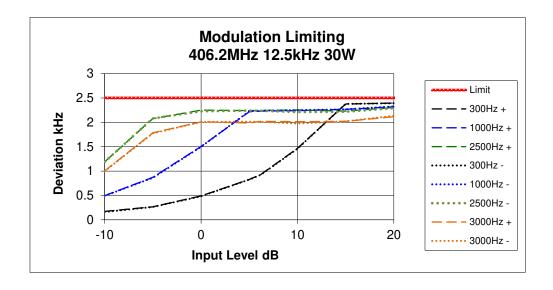
See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

MEASUREMENT UNCERTAINTY: ± 1.5 %

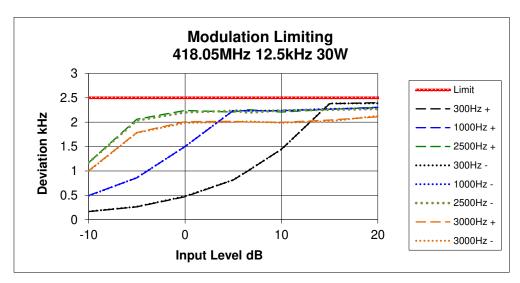
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



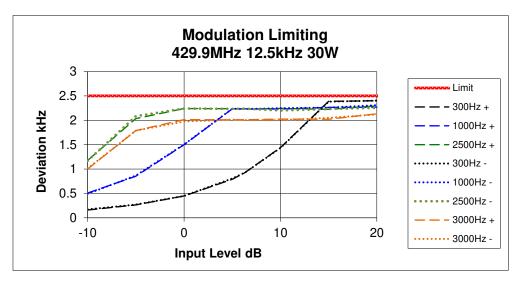
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 418.05 MHz 12.5 kHz Channel Spacing



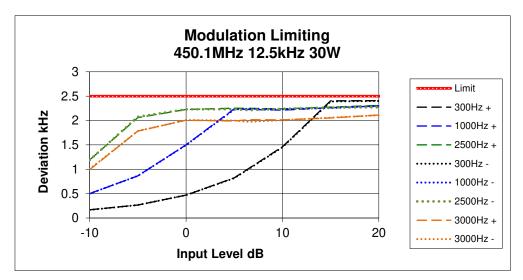
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing



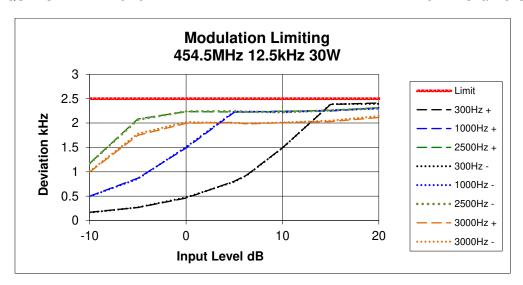
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



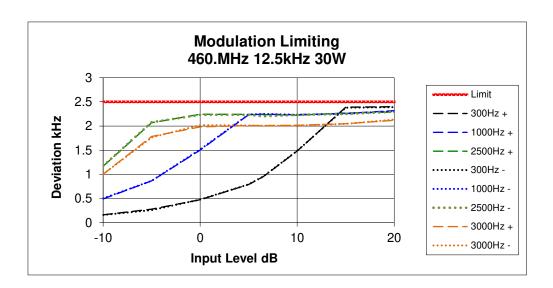
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 454.5 MHz 12.5 kHz Channel Spacing



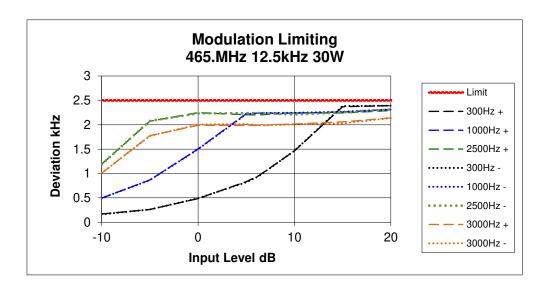
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 460.0 MHz 12.5 kHz Channel Spacing



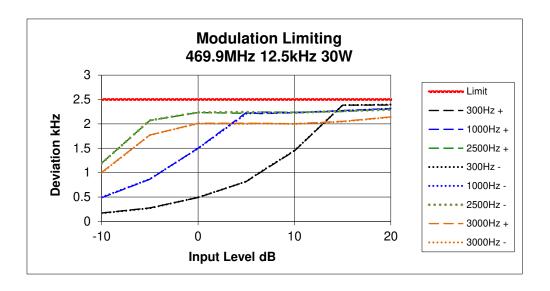
SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 465.0 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC 47 CFR 2.1047 (b)

Tx FREQUENCY: 469.9 MHz 12.5 kHz Channel Spacing



#### TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA/EIA-603D 2.2.11 (Analogue)

TIA-102.CAAA-C 2.2.5 (Digital)

#### **MEASUREMENT PROCEDURE:**

1. Refer Annex A for Equipment Set up.

- 2. For Analogue measurements: The EUT was modulated by a 2500 Hz tone at an input level 16 dB above a level that produced 50% deviation. The input level was established at the frequency of maximum response of the audio modulating circuit.
  - For Data measurements: 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 noted on the recorded plots.

#### **MEASUREMENT RESULTS:**

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

MEASUREMENT UNCERTAINTY 95% ±0.65dB

LIMIT CLAUSE: FCC 47 CFR 90.210

**EMISSION MASKS** 

Emission Mask D 12.5 kHz Channel Spacing Analogue, FFSK, Digital Voice/data

DATA SPEED

FCC ID: CASTBDH5F

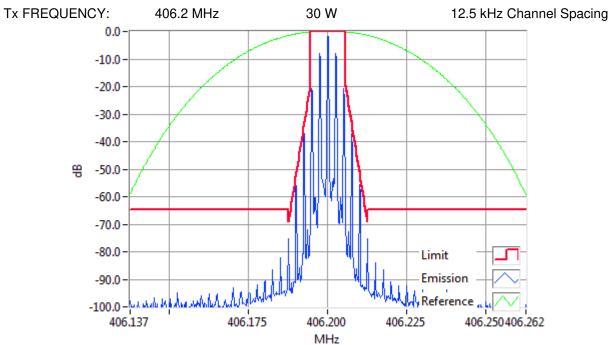
Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps & 12000 bps FFSK 12.5 kHz Channel Spacing 1200 bps & 2400 bps

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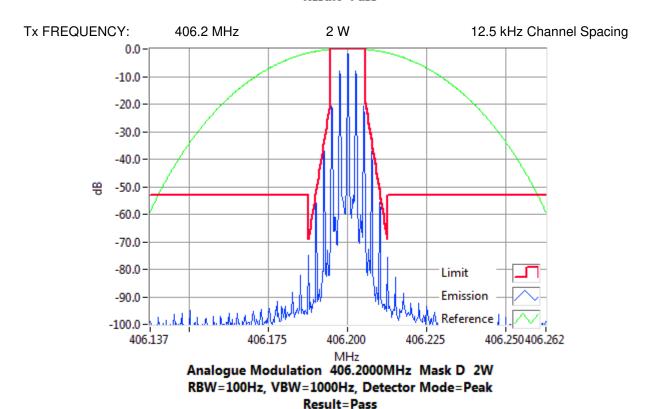
#### **ANALOGUE VOICE**

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



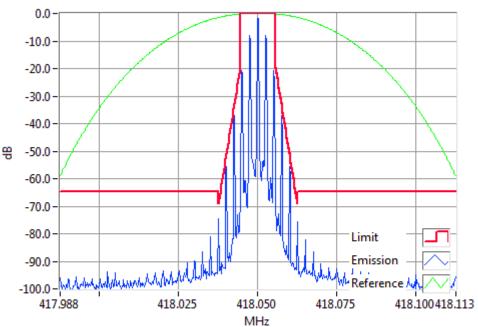
Analogue Modulation 406.2000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



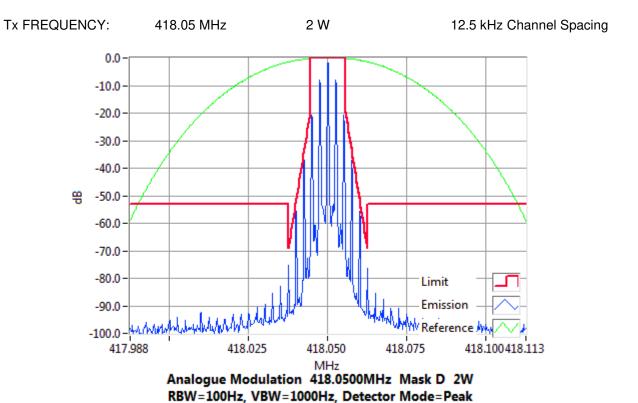
#### **ANALOGUE VOICE**

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 418.05 MHz 30 W 12.5 kHz Channel Spacing



Analogue Modulation 418.0500MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



Result=Pass

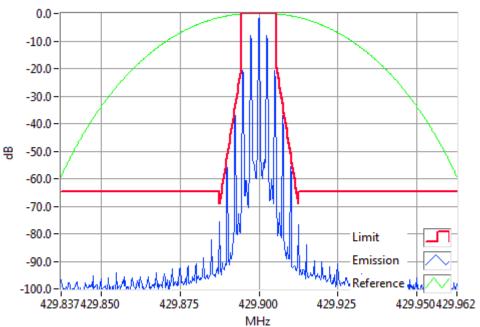
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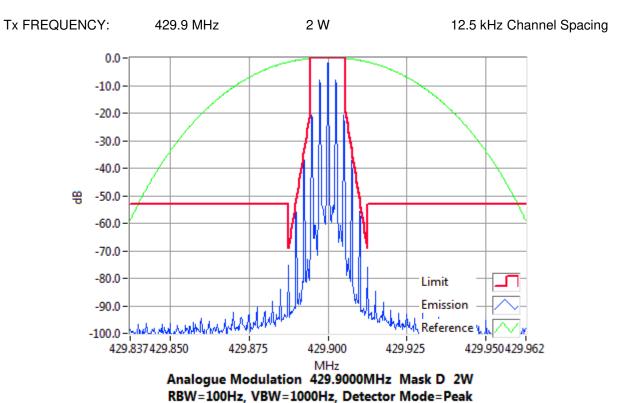
#### **ANALOGUE VOICE**

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 429.9 MHz 30 W 12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



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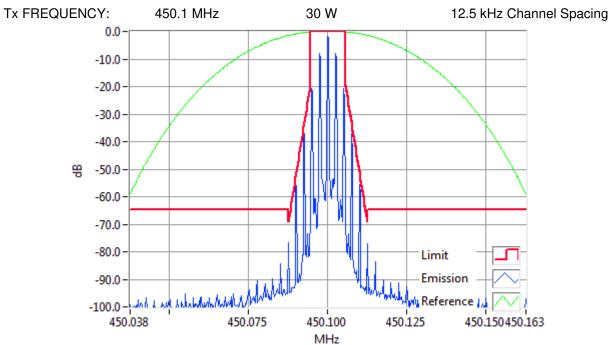
Result=Pass

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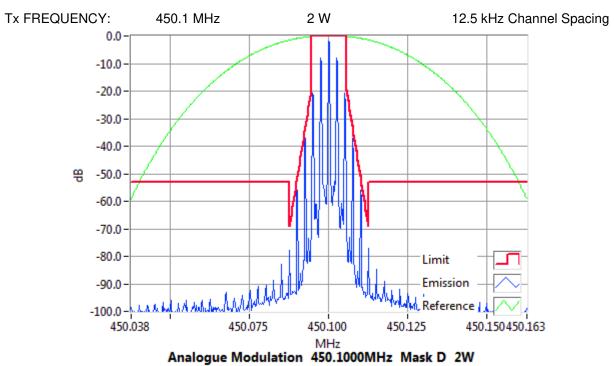
#### **ANALOGUE VOICE**

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



Analogue Modulation 450.1000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

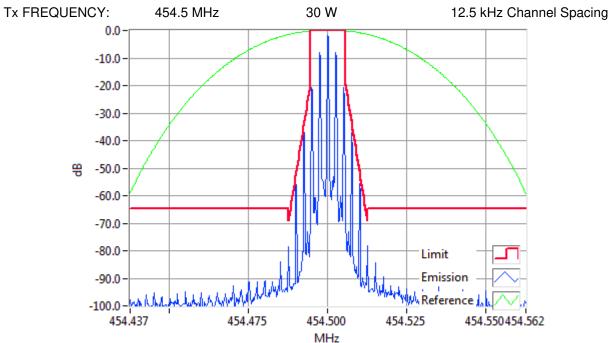


Analogue Modulation 450.1000MHz Mask D 2W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

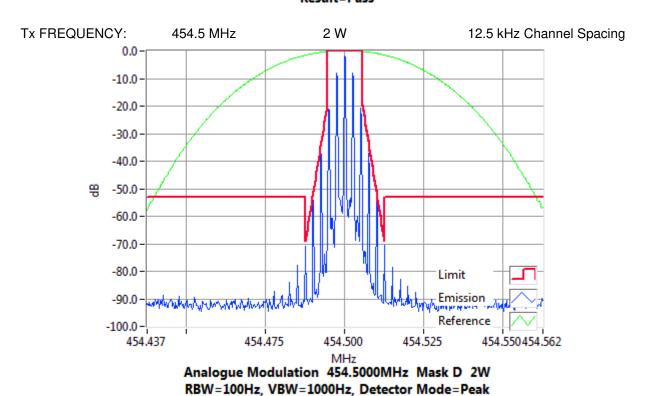
#### **ANALOGUE VOICE**

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



Analogue Modulation 454.5000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

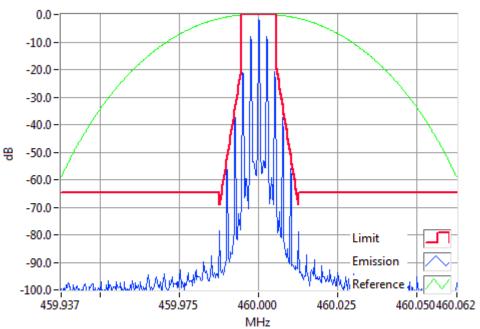


Result=Pass

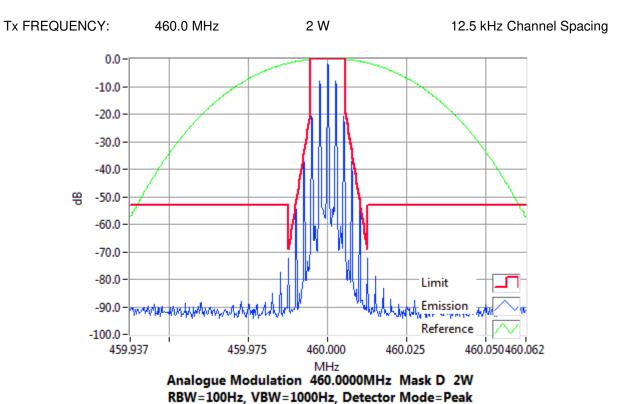
#### **ANALOGUE VOICE**

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 460.0 MHz 30 W 12.5 kHz Channel Spacing



Analogue Modulation 460.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



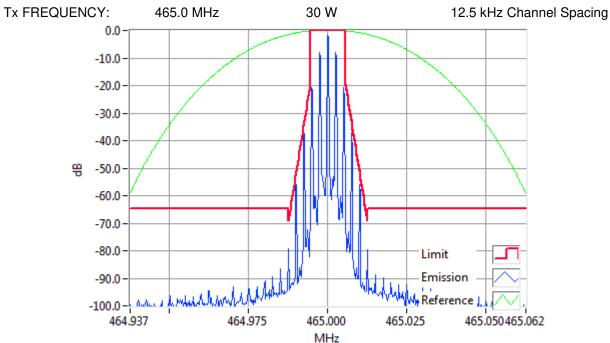
Result=Pass

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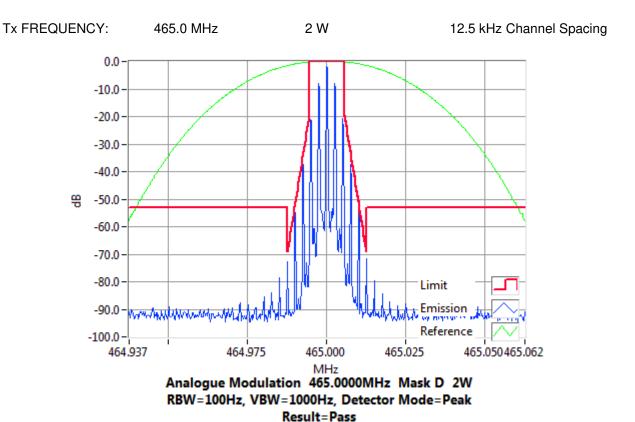
Report Revision: 1 Issue Date: 18 October 2019

#### **ANALOGUE VOICE**

SPECIFICATION: FCC CFR 2.1049 (c)



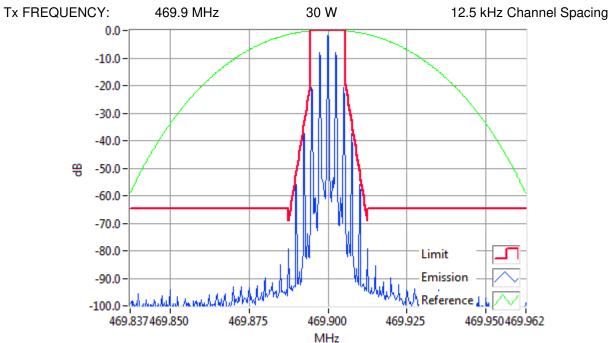
Analogue Modulation 465.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



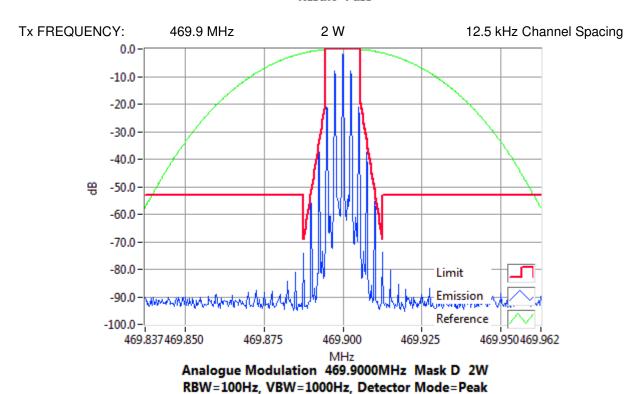
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#### **ANALOGUE VOICE**

SPECIFICATION: FCC CFR 2.1049 (c)



Analogue Modulation 469.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

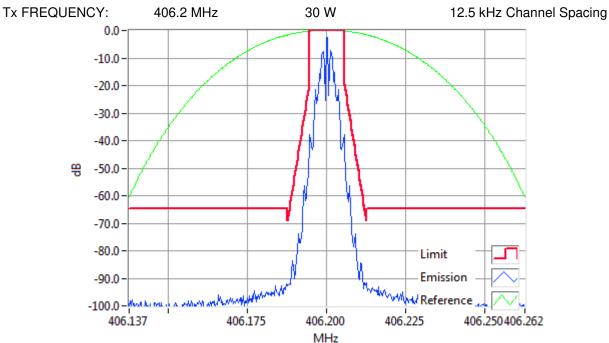


Result=Pass

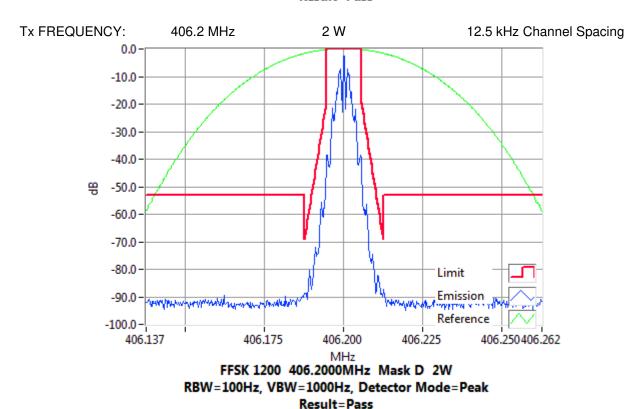
FFSK 1200 bps

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)

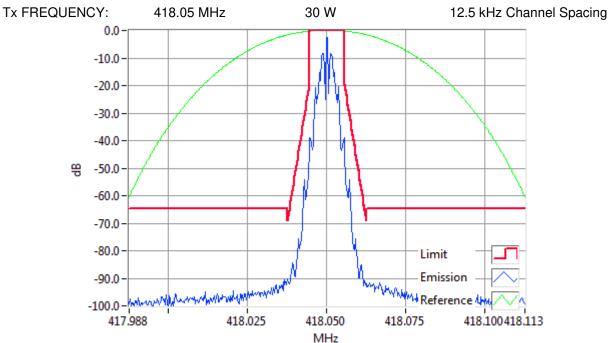


FFSK 1200 406.2000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

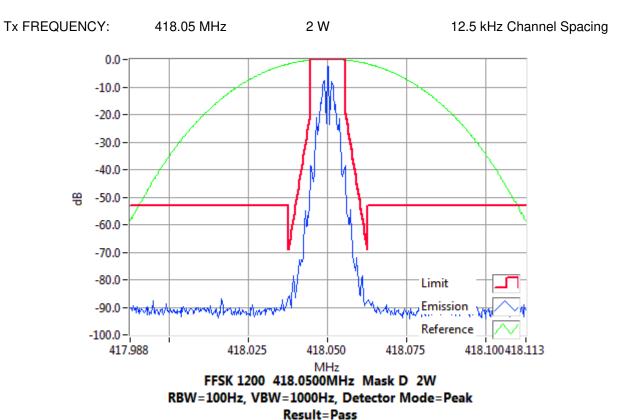


FFSK 1200 bps

SPECIFICATION: FCC CFR 2.1049 (c)



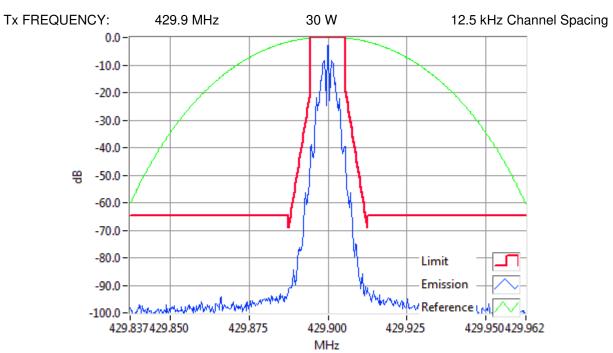
FFSK 1200 418.0500MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



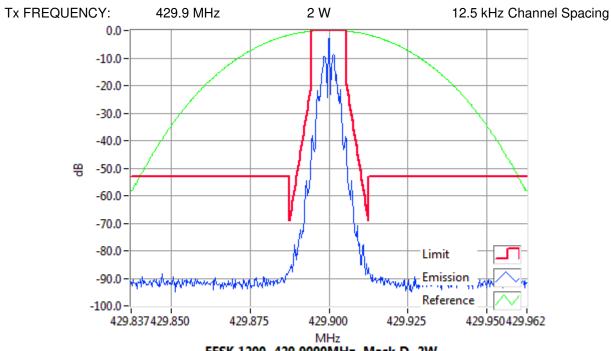
FCC ID: CASTBDH5F Page 31 of 100 Report Revision: 1
Issue Date: 18 October 2019

FFSK 1200 bps

SPECIFICATION: FCC CFR 2.1049 (c)



FFSK 1200 429.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



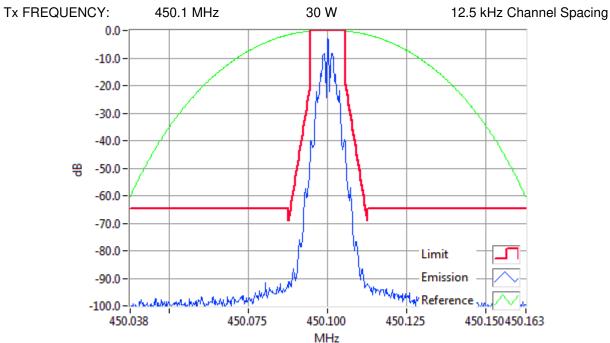
FFSK 1200 429.9000MHz Mask D 2W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

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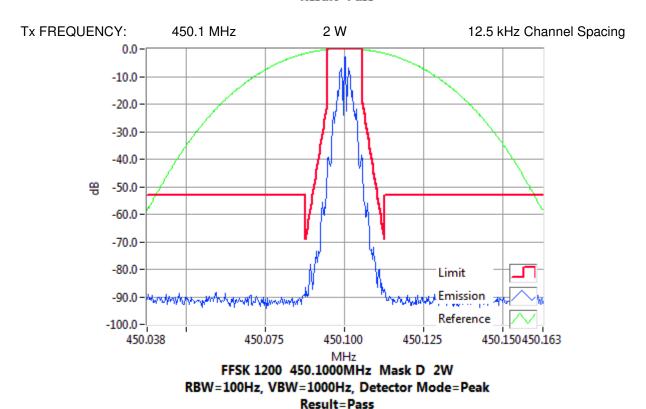
FFSK 1200 bps

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



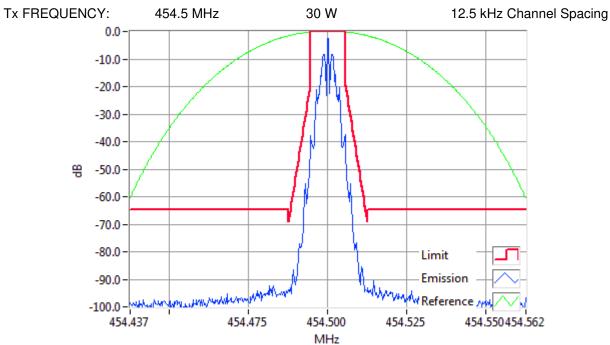
FFSK 1200 450.1000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



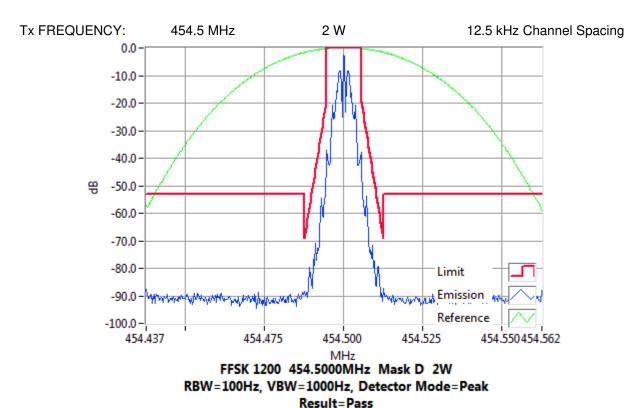
FFSK 1200 bps

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)

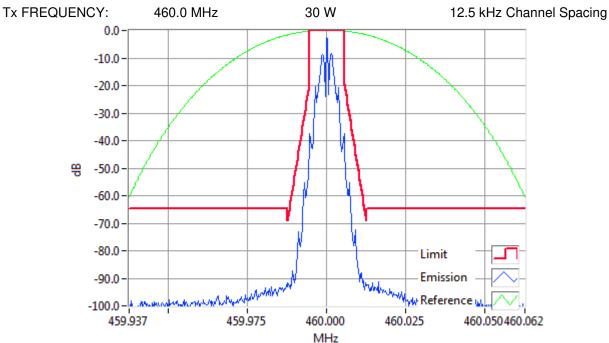


FFSK 1200 454.5000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

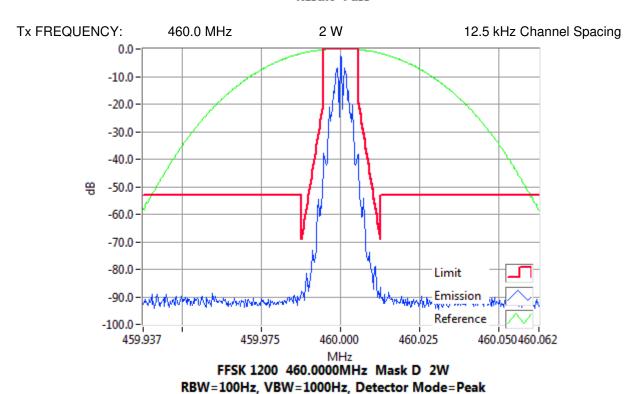


FFSK 1200 bps

SPECIFICATION: FCC CFR 2.1049 (c)



FFSK 1200 460.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

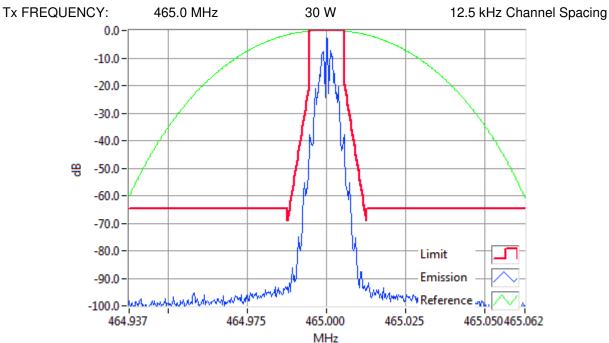


Result=Pass

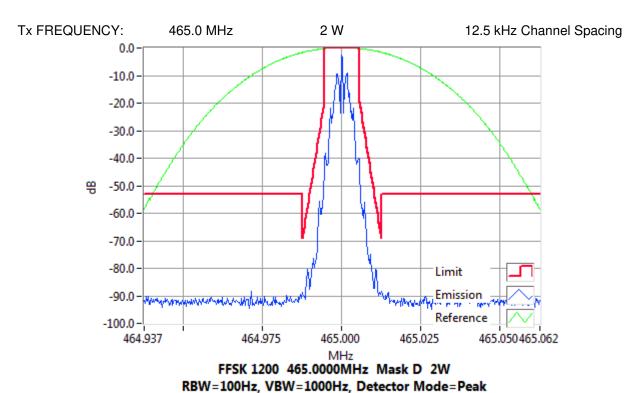
FFSK 1200 bps

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



FFSK 1200 465.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

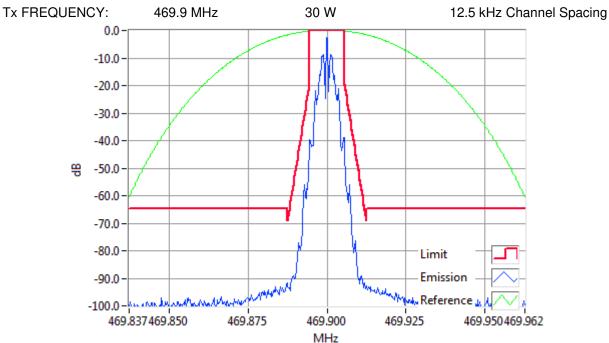


Result=Pass

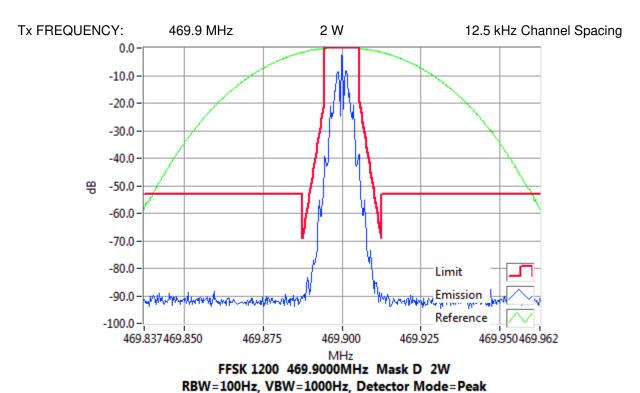
FFSK 1200 bps

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



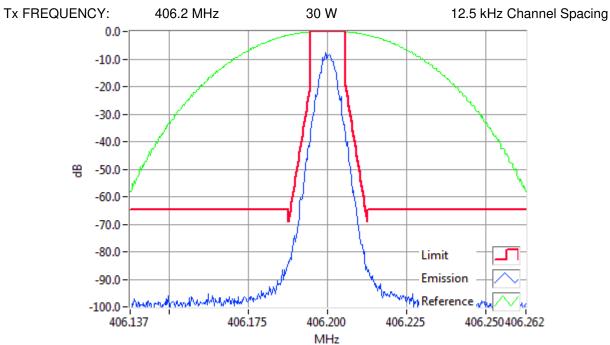
FFSK 1200 469.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



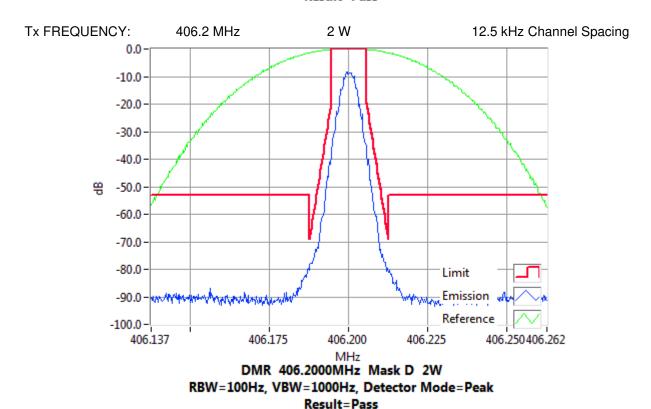
Result=Pass

**DMR** 

FCC ID: CASTBDH5F

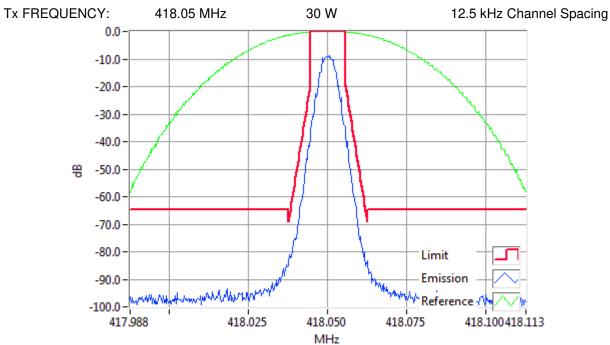


DMR 406.2000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

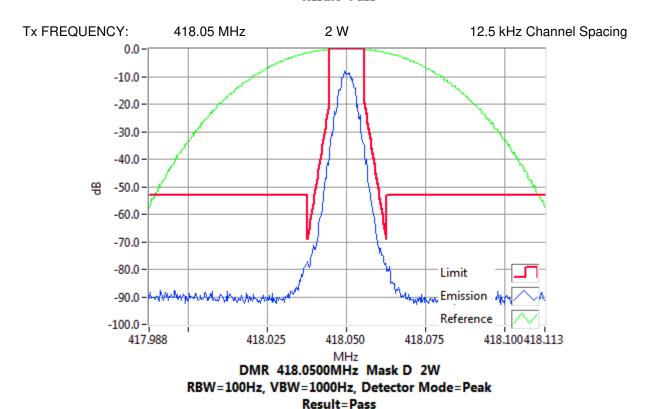


**DMR** 

FCC ID: CASTBDH5F

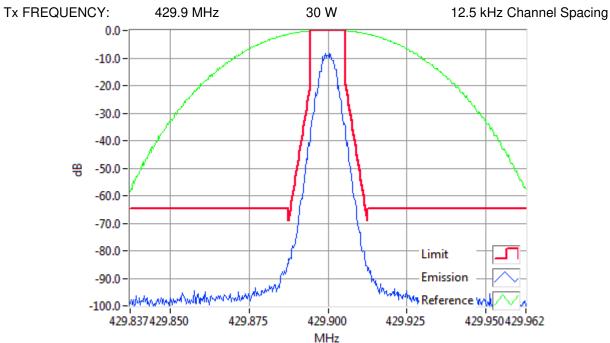


DMR 418.0500MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

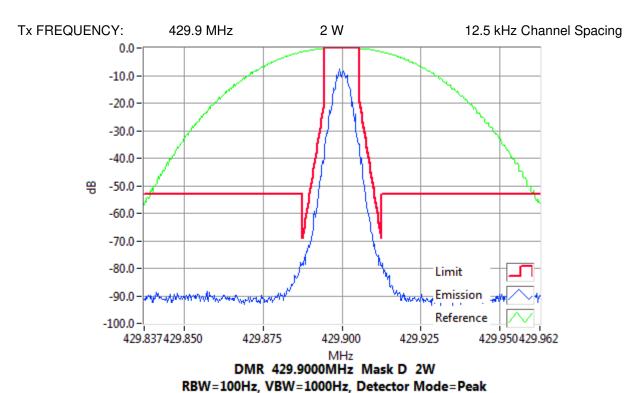


**DMR** 

SPECIFICATION: FCC CFR 2.1049 (c)



DMR 429.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

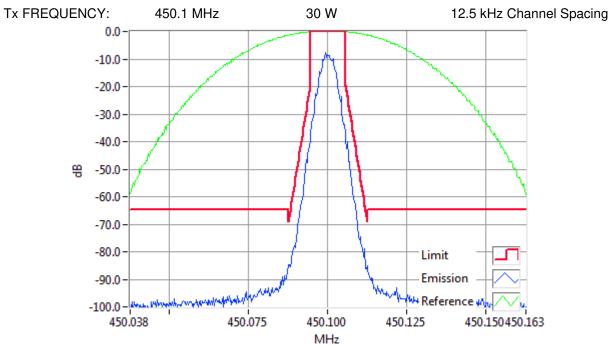


Result=Pass

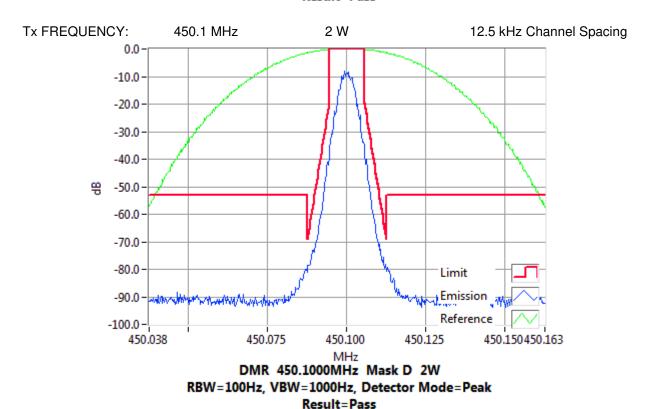
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**DMR** 

SPECIFICATION: FCC CFR 2.1049 (c)



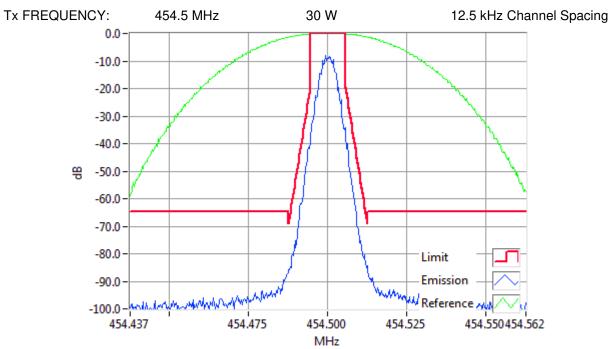
DMR 450.1000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



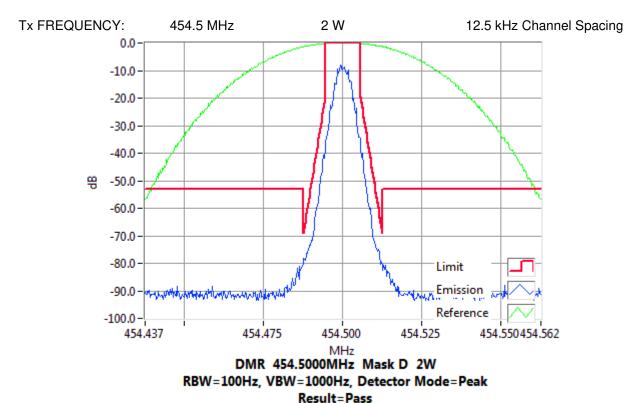
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**DMR** 

FCC ID: CASTBDH5F

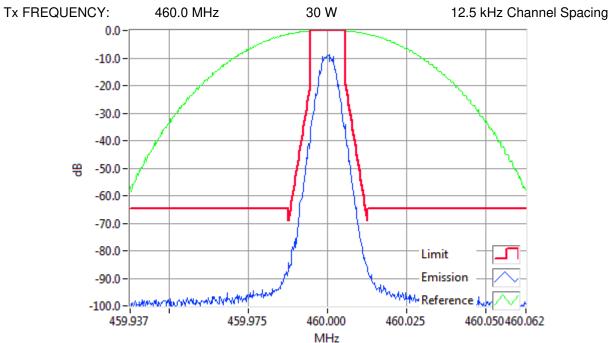


DMR 454.5000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

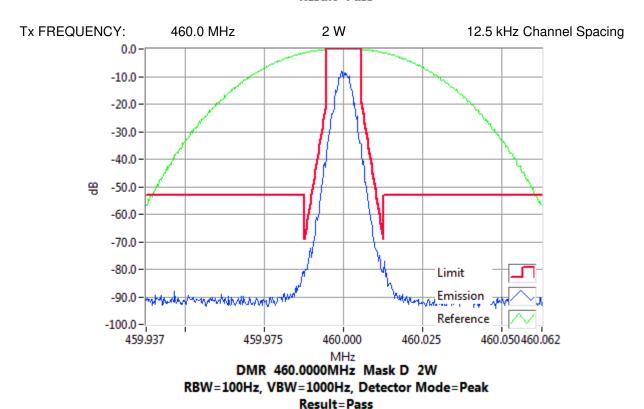


**DMR** 

FCC ID: CASTBDH5F

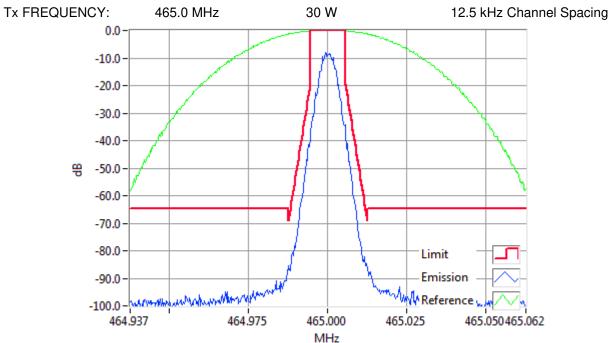


DMR 460.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

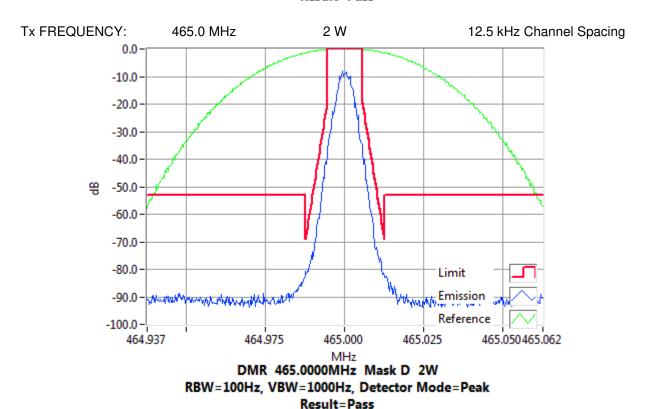


**DMR** 

FCC ID: CASTBDH5F

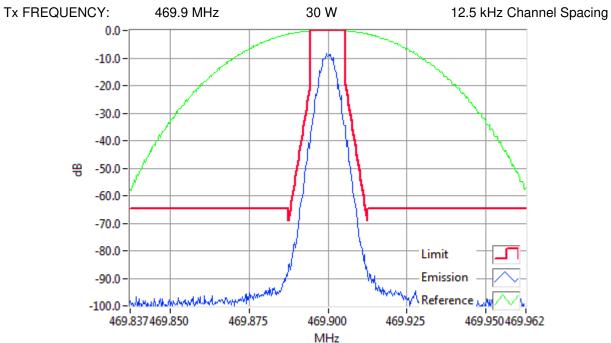


DMR 465.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

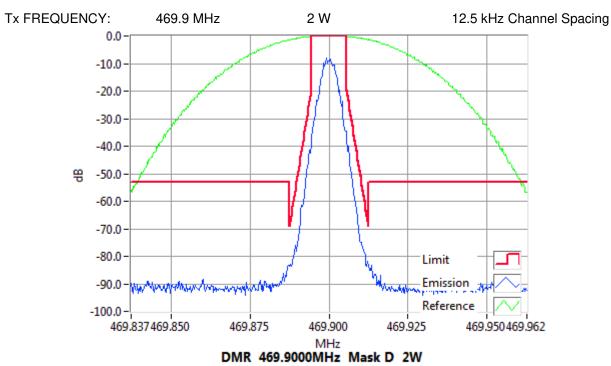


**DMR** 

SPECIFICATION: FCC CFR 2.1049 (c)



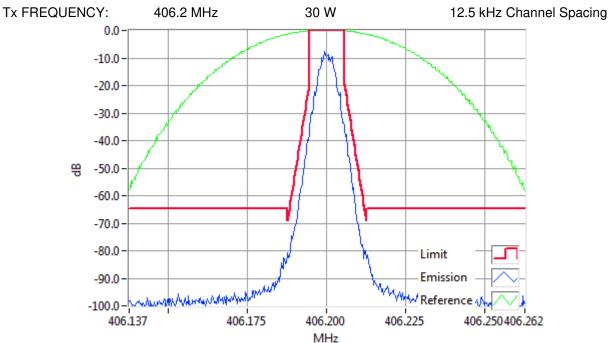
DMR 469.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



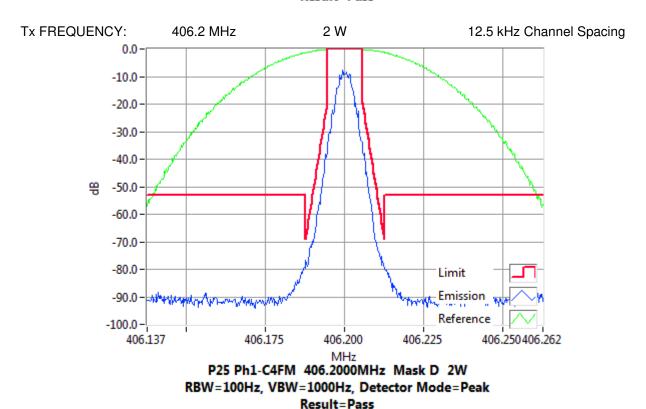
DMR 469.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

APCO P25 phase-1

FCC ID: CASTBDH5F

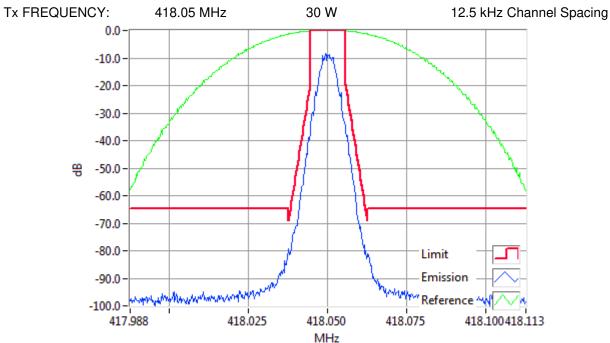


P25 Ph1-C4FM 406.2000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

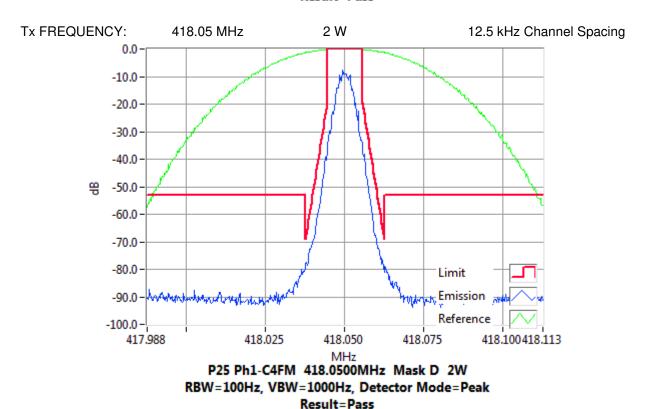


APCO P25 phase-1

FCC ID: CASTBDH5F



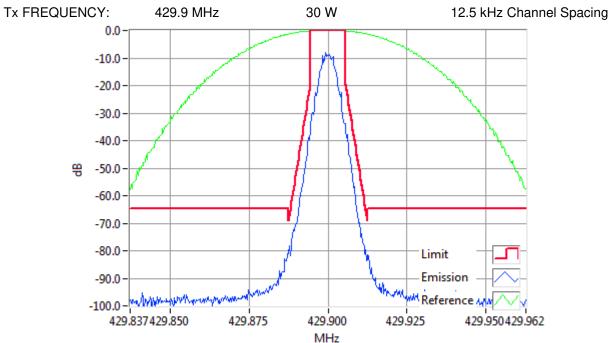
P25 Ph1-C4FM 418.0500MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



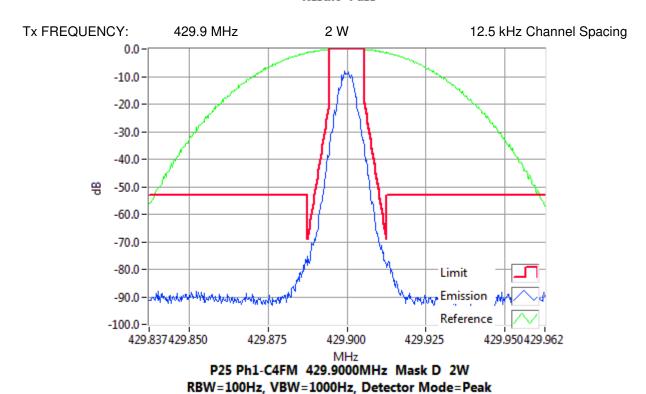
APCO P25 phase-1

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)



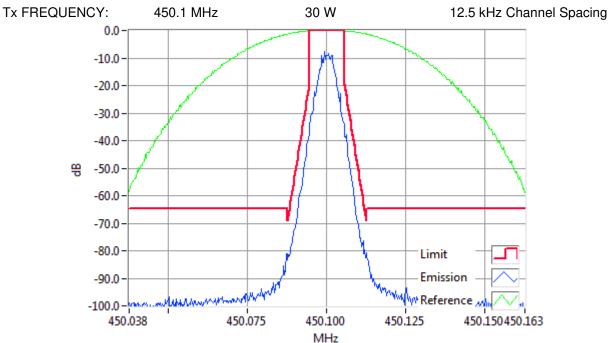
P25 Ph1-C4FM 429.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



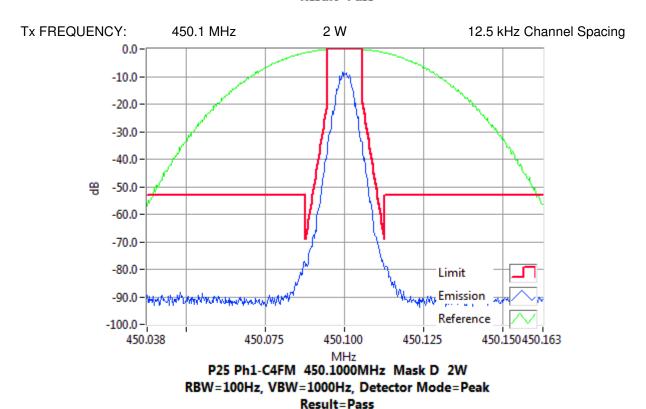
Result=Pass

APCO P25 phase-1

FCC ID: CASTBDH5F

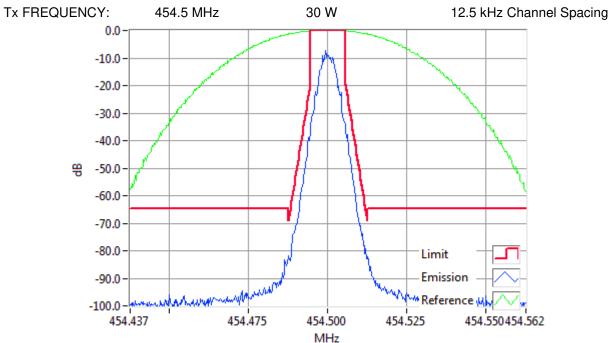


P25 Ph1-C4FM 450.1000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

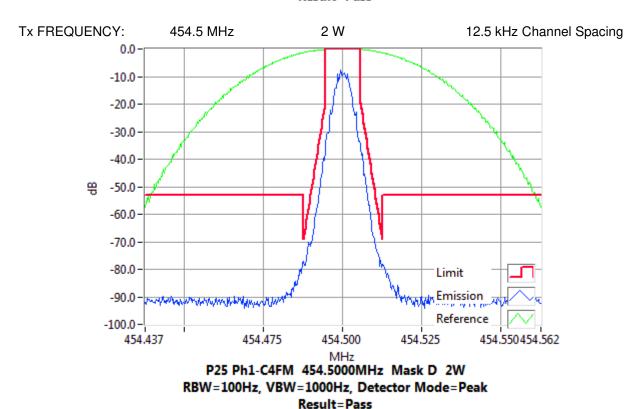


APCO P25 phase-1

FCC ID: CASTBDH5F

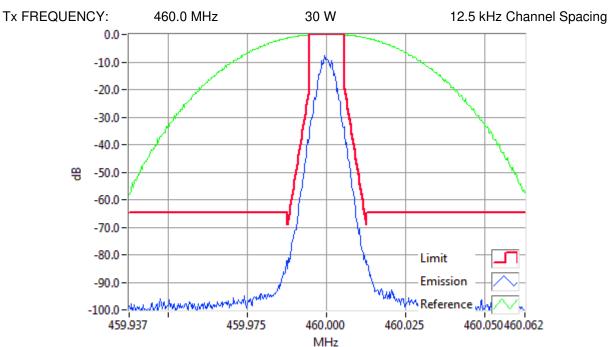


P25 Ph1-C4FM 454.5000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

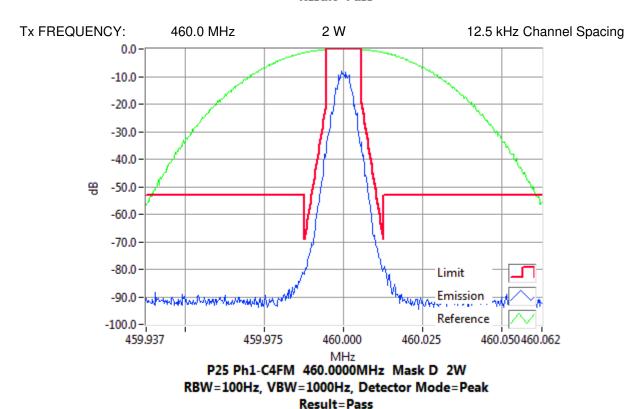


APCO P25 phase-1

FCC ID: CASTBDH5F



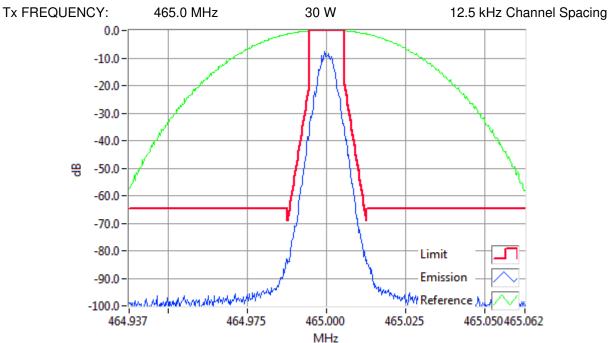
P25 Ph1-C4FM 460.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



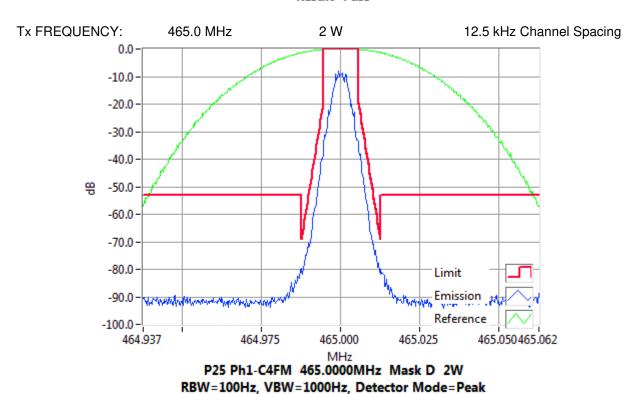
APCO P25 phase-1

FCC ID: CASTBDH5F

SPECIFICATION: FCC CFR 2.1049 (c)

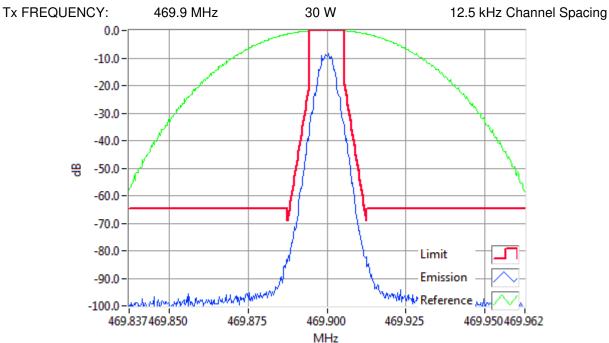


P25 Ph1-C4FM 465.0000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

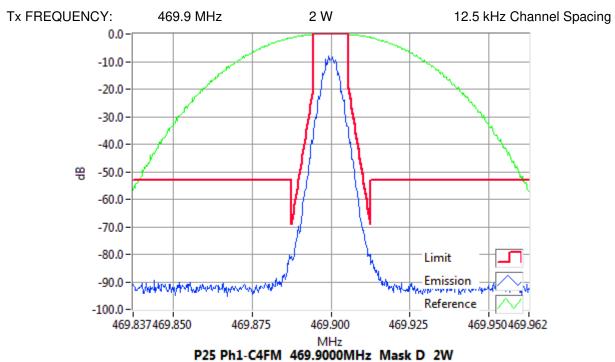


Result=Pass

APCO P25 phase-1



P25 Ph1-C4FM 469.9000MHz Mask D 30W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass



P25 Ph1-C4FM 469.9000MHz Mask D 2W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass

### TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051

GUIDE: TIA/EIA-603D 2.2.13

#### **MEASUREMENT PROCEDURE:**

1. Refer Annex A for equipment set up.

2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10<sup>th</sup> Harmonic: 100 kHz to Fc-BW

Fc+ BW to 10Fc (4.700 GHz)

- 3. The EUT was set to transmit high or low power, modulated with P25 Phase 1 (C4FM). A scan is performed with a resolution bandwidth of 10 kHz and a video bandwidth of 30 kHz for frequencies up to 1 GHz, and a resolution bandwidth of 1 MHz and a video bandwidth of 3 MHz for frequencies above 1 GHz. A filter was used for frequencies just below the second harmonic to 4.000 GHz.
- 4. For each frequency range the spectrum analyser was loaded with the appropriate calibration figures to compensate for the cables, attenuator and filter losses, allowing the emission levels to be read directly with no further calculation.

The calibrations are loaded as an overall reference level offset plus a set of correction factors for the required frequency band.

Spurious emissions which were attenuated by more than 20 dB below the limit were not recorded.

Example of attenuation correction:

32.25	
0.76	
0.69	
1.33	
	Sum of
	component
	attenuation
35.04	(a)
37.05	(b)
-2.01	(a-b)
	0.76 0.69 1.33 35.04 37.05

#### **MEASUREMENT RESULTS:**

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

LIMIT CLAUSES: FCC 47 CFR 90.210

Photo: Conducted Emissions Test Setup



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# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

12.5 kHz Channel Spacing 40	06.2 MHz @ 30 W	Emission Mask D
-----------------------------	-----------------	-----------------

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing	406.2 MHz @ 2 W	Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty: ≤12.75 GHz ± 3.0 dB		
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 406.2 MHz 2 W 30 W Alvy Type: 7555 Angitted: 50 Alvy Type: RMS Aughtent 50 PRO: For Trig Free Run. Prints Com. Albert 23 48 PRO: For Trip Free Run. Prints Com. Albert 23 dB Mkr1 408.7 MHz 44.037 dBm Mkr1 406.7 MHz 33.603 dBm Ref 05set 36:34 dB Ref 45:00 dBm Ref 05set3634 dB Ref 45.00 dBm Start 10 kHz RRes BW 10 kHz Stop 800.0 MH: Sweep 7.645 s (601 pts EVBW 30 kHz EVBW 30 kHz lerher 1 812,400000000 MHz THE Tax to Try Free Park PHILIP IN Try Prooffee. Mkr1 812.4 MHz -57,599 dBm Ref 20,00 dBm tart 889.0 MHz Reo BW 10 kHz Stop 1,0000 GHz Sweep 1,011 s (601 pts Start 889,0 MHz Rep BW 10 kHz Stop 1,0000 Gr Sweep 1,011 s (601 pt EVBW 30 KHZ EVBW 30 KHZ Mary Type 1995 Aughters-56 Many Type 1906 Aughter-26 PROTES TO Try free flore PROTOS D Tractor the Office 27 20 cm me Ref 10.00 dBm Not office 37 35 cm Ref 10.09 dBm Start 1.000 GHz Reo BW 1.0 MHz Stop 4,000 GHz Sweep 0,000 ms (991 pcs) Stop 4,000 GHz Sweep 0,000 ms (901 pcs tart 1.000 GHz Res BW 1.0 MH BW 1.0 MHz REW 1.0 MHz PROTECT TO Transfer. PROTES IN Trig Free Park Stop 4,7866 G Sweep 1,286 ms (691 p Step 4,7980 c Sweep 1,200 ms (691 EVBW 3.0 MHz

FCC ID: CASTBDH5F Page 56 of 100

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

FCC ID: CASTBDH5F

	12.5 kHz Channel Spacing	418.05 MHz @ 30 W	Emission Mask D
--	--------------------------	-------------------	-----------------

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 418.05 MHz @ 2 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty: ≤12.75 GHz ± 3.0 dB		
No emissions were detected at a level greater than 20 dB below the limit		

Spurious Emissions (Tx Conducted) 418.05 MHz 30 W 2 W Ming Type 1988 Aughterio-56 Mang Type RANS Angiftenin SM PRETER ID Try Free flore Hilliam C Sig Free Ram. Mkr1 418.7 MHz 44.019 dBm Mkrt 418.7 MHz 33.503 dBm Not Office 38.34 cm Ref 45.00 dBm Ref 45.00 dBm Binp 600.0 Mer Bweep 7,845 s (601 ph ert 10 kHz eo BW 10 kHz Stop 800.0 MHz Sweep 7.645 s (601 pcs rt 10 kotz io BW 10 kHz EVEW 30 KHZ **#VBW 30 KHZ** ferher 1 418.671433333 MHz erker 1 418.671433333 MHz King Tope 1901 Aughters-06 PHILIP IN Try Prooffee. PRETER TO Try Free But. Mkr1 418.7 MHz --- dBm Mazi 418.7 MHz --- dBm Ref 20,00 dBm Stop 1,0000 GH Sweep 1,911 s (991 pc Start 899.0 MHz Rep BW 19 kHz Stop 1,0000 GHz Sweep 1,011 s (601 pts tart 888.0 MHz Res BW 18 kHz EVBW 30 KHZ EVBW 30 KHZ tef Level 18,00 dilm tef Level 10,00 difm Bivg Type 1998 Aughter 1999 Alvy Type 1988 Aughtent-66 PHILIP IN Try Prooffee. PROTES TO Try Free But. Mkr1 419 MHz --- dBm MKr1 419 MHz Ref 10.00 dBm Ref 10.00 dbm Stop 4.000 GHz Sweep 0.000 ms (931 pcs Stop 4.000 GHz Sweep 0.000 ms (991 pcs Start 1.000 GHz Mice BW 1.0 MHz art 1.000 GHz kee BW 1.0 MHz EVBW 3.0 MHz EVBW 3.0 MHz tart Freq 4.000000000 GHz Start Freq 4.000000000 GHz Mang Type RMS Angithme-RM Mang Type RMS Angithesis RMS PROTECT TO Stag Free Burn Principal Miller & Miller PROTECT OF THE PARK BUT Mkr1 418,7 MH; — dBm Mirt 418,7 MH #VBW 5.0 MHz IVBW 5.0 NHz

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FCC ID: CASTBDH5F

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

FCC ID: CASTBDH5F

12.5 kHz Channel Spacing 429.9 MHz @ 30 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 429.9 MHz @ 2 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty: ≤12.75 GHz ± 3.0 dB		
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 429.9 MHz 30 W 2 W ker 1 429.337966667 MHz Along Type: RMS Angitheral-Sid rker 1 429.337966667 MHz Alvy Type: 1950 Angittent: 50 PRO: For Trig Free Run. Print Com. Miller: 20 48 PRO: Fee Trig Free Run. Printel our Miller: 20 48 Mkr1 429.3 MHz 44.144 dBm Mkr1 429.3 MHz 33,595 dBm Ref 45.00 dBm Ran Offset 36.34 eB Ref 45.00 dBm Stop 800.0 MH Sweep 7.845 s (801 pts EVBW 30 kHz EVBW 30 kHz arker 1 859.800000000 MHz erker 1 959,930000000 MHz King Type 1999 Aughter-105 THE Tax to Try Free Park PROTOTO TO Try free flore Ref 20,00 dBm Ref 20,00 dBm Start 889.0 MHz Mkes BW 10 kHz Start 889.0 MHz Mice BW 10 kHz Stop 1,0000 GH Sweep 1,011 s (601 pc Stop 1,0000 GH Sweep 1,011 s (001 pt EVBW 30 KHZ Alvy Type 1988 Aughtent-66 Alvy Type 1998 Aughtent-50 PROTES TO Try free flore PROTECT TO Trig Free Park. Nef 10.09 dBm Not office 37 35 cm Ref 10.09 dBm Start 1.000 GHz Mico BW 1.0 MHz Stop 4,000 GHz Sweep 0,000 ms (991 pcs) Start 1.000 GHz Mico BW 1.0 MH Stop 4.000 GH Sweep 9.000 ms (931 pc top Freq 4.700000000 GHz of Level -13,00 dBm Many Type 1988 Aughteria-1880188 PROTECT TO Transfer. PROTES IN Trig Free Park

FCC ID: CASTBDH5F Page 60 of 100

Stop 4.7866 Gr Sweep 1.286 ms (691 pr

EVBW 3.0 MHz

Stop 2,0000 GH Sweep 1,000 res (601 pc

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

12.5 kHz Channel Spacing 450.1 MHz @ 30 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 450.1 MHz @ 2 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty: ≤12.75 GHz ± 3.0 dB		
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 450.1 MHz 30 W 2 W Many Topic 1988 Aughterio-00 erker 1 450,671033333 MHz arker 1 450.671033333 MHz Alvy Type: RMS Aughtent-SS PRETER TO Try Free But. PRO: Test Trig Free Run. Phain.low Miller: 20 dB Mkr1 450.7 MHz 46.199 dBm Ref 45,00 dBm Ref 45.00 dBm tart 10 kHz Res BW 10 kHz Stop 800.0 MH Sweep 17.10 s (601 pt Stop 800.0 MH Oweep 17.19 s (601 pc art 10 kHz tes BW 10 kHz EVBW 30 kHz erher 1 900,33333333 MHz erker 1 900 33333333 MHz Mary Type 1999 Aughters-06 King Type 1999 Aughter-105 PROTOS D Tractor PROTOTO TO Try free flore Ref 20.00 dBm Stop 1.0000 GHz Sweep 4.274 s (991 pts Stop 1.0000 Gr Sweep 4.274 s (691 pt EVBW 30 KHZ splay Line -29.00 dBm splay Line -29.00 dBm King Type 1998 Aughters-56 Alvy Type 1998 Aughters-50 PROTES TO Try free flore PRETER IN Trig Free Part. Mkr1 900 MHz --- dBm Mkr1 900 MHz Ref 10.00 dBm me Ref 10.00 dBm Start 1.000 GHz Mice BW 1.0 MHz Stop 4.000 GH Sweep 0.000 ms (991 pc Start 1.000 GHz Mice BW 1.0 MHz 8top 4.000 GHz 8weep 0.000 ms (991 pcs) EVBW 3.0 MHz of Level 10,00 differ Ref Level 10,00 dilim Mary Type 1999 Aughters-06 Many Type 1906 Aughten-06 PROTECT TO Traction PROTEST TO Trig Free Park Mkrt 900.33 MHz Mkrt 900.33 MHz

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FCC ID: CASTBDH5F

Stop 4.7586 GP Sweep 1.288 ms (691 pc

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EVBW 3.0 MHz

Stop 4.7586 G Sweep 1.288 ms (691 p

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

FCC ID: CASTBDH5F

12.5 kHz Channel Spacing 454.5 MHz @ 30 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 454.5 MHz @ 2 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 454.5 MHz 30 W 2 W Along Type: RMS Angitheral-Sid rker 1 454.670983333 MHz rher 1 454,670983333 MHz Many Type 1988 Aughters-06 THE Tax In Try Prooffee. FREE Test Trig Free Run. Phainton Miles: 20 dB Mkr1 454.7 MHz 43.958 dBm Mkr1 454.7 MHz 33.516 dBm Ref 05set 36.34 dB Ref 45.02 dBm Not Office 38.34 cm Ref 45,00 dBm ert 10 kHz eo BW 10 kHz Stup 800.0 MHz Sweep 7,545 s (601 pts EVBW 30 kHz EVEW 30 KH larker 1 909,000000000 MHz arker 1 909,666666667 MHz Mary Type 1999 Aughters-06 Many Type 1988 Aughters-06 THE Tax In Try Free State PROTOTO TO Try free flore the Ref 20,00 dBm Start 889,0 MHz MReo BW 10 kHz Stop 1,0000 GH Sweep 1,011 s (601 pc Start 888.0 MHz MReo BW 10 kHz Stop 1,0000 Gr Sweep 1,011 s (601 pt Hof Level 10,00 dilim RBW 1.0 MHz Many Type 1906 Aughter-26 King Type 1998 Aughters-56 PRETER IN Trig Free Part. PRETER IN Trig Free Part. Mkrt 2.115 GH: -47,729 dBm Mkr1 2.115 GH -49.877 dBr the Office 27 20 cm me Ref 10.00 dBm the Office STOR offi the Ref 10.00 dBm Start 1.000 GHz Mico BW 1.0 MHz 8top 4.000 GHz 8wrep 0.000 ms (601 pcs Start 1.000 GHz Mkes BW 1.0 MHz Stop 4.000 GH Sweep 0.000 ms (991 pc play Line -29.00 dBm spley Line -29.00 dBm Mary Type 1999 Aughters-06 Many Type 1906 Aughten-06 PROTECT TO Traction PROTEST TO Trig Free Park Mar1 2.115 0 GHz Mar1 2.115 0 GHz

FCC ID: CASTBDH5F Page 64 of 100

Stop 4,7860 Ga Sweep 1,286 ms (691 pc

EVBW 3.0 MHz

Stop 4.7866 G Sweep 1.286 ms (691 p

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

12.5 kHz Channel Spacing 460.0 I	1Hz @ 30 W	Emission Mask D
----------------------------------	------------	-----------------

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing	460.0 MHz @ 2 W	Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 460.0 MHz 30 W 2 W Alvy Type: PMS Aughtent-65 PRO: Fee Trig Free Run. Printel our Miller: 20 48 PRO: Fee Trig Free Run. Printstow Miller: 20 48 Mkr1 460.0 MHz 44.109 dBm Ref 45.00 dBm Ref 05set 36.34 dB Ref 45.00 dBm Stop 800.0 Mi Sweep 7.845 s (801 pt Stop 800.0 MH: Sweep 7.645 s (601 pts #VBW 30 kHz EVBW 30 kHz Pher 1 929.000000000 MHz rker 1 829.000000000 MHz Militar (2) Nighterfor Militar (2) Dep Free Sun. Mkrt 920.0 MH; -63.269 dBm Ref 26.00 dBm Ref 26,00 dBm Brop 1,0000 GH Bweep 1,911 s (601 pt Rec BW 10 kH Stop 1.0000 GHz Sweep 1.911 s (601 pts) Start 900.0 MHz Rec BW 10 kHz **#VBW 30 KHz** Ref Level 10.00 dBm Ref Level 10.00 dBm Mag Type RMS Argithma ASS Ming Type RMS Argithman SS PRICE OF State Sta PRESTANT TO THE PARK SHAPE Mkr1 920 MH — dBr Mkr1 920 Mi - dB Ref 18,00 dBm Ref 19.00 dBm Stop 4.560 GHz Sweep 5.860 avs (601 pts) Stop 4.500 GHz Sweep 5.500 ms (601 pts) Start 1,000 GHz #Res BW 1,0 MHz of Level 10.00 dBm Ref Level 10.00 dBm Mang Type RASS Angithera ASS Ming Type RMS Angithments PROTECT OF THE PARK BUT PROTECT OF THE PARK SAME Mkrt 920.0 MH — dBr Mkrt 920.0 MHz — dBm

Blog 4.7660 GHz
WHEN 3.0 NHz
WHEN 3.0 NH

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

12.5 kHz Channel Spacing	465.0 MHz @ 30 W	Emission Mask D
--------------------------	------------------	-----------------

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing	465.0 MHz @ 2 W	Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted) 465.0 MHz 30 W 2 W wher 1 465,000000000 MHz Ang Type Lag Por erker 1 465.000000000 MHz Ang Type Lag Por PRETER TO Try Free But. PRETON IN Trig Free Plant Mkr1 465.0 MHz 44.014 dBm Mkr1 465.0 MHz 33.093 dBm Not Office 38.34 cm Ref 45,00 dBm Not Office 38.34 cm Ref 45,00 dBm Stop 800.0 MHz Sweep 7.545 s (601 pcs Stop 800.0 MHz Sweep 7,645 s (601 pcs Start 10 kHz Rico BW 10 kHz EVEW 30 NH EVEW 30 KH erher 1 930,000000000 MHz erker 1 930 000000000 MHz THE Tax In Try Free State PROTOTO TO Try free flore Mkr1 930.0 MHz -63.879 dBm Ref 20,00 dBm Ref 20,00 dBm tert 888.0 MHz Reo BW 10 kHz Stop 1,0000 GH Sweep 1,011 s (601 pc Stop 1,0000 GHz Sweep 1,011 s (601 pcs Start 889.0 MHz Mice BW 10 kHz EVBW 30 KHZ EVBW 30 KHZ Ref Level 10,00 dilim of Level 16,00 dilm Ang Type Lag Por Angitest-50 Ang Type Legitur Angitest-St PROTES TO Try free flore PROTOTO TO Trig Free Park. Mkr1 930 MHz --- dBm Mkr1 930 MHz Ref 10.00 dbm the Offices 27.00 cm Start 1.000 GHz Mes BW 1.0 MHz Stop 4,000 GHz Sweep 0,000 ms (991 pcs 8top 4.000 GHz 8weep 0.000 ms (601 pcs) Start 1.000 GHz Mkes BW 1.0 MHs of Level 10,00 differ of Level 10,00 differ PROTECT TO Traction PROTEST TO Trig Free Park Mk/1 930.0 MHz Mk/1 930.0 MHz

FCC ID: CASTBDH5F Page 68 of 100

Stop 4,7860 Ga Sweep 1,286 ms (691 pc

EVBW 3.0 MHz

Stop 4.7866 G Sweep 1.296 ms (691 p

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

12.5 kHz Channel Spacing	469.9 MHz @ 30 W	Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

	12.5 kHz Channel Spacing	469.9 MHz @ 2 W	Emission Mask D
--	--------------------------	-----------------	-----------------

Emission Frequency (MHz)	Level (dBm)	Level (dBc)		
~	~	~		
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB			
No emissions were detected at a level greater than 20 dB below the limit.				

Spurious Emissions (Tx Conducted) 469.9 MHz 30 W 2 W arker 1 469,900000000 MHz Along Type: RMS Angitheral-Sid Alvy Type: 7555 Angittent-55 PRO: For Trig Free Run. Print Com. Miller: 20 48 PRO: Fee Trig Free Run. Printel our Miller: 20 48 Mkr1 469.9 MHz 44.430 dBm Ref 05set 36:34 dB Ref 45:00 dBm Ref 45.00 dBm Stop 800.0 MH Sweep 7.645 s (601 pc Start 10 kHz MRes BW 10 kHz Stop 800.0 MH: Sweep 7.645 s (601 pts EVBW 30 kHz EVBW 30 kHz larker 1 939.800000000 MHz THE Tax In Try Free State THE Tax In Try Free Park. Mkrt 939,8 MHz -61,940 dBm the Office 27 35 cm to Ref 20,00 dBm Ref 20,00 dBm Start 889,0 MHz MReo BW 10 kHz Stop 1,0000 GH Sweep 1,011 s (601 pc Stop 1,0000 GH Sweep 1,011 s (601 pc EVBW 30 KHZ EVBW 30 KHZ Start Freq 1,000000000 GHz tert Freq 1,000000000 GHz Mary Type 1909 Aughters-06 Many Type 1906 Aughter-26 PROTOTO TO Trig Free Plan. PROTOS D Tractoritos Ref 10.00 dBm Ref 10.00 dbm Start 1.000 GHz Mkes BW 1.0 MHz Stop 4.000 GHz Sweep 0.000 ms (991 pcs Start 1.000 GHz Mico BW 1.0 MH Stop 4.000 GH Sweep 0.000 ms (991 po of Level 10,00 differ of Level 10,00 differ PROTECT TO Traction PROTEST TO Trig Free Park Stop 4,7866 Gr Sweep 1,286 ms (691 pr Stop 4,7989 G Sweep 1,286 ms (691) EVBW 3.0 MHz

FCC ID: CASTBDH5F Page 70 of 100

# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

LIMITS: FCC 47 CFR 90.210

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing 50 + 10 Log <sub>10</sub> (P <sub>Watts</sub> )	
30 W	-20 dBm	-64.8 dBc
2 W	-20 dBm	-53.0 dBc

### TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA/EIA-603D 2.2.12

#### **MEASUREMENT PROCEDURE:**

#### Initial Scan:

- 1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 800 MHz. Any emission within 20 dB of the limit is then re-tested on the OATS.
- 2. The EUT is placed in the reverberation chamber and emissions are measured from 800 MHz to the upper frequency required. Any emission within 20 dB of the limit is then re-tested on the OATS.
- 3. The harmonics emissions up to the 6<sup>th</sup> harmonic of the fundamental frequency are measured on the OATS

#### **OATS** Measurement:

- 1. The EUT is placed on a wooden turntable at a distance of three metres from the test antenna. The output terminal is connected to an RF dummy load.
- 2. The test antenna is raised from 1 m to 4 m to obtain a maximum reading; the turntable is then rotated through 360° to obtain the maximum response of each spurious emission. Valid emissions are determined by switching the EUT on and off.
- 3. The EUT is then replaced by a signal generator and substitution antenna to make measurements by the substitution method.

#### MEASUREMENT RESULTS:

FCC ID: CASTBDH5F

See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

### Spurious Emissions (Tx Radiated) - Continued

SPECIFICATION: FCC 47 CFR 2.1053 406.2 MHz @ 30 W Emission Mask D 12.5 kHz Channel Spacing Emission Frequency (MHz) Level (dBm) Level (dBc) 812.400000 -38.36 -83.4 12.5 kHz Channel Spacing 406.2 MHz @ 2 W Emission Mask D Emission Frequency (MHz) Level (dBm) Level (dBc) ± 4.6 dB Measurement Uncertainty No emissions were detected at a level greater than 20 dB below the limit. 12.5 kHz Channel Spacing 418.05 MHz @ 30 W **Emission Mask D** Emission Frequency (MHz) Level (dBm) Level (dBc) 12.5 kHz Channel Spacing 418.05 MHz @ 2 W Emission Mask D Emission Frequency (MHz) Level (dBm) Level (dBc) Measurement Uncertainty ± 4.6 dB No emissions were detected at a level greater than 20 dB below the limit. 12.5 kHz Channel Spacing 429.9 MHz @ 30 W Emission Mask D Emission Frequency (MHz) Level (dBm) Level (dBc) 12.5 kHz Channel Spacing 429.9 MHz @ 2 W **Emission Mask D** Emission Frequency (MHz) Level (dBm) Level (dBc) Measurement Uncertainty ± 4.6 dB

FCC ID: CASTBDH5F Page 73 of 100 Report Revision: 1
Issue Date: 18 October 2019

No emissions were detected at a level greater than 20 dB below the limit.

# Spurious Emissions (Tx Radiated) - Continued

12.5 kHz Channel Spacing	450.1 MHz @ 30 W Emission N		
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
12.5 kHz Channel Spacing	450.1 MHz @ 2 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
Measurement Uncertainty	± 4.0	6 dB	
No emissions were	detected at a level greater than 20	) dB below the limit.	
12.5 kHz Channel Spacing	454.5 MHz @ 30 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
3636.000000	-38.76	-83.7	
~	~	~	
12.5 kHz Channel Spacing	454.5 MHz @ 2 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
3636.000000	-38.89	-83.9	
~	~	~	
Measurement Uncertainty	± 4.6 dB		
No other emissions we	ere detected at a level greater than	20 dB below the limit.	
12.5 kHz Channel Spacing	460.0 MHz @ 30 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
920.000000	-36.45	-81.45	
12.5 kHz Channel Spacing	460.0 MHz @ 2 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
Measurement Uncertainty	± 4.6 dB		
No other emissions were detected at a level greater than 20 dB below the limit.			

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# Spurious Emissions (Tx Radiated) - Continued

12.5 kHz Channel Spacing	465.0 MHz @ 30 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
12.5 kHz Channel Spacing	465.0 MHz @ 2 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
Measurement Uncertainty	± 4.6 dB		
No emissions were	No emissions were detected at a level greater than 20 dB below the limit.		
12.5 kHz Channel Spacing	469.9 MHz @ 30 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
12.5 kHz Channel Spacing	469.9 MHz @ 2 W	Emission Mask D	
Emission Frequency (MHz)	Level (dBm) Level (dBc)		
~	~	~	
Measurement Uncertainty	± 4.6 dB		
No emissions were detected at a level greater than 20 dB below the limit.			

# Spurious Emissions (Tx Radiated) - Continued

LIMITS: FCC 47 CFR 2.1053

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing 50 + 10 Log <sub>10</sub> (P <sub>Watts</sub> )		
30 W	-20 dBm -65 dBc		
2 W	-20 dBm -53 dBc		

### Open Area Test Site Results:

12.5 kHz Channel Spacing 406.2 MHz @ 30 W Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
812.400000	-38.36	-83.36
1218.600000	-53.20	-98.2
1624.800000	-59.05	-104.05
2031.000000	-74.17	-119.17
2437.200000	-64.85	-109.85
2843.400000	-69.22	-114.22
Measurement Uncertainty	± 4.6 dB	

Sample Calculation	Measurement					
	Reference	ference Substitution			Result	
Emission Frequency (MHz)	Reference Level (dBm)	Sig-gen Level	Cable and Attenuator Gain	Antenna Gain (dBd)	Path and Boresight corrections	dBm
812.400000	-71.22	-20.70	-16.63	-1.11	0.09	-38.36
		Α	В	С	D	E

Result (E) = A+B+C+D Result Photo: OATS Setup



### TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

GUIDE: TIA/EIA-603D 2.2.19

#### **MEASUREMENT PROCEDURE:**

- 1. Refer Annex A for equipment set up.
- 2. Measurements and plots were made following the TIA/EIA procedure.

#### **MEASUREMENT RESULTS:**

FCC ID: CASTBDH5F

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

LIMIT CLAUSES: FCC 47 CFR 90.214

Issue Date: 18 October 2019

# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 406.2 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL		
PERIOD	Key ON (kHz)	Key OFF (kHz)	
t1	-0.2	N/A	
t2	-0.3	N/A	
t3	N/A	-0.4	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	<b>✓</b>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	<b>✓</b>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

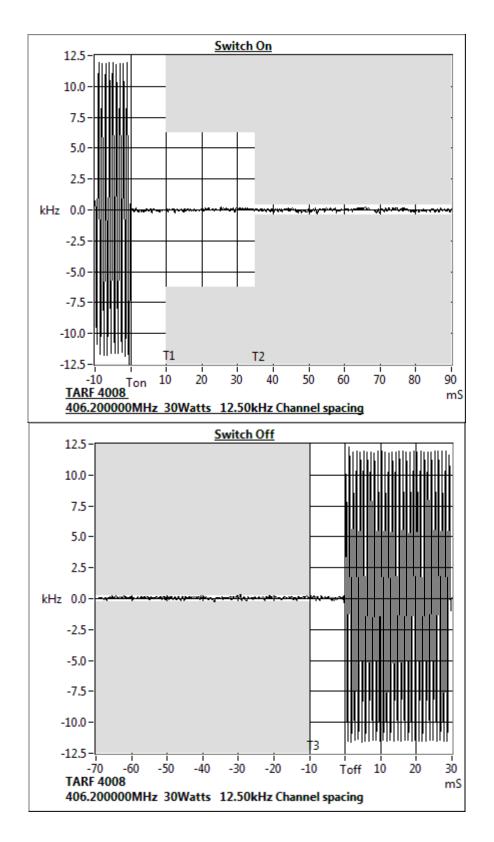
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

LIMIT: FCC 47 CFR 90.214

100 17 01 11 00121 1			
TRANSIENT PERIODS	FREQUENCY RANGE		
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz	
t1 (ms)	5 ms	10 ms	
t2 (ms)	20 ms	25 ms	
t3 (ms)	5 ms	10 ms	

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 406.2 MHz 30 W 12.5 kHz Channel Spacing



# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.05 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL		
PERIOD	Key ON (kHz)	Key OFF (kHz)	
t1	0.2 N/A		
t2	0.2	N/A	
t3	N/A	-2.6	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

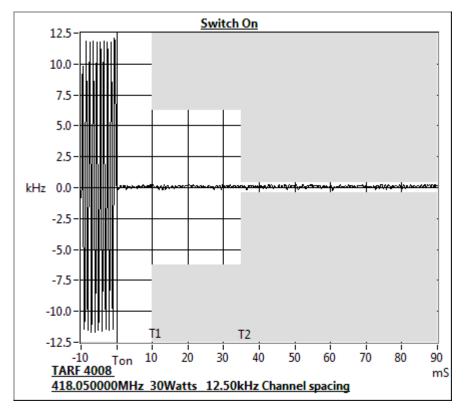
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

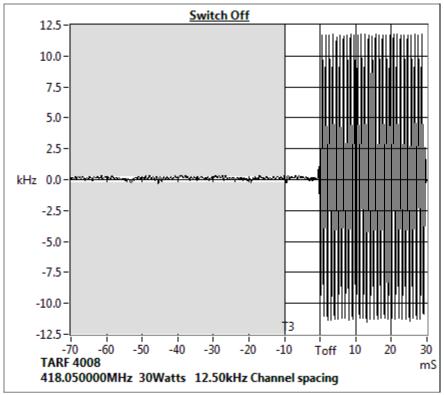
LIMIT: FCC 47 CFR 90.214

100 17 01 11 00121 1			
TRANSIENT PERIODS	FREQUENCY RANGE		
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz	
t1 (ms)	5 ms	10 ms	
t2 (ms)	20 ms	25 ms	
t3 (ms)	5 ms	10 ms	

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.05 MHz 30 W 12.5 kHz Channel Spacing





# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL		
PERIOD	Key ON (kHz)	Key OFF (kHz)	
t1	-0.8	N/A	
t2	-0.3	N/A	
t3	N/A	1.2	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

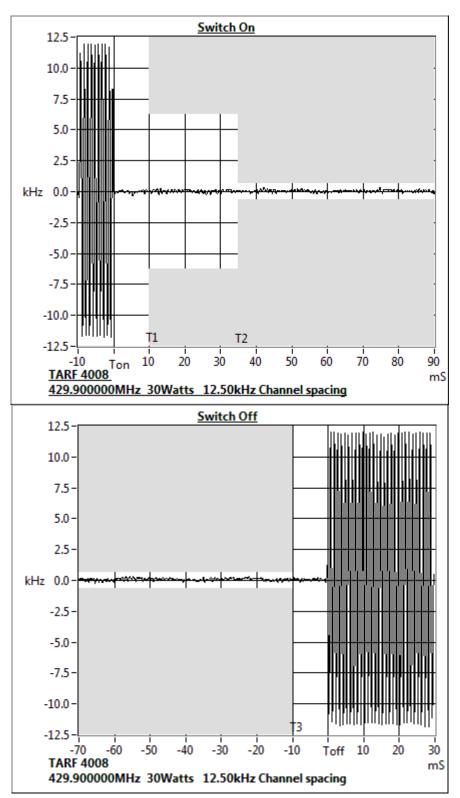
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

LIMIT: FCC 47 CFR 90.214

TRANSIENT PERIODS	FREQUENCY RANGE		FREQUENCY RANGE	
THANSIENT PERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz		
t1 (ms)	5 ms	10 ms		
t2 (ms)	20 ms	25 ms		
t3 (ms)	5 ms	10 ms		

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz 30 W 12.5 kHz Channel Spacing



# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL	
PERIOD	Key ON (kHz)	Key OFF (kHz)
t1	0.5	N/A
t2	-0.4	N/A
t3	N/A	-2.4

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

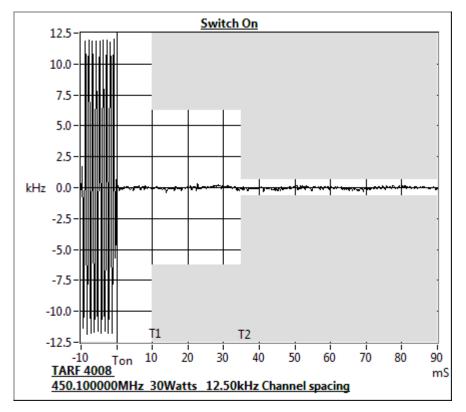
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

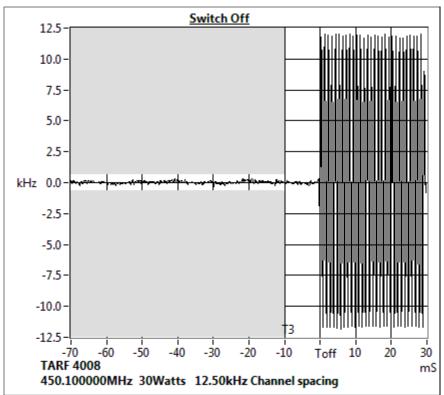
LIMIT: FCC 47 CFR 90.214

100 11 01 11 00 12 11		
TRANSIENT PERIODS	FREQUENCY RANGE	
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz
t1 (ms)	5 ms	10 ms
t2 (ms)	20 ms	25 ms
t3 (ms)	5 ms	10 ms

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz 30 W 12.5 kHz Channel Spacing





# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 454.5 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL	
PERIOD	Key ON (kHz)	Key OFF (kHz)
t1	-0.2	N/A
t2	0.2	N/A
t3	N/A	1.0

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	<b>&gt;</b>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

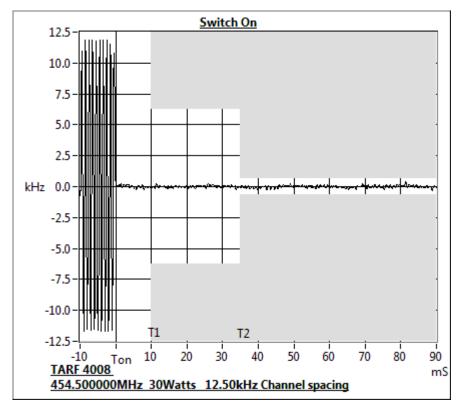
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

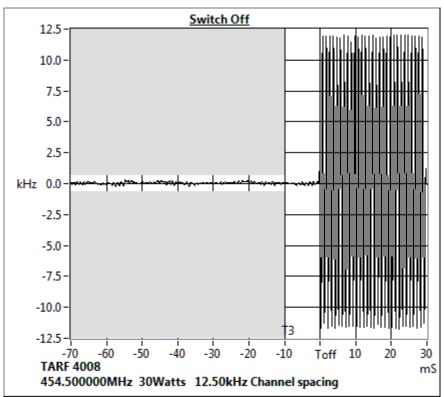
LIMIT: FCC 47 CFR 90.214

TRANSIENT PERIODS	FREQUENCY RANGE		FREQUENCY RANGE	
THANSIENT PERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz		
t1 (ms)	5 ms	10 ms		
t2 (ms)	20 ms	25 ms		
t3 (ms)	5 ms	10 ms		

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 454.5 MHz 30 W 12.5 kHz Channel Spacing





# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 460.0 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL	
PERIOD	Key ON (kHz)	Key OFF (kHz)
t1	-0.2	N/A
t2	-0.6	N/A
t3	N/A	-1.0

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	<b>&gt;</b>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

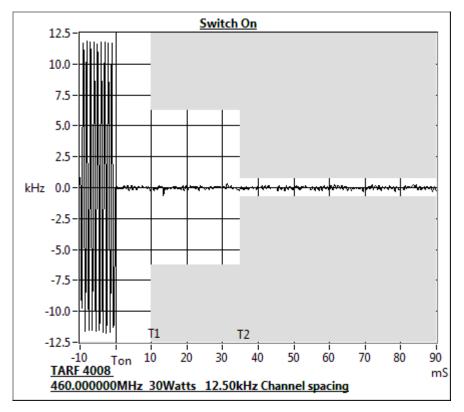
Measurement Uncertainty: Frequency  $\pm$  130 Hz; Time  $\pm$  0.2%

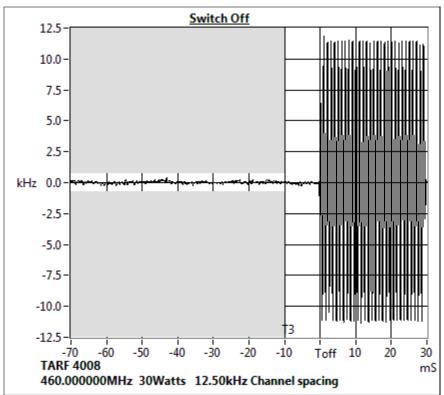
LIMIT: FCC 47 CFR 90.214

100 17 01 11 00121 1		
TRANSIENT PERIODS	FREQUENCY RANGE	
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz
t1 (ms)	5 ms	10 ms
t2 (ms)	20 ms	25 ms
t3 (ms)	5 ms	10 ms

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 460.0 MHz 30 W 12.5 kHz Channel Spacing





# Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 465.0 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL	
PERIOD	Key ON (kHz)	Key OFF (kHz)
t1	-1.5	N/A
t2	-0.3	N/A
t3	N/A	-3.9

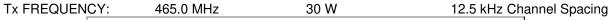
Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

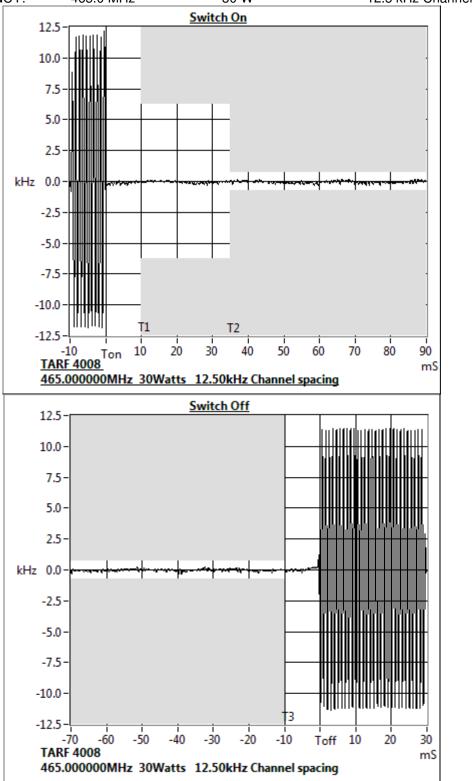
Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

LIMIT: FCC 47 CFR 90.214

TRANSIENT PERIODS	FREQUEN	CY RANGE			
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz			
t1 (ms)	5 ms	10 ms			
t2 (ms)	20 ms	25 ms			
t3 (ms)	5 ms	10 ms			

SPECIFICATION: FCC 47 CFR 90.214





### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 469.9 MHz 30 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL		
PERIOD	Key ON (kHz)	Key OFF (kHz)	
t1	-1.1	N/A	
t2	-0.3	N/A	
t3	N/A	-2.9	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	<b>✓</b>	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	<b>✓</b>	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	<b>✓</b>	

Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

LIMIT: FCC 47 CFR 90.214

<u>LIIVII 1. 1 00 47 0</u>	JI 11 30.21 <del>4</del>		
TRANSIENT PERIODS	FREQUENCY RANGE		
THANSIENT FERIODS	150 MHz – 174 MHz	421 MHz – 512 MHz	
t1 (ms)	5 ms	10 ms	
t2 (ms)	20 ms	25 ms	
t3 (ms)	5 ms	10 ms	

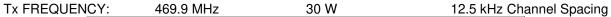
LIMIT: RSS-119 5.9

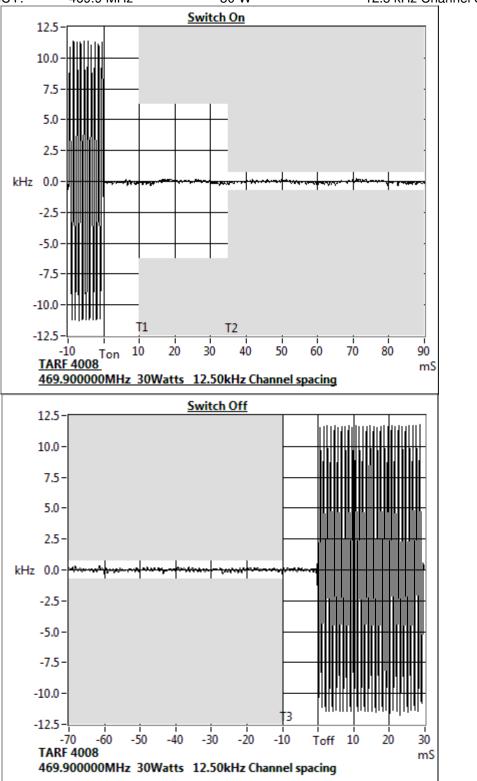
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels						
TRANSIENT PERIODS	Maximum Frequency	FREQUENCY RANGE				
	Difference	138 – 174 MHz	406.1 – 470 MHz			
t1 (ms)	± 12.5 kHz	5 ms	10 ms			
t2 (ms)	± 6.25 kHz	20 ms	25 ms			
t3 (ms)	± 12.5 kHz	5 ms	10 ms			

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

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SPECIFICATION: FCC 47 CFR 90.214





### TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

SPECIFICATION: FCC 47 CFR 2.1055 (a) (1)

GUIDE: TIA/EIA-603D 2.2.2

#### **MEASUREMENT PROCEDURE:**

- 1. Refer Annex A for equipment set up.
- 2. The EUT was tested for frequency error from -30° C to +50° C in 10° C increments
- 3. The frequency error was recorded in parts per million (ppm).

#### **MEASUREMENT RESULTS:**

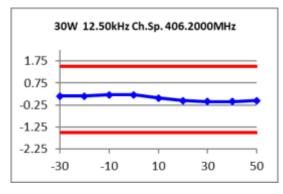
See the plots on the following pages for 12.5 kHz channel spacing.

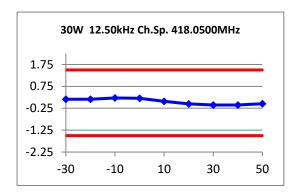
		Error (ppm)						
Temperature (°C)	406.2 MHz	418.05 MHz	429.9 MHz	450.1 MHz	454.5 MHz	460.0 MHz	465.0 MHz	469.9 MHz
-30	0.16	0.16	0.17	0.16	0.16	0.17	0.18	0.17
-20	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17
-10	0.21	0.22	0.21	0.22	0.21	0.22	0.22	0.22
0	0.21	0.21	0.21	0.21	0.2	0.2	0.21	0.2
10	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.06
20	-0.05	-0.05	-0.05	-0.06	-0.06	-0.06	-0.05	-0.06
30	-0.1	-0.1	-0.1	-0.1	-0.1	-0.09	-0.09	-0.1
40	-0.1	-0.1	-0.1	-0.1	-0.1	-0.09	-0.09	-0.1
50	-0.05	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Measurement Ur	ncertainty					± 7 x 10 <sup>-8</sup>		

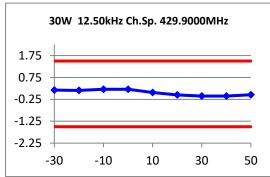
LIMIT: FCC 47 CFR 90.213

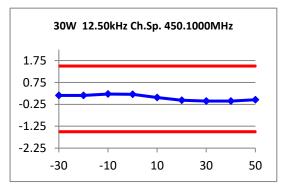
Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5

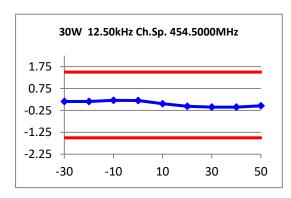
### Transmitter Frequency Stability - Temperature

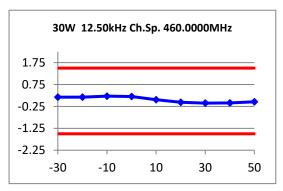


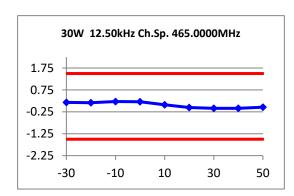


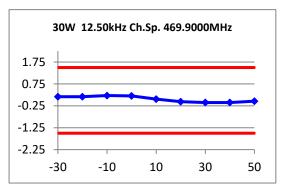












### TRANSMITTER FREQUENCY STABILITY - VOLTAGE

SPECIFICATION: FCC 47 CFR 2.1055 (d) (1)

GUIDE: TIA/EIA-603D 2.2.2

#### **MEASUREMENT PROCEDURE:**

- 1. Refer Annex A for equipment set up.
- 2. The EUT was tested for frequency error at an input voltage to the radio of nominal battery voltage and battery end point .
- 3. The frequency error was recorded in parts per million (ppm).

#### **MEASUREMENT RESULTS:**

	FREQU	ENCY ERROR (ppm) for	12.5 kHz
	13.8 V <sub>DC</sub>	11.0 V <sub>DC</sub>	15.0 V <sub>DC</sub>
406.2 MHz	-0.09	-0.09	-0.09
418.05 MHz	-0.09	-0.09	-0.09
429.9 MHz	-0.08	-0.08	-0.08
450.1 MHz	-0.08	-0.08	-0.08
454.5 MHz	-0.08	-0.08	-0.09
460.0 MHz	-0.08	-0.08	-0.08
465.0 MHz	-0.09	-0.08	-0.08
469.9 MHz	-0.09	-0.09	-0.09
Measuremer	t Uncertainty	±7×	10-8

LIMIT CLAUSES: FCC 47 CFR 90.213

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5

# TEST EQUIPMENT LIST

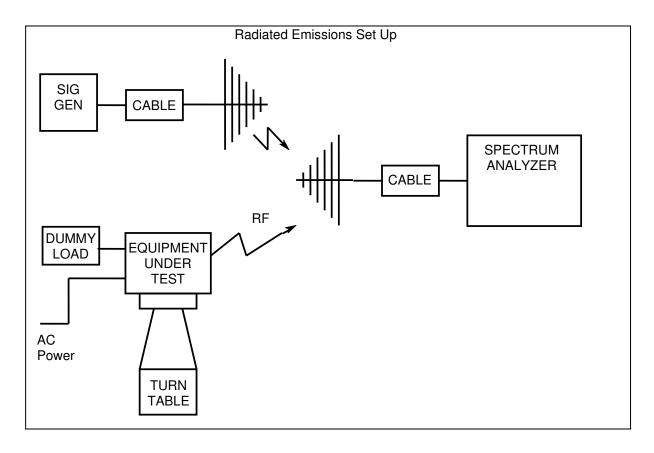
Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
AC Voltmeter		Tait		2		15-Apr-20
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	14-May- 22
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	15-May- 20
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-884	E4858	
Audio Analyser	TREVA2	Hewlett Packard	HP8903B	2818A04275	E3710	9-Oct-20
Coax Cable	OATS Turntable Cable 1	Intelcom	RG214	OATS1	E4621	15-Nov-19
Coax Cable	OATS Tower Cable	Intelcom	RG214	OATS2	E4622	14-Nov-19
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack2	E4623	17-Oct-19
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack3	E4624	17-Oct-19
Coax Cable	Reverb - 4.5m Multiflex 141	TeltestBlue6	MF 141	TeltestBlue6	E4843	18-Oct-19
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue5	MF 141	TeltestBlue5	E4844	18-Oct-19
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue4	MF 141	TeltestBlue4	E4845	18-Oct-19
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue3	MF 141	TeltestBlue3	E4846	18-Oct-19
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue2	MF 141	TeltestBlue2	E4847	18-Oct-19
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue1	MF 141	TeltestBlue1	E4848	18-Oct-19
Coax Cable	OATS Turntable Cable 2	Intelcom	RG215	OATS3	E4995	14-Nov-19
Coax Cable	2.5m Blue	Suhner	Sucoflex 104A	33449/4PEA	E4997	19-Oct-19
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack7	E5004	17-Oct-19
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack8	E5005	17-Oct-19
Coax Cable	3m Blue	Suhner	Sucoflex 126EA	503429/126EA	E5015	19-Oct-19
Environ. Chamber	Upright	Contherm	5400 RHSLT.M	1416	E4051	7-Aug-23
Environ. Chamber	Upright	Contherm	5400 RHSLT.M	1416	E4051	15-May- 20
Filter High Pass/ Notch	400 to 520MHz	Tait		N/A	E3384	25-Sep-19
ISN		Rohde & Schwarz	ENY41	100136	E4277	27-May- 20
Modulation Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	4-Oct-20
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	NSA	Tait				18-Jun-20
Oscilloscope	400MHz	Tektronics	TDS380	B017095	E3782	28-Sep-21
Power Supply	AC Variac	Yamabishi	S-260-5	TX-533	E1737	
Power Supply	TREVA2 60V/25A	Agilent	N5767A	US09F4901H	E4656	3-Oct-21
RF Amplifier	+21.7 dB 1GHz	Tait	ZFL-1000LN	E3660	E3360	30-Apr-20
RF Amplifier	0.2 to 4GHz 15W	Ophir	5161FE	1044	E4851	
RF Amplifier	Pre-amplifier	Agilent	87405C	MY47010688	E4941	
RF Attenuator	10dB 50W	Weinschel	24-10-34	AZ0401	E3388	17-Oct-19
RF Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	17-Oct-19
RF Attenuator	10dB 150W	Weinschel	57-10-34	LB590	E3674	18-Oct-19

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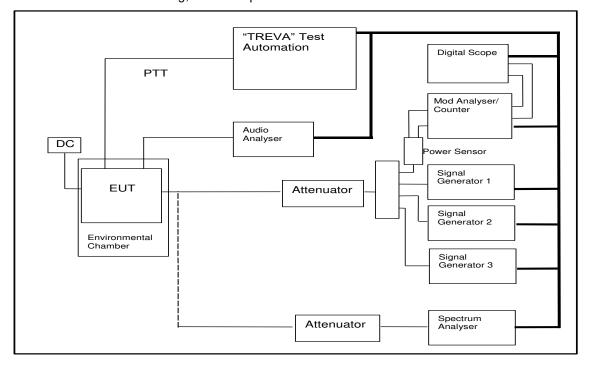
RF Attenuator	TREVA2 20dB 150W	Weinschel	40-20-33	CJ405	E3733	17-Oct-19
RF Attenuator	10dB 50W	Weinschel	24-10-34	BC3293	E4364	17-Oct-19
RF Attenuator	TREVA2 3dB	Weinschel	Model 1	BL9950	E4080	17-Oct-19
RF Attenuator	3dB 0.5W	Weinschel	Model 2	CH6857	E5012	17-Oct-19
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	12-Sep-20
RF Chamber	Reverb - Stirrer controller for reverb chamber	Teseq	Stirrer Controller	29765.1	E4854	
RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	-	E4084	
RF Load	50W	Weinschel	F1426	AE2490	E3624	18-Oct-19
RF Load	150W	Bird	8166	524	E3625	17-Oct-19
Signal Generator	Analog 3.2GHz	Hewlett Packard	HP8648C	3443U00543	E3558	9-Oct-20
Signal Generator	Analog 4GHz	Agilent	E4422B	GB40050320	E3788	10-Oct-20
Signal Generator	Digital 4GHz	Agilent	E4438C	MY49070242	E4600	3-Oct-20
Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	19-Jul-20
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	27-Oct-20
Temp & Humidity datalogger		Hobo	U21-011	10134275	E4980	5-May-20
TREVA 2		Teltest	-	2	-	5-Nov-19
Testware	Base Station Network Audio Generator		December 2017	-	-	
Testware	Frequency Vs Temperature		April 2018	-	-	
Testware	Radiated Emissions		April 2018	-	-	
Testware	Reverb Emissions		May 2019	-	-	
Testware	Sideband Spectrum		February 2017	-	-	
Testware	TREVA		7 February 2019	-	-	
Testware	Spec An Correction Loader		June 2019	-	-	

<sup>\*</sup> NOTE: Items without calibration dates are calibrated immediately before use, or set using calibrated instruments.

### ANNEX A - TEST SETUP DETAILS



All other testing is performed using the **T**eltest **R**adio **EVA**luation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.



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