LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBDH5G BASE STATION Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12 RSS-Gen Issue 4

Report Revision:

2

Issue Date:

01-June-2016

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Laboratory Technical Manager



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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FCC ID: CASTBDH5G IC : 737A-TBDH5G Page 1 of 75

Report Revision: 2 Issue Date: 01-June-2016

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REVISION

Date	Revision	Comments
16-May-2016	1	Initial test report
01-June-2016	2	Added FCC 47 CFR Part 74 to report

INTRODUCTION

Type approval testing of the TBDH5G, 40 Watt, BASE STATION transceiver in order to demonstrate compliance with FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 12 & RSS-Gen Issue 4. This radio supports analogue, digital FFSK, Digital Mobile Radio (DMR) modulations.

Type Approval Testing of the	TBDH5G
Serial number	18236735
Frequency range	400 → 470 MHz

in accordance with:

FCC 47 CFR Parts 22, 74 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:	TBDH5G
Product Code:	TB7310-H5B0-0000-00AE-10
Serial Number(s):	18236735
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 Version	Hardware Version
Reciter	T01-01403-SAZZ	18236681	dmr-2.15.00.0006	1
Power Amplifier	T01-01405-SAZZ	18236684		0.01
Front Panel	T01-01410-AAAA	2887992	1.08.00.0002	0.01

TEST CONDITIONS

All testing was performed between 02 \rightarrow 12-May-2016, and under the following conditions: Ambient temperature: $15^{\circ}C \rightarrow 30^{\circ}C$

Relative Humidity: $20\% \rightarrow 75\%$ Standard Test Voltage $13.8 V_{DC}$

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:	TBDH5G
Product Code:	TB7310-H5B0-0000-00AE-10
Serial Number(s):	18236735
Quantity:	1

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

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12 & RSS-Gen Issue 4

Signature: _____

Mike James Technical Manager

Date: _____

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

F3E	Analogue Frequency Modulation		
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:

FM Voice	11K0F3E
FFSK	7K60F2D
Digital Voice DMR	7K60FXW
Digital Data DMR	7K60FXD
FM	11K0F3E

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 M = 3.0 kHz D = 2.5 kHz Bn = (2x3.0) + (2x2.5) x 1 = 11.0 kHz	Emission Designator 11K0F3E F3E represents an FM voice transmission
Fast Frequency Shift Keying (FFSK – 12 Necessary bandwidth M = 1.8 kHz D = 2.0 kHz $Bn = (2 \times 1.8) + (2 \times 2.0) \times 1$ = 7.6 kHz	200 bps) 12.5 kHz Channel Spacing Emission Designator 7K60F2D F2D represents a FM data transmission with the use of a modulating sub carrier
Digital Voice 12.5 kHz Bandwidth DMR 99% bandwidth = 7.6 kHz FXW represents a FM Time Division Multiple Ac	Emission Designator 7K60FXW cess (TDMA) combination of data and telephony
Digital Data 12.5 kHz Bandwidth DMR	

99% bandwidthEmission Designator= 7.6 kHz**7K60FXD**FXD represents FM Time Division Multiple Access (TDMA) data only

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: 40 W and 2 W

Nominal 40 W	406.2 MHz	418.1 MHz	429.9 MHz	450.1 MHz	459.9MHz	469.9MHz
Measured	41.7	40.3	40.4	40.3	42.0	40.7
Variation (%)	4.1	0.8	1.1	0.8	5.0	1.7
Variation (dB)	0.2	0.0	0.0	0.0	0.2	0.1
Nominal 2 W	406.2 MHz	418.1 MHz	429.9 MHz	450.1 MHz	459.9MHz	469.9MHz
Measured	2.0	1.9	1.9	1.9	1.9	1.9
Variation (%)	-2.2	-5.3	-3.8	-3.9	-3.3	-5.1
Variation (dB)	-0.1	-0.2	-0.2	-0.2	-0.1	-0.2
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.

RSS-119 5.4 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-603D 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 40 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 406.2 MHz



Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 418.1 MHz

12.5 kHz Channel Spacing

12.5 kHz Channel Spacing



SPECIFICATION:

FCC CFR 2.1047 (a)

Tx FREQUENCY:

429.9 MHz



Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing



SPECIFICATION:

FCC CFR 2.1047 (a)

Tx FREQUENCY:

459.9MHz



Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY:

469.9 MHz



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 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.

406.2 MHz

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

Tx FREQUENCY:

12.5 kHz Channel Spacing



Tx FREQUENCY:

418.1 MHz



Transmitter Modulation Limiting



Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY:

450.1 MHz



Transmitter Modulation Limiting



Tx FREQUENCY: 459.9MHz

12.5 kHz Channel Spacing

12.5 kHz Channel Spacing



Tx FREQUENCY:

469.9 MHz



TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION:	FCC 47 CFR 2.1049 (c)
GUIDE:	TIA/EIA-603D 2.2.11 (Analog) TIA-102.CAAA-C 2.2.5 (Digital)

MEASUREMENT PROCEDURE:

- Refer Annex A for Equipment Set up. The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
- 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

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

LIMIT CLAUSE:	FCC 47 CFR 90.210	RSS-119 5.5
EMISSION MASKS Emission Mask D	12.5 kHz Channel Spacing	Analog, FFSK, Digital Voice/Data
DATA SPEED FFSK Digital Voice/Data	12.5 kHz Channel Spacing 12.5 kHz Channel Spacing	1200 bps 9600 bps

RSS-119 5.5

Occupied Bandwidth and Spectrum Masks













Occupied Bandwidth and Spectrum Masks











Occupied Bandwidth and Spectrum Masks



MHz DMR 459.9000MHz Mask D 2W RBW=100Hz, VBW=1000Hz, Detector Mode=Peak Result=Pass







Occupied Bandwidth and Spectrum Masks



FCC ID: CASTBDH5G IC : 737A-TBDH5G Report Revision: 2 Issue Date: 01-June-2016

Occupied Bandwidth and Spectrum Masks



Occupied Bandwidth and Spectrum Masks





Occupied Bandwidth and Spectrum Masks



TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051

RSS-119 5.8

GUIDE: TIA-102.CAAA-C 2.2.7

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 10th Harmonic: 100 kHz to Fc-BW

Fc+ BW to 10Fc GHz

3. A Pre-scan is performed with a resolution bandwidth of 1 kHz, and a video bandwidth of 3 kHz. If any emissions are found to be within 20 dB of the limit a second measurement is made with the carrier modulated, and a resolution bandwidth of 10 kHz, and a video bandwidth of 30 kHz.

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

A photograph of the test set-up is included below.

MEASUREMENT RESULTS:

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

LIMIT CLAUSES: FCC 47 CFR 90.210

RSS-119 5.8

Photo: Conducted Emissions Test Setup



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CF	R 2.1051	RSS-119 5.8					
Tx FREQUENCY: 406.2 M	IHz						
12.5 kHz Channel Spacing	406.2 MHz @ 40 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)					
~	~	~					
No emissions were detected at a level greater than 20 dB below the limit.							

Agiler	it Spectrum Ana	alyzer - Swept S	4							
XI.	RF	50 Ω 🧥 DC	CORREC		SENSE:INT	AL	IGN AUTO		02:08:	21 p.m. May 04, 2016
Mar	ker 1 406.	20000000	0 MHz	PNO: Fast G FGain:Low	Trig: Free I #Atten: 30	Run dB	Avg Type: Avg Hold: (Log-Pwr 3/100		TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N N
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29.8										
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-10.2				0					~	
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Agilen	nt Spectru	ım Analyzer	- Swept SA								
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Star #Re:	t 800.0 s BW 1) MHz 10 kHz			#VE	SW 30 kHz			Sw	Stop	1.0000 GHz s (1001 pts)
MSG								STATUS			

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Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFF	R 2.1051	RSS-119 5.8
12.5 kHz Channel Spacing	418.1 MHz @ 40 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	418.1 MHz @ 2 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
Emission Frequency (MHz)	Level (dBm) ~	Level (dBc) ~
Emission Frequency (MHz) ~ No emissions were	Level (dBm) ~ detected at a level greater than 20	Level (dBc) ~) dB below the limit.

L RF 50 Ω <u>A</u> DO Iarker 1 418.10000000	IO MHz P	NO: Fast G Gain:Low	SENSE:INT Trig: Free #Atten: 30	Run dB	ALIGNAUTO Avg Type: Avg Hold:	Log-Pwr 12/100	04:12:40 TF	2.m. May 09, 201 RACE 1 2 3 4 5 TYPE MWWWWM DET P N N N N
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L Start #Res	1.000 C BW 1.0	GHz MHz		#VE	3W 3.0 MHz			Swe	Stop ep 6.20 ms	4.700 GHz s (1001 pts)
MSG							STATUS			

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFF	R 2.1051	RSS-119 5.8
12.5 kHz Channel Spacing	429.9 MHz @ 40 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)
~	~	~

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

Agilent Spec	trum Analyze	er - Swept SA									
<mark>Warkor</mark>	RF	50 Ω 🧥 DC			SENSE:INT		AL		log-Pwr	02:07:26) TF	p.m. May 04, 2016 RACE 1 2 3 4 5 6
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19.8 ——				-							
9.84 ——				-							
-0.16											
-10.2											
-20.2											-20.00 dBm
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MSG								STATUS 🚺	DC Coupled		

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<mark>w</mark> Stop	Freq 4.7	alyzer - Swept SA 50 Ω AC 7000000000	GHz	PNO: Fast G	SENSE:INT) Trig: Free #Atten: 6 d	AL Run B	IGN AUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:49:13 TI	p.m. May 04, 2016 RACE 1 2 3 4 5 6 TYPE M WWWWM DET P N N N N N
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Stop	Ref /div Ref	alyzer - Swept SA 50 Ω AC 7000000000 Offset 20.91 dl f 9.91 dBm	GHz B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:49:13 Т	p.m. May 04, 2016 RACE 1 2 3 4 5 6 TYPE M WANNAN DET P N N N N N
10 dB Log -0.09 -	Ref /div Ref	alyzer - Swept SA 50 Ω AC 7000000000 Offset 20.91 dl f 9.91 dBm	GHZ B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 Ti	р.т. Мау 04, 2016 RACE 11 2 3 4 5 6 ТҮРЕ МИЛИИИ DET P NNNN
10 dB Log -0.09 - -10.1 -	Ref /div Ref	offset 20.91 dBm	GHz B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	p.m. May 04, 2016 RACE [12:3 4 5 6 DET P NNNN DET P NNNN
10 dB -0.09 - -10.1 -	Freq 4.7	Offset 20.91 dBm	GHz B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	р.т. Мау 04, 2016 RACE 11 2 3 4 5 6 DET P N N N N N DET P N N N N N
10 dB Log -0.09 - -10.1 - -20.1 -	Ref Freq 4.7	0ffset 20.91 dB	GHz B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 Ti	p.m. May 04, 2016 RACE [1] 2 3 4 5 6 VPC MWWWWW DET P N N N N N DET P N N N N N -20.00 dBm
10 dB -0.09 - -10.1 - -20.1 - -30.1 -	Ref Freq 4.7 Ref	0ffset 20.91 dl	GHz IF	PNO: Fast Gain:Low	SENSE:INT	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	p.m. May 04, 2016 RACE [1 2 3 4 5 6 DET P NNNN DET P NNNN -20.00 dBm
10 dB Stop -0.09 - -10.1 - -20.1 - -30.1 - -40.1 -	Ref Freq 4.7	Image: Second condition So @ AC 50 @ AC 7000000000 Offset 20.91 dl 9.91 dBm	GHz F	PNO: Fast Gain:Low	SENSE:INT	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	p.m. May 04, 2016 RACE [1 2 3 4 5 6 DET P NNNN DET P NNNN -20.00 dBm
20 dB 10 dB 10 dB -0.09 - -10.1 - -20.1 - -40.1 - -50.1 -	Ref /div Ref	Offset 20.91 dl	B	PNO: Fast Gain:Low	SENSE:INT) Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg[Hold>	Log-Pwr 100/100	02:49:13 Ti	р.т. Мау 04, 2016 RACE 11 2 3 4 5 6 VPC MWWWWW DET P N N N N N DET P N N N N N -20 00 dBm
20 dB 10 dB 10 dB -0.09 - -10.1 - -20.1 - -30.1 - -40.1 - -50.1 - -60.1 -	Ref /div Ref	offset 20.91 dl 9.91 dBm	CORREC GHz	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avgl/Hold>	Log-Pwr 100/100	02:49:13 T	р.т. Мау 04, 2016 ГАСЕ [] 2 3 4 5 6 DET Р N N N N DET Р N N N N N -20 00 dBm
Stop 10 dB -0.09 - -10.1 - -20.1 - -30.1 - -50.1 - -60.1 - -70.1 -	Ref Freq 4.7 Ref /div Ref	Alyzer - Swept SA 50 Ω AC 700000000 Offset 20.91 dl f 9.91 dBm	CORREC	PNO: Fast Gain:Low	Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg[Hold>	Log-Pwr 100/100	02:49:13 Ti	р.т. Мау 04, 2016 RACE [1] 2 3 4 5 6 DET P NNNN DET P NNNN -20.00 dBm
Stop 10 dB -0.09 -0.09 -0.11 -20.1 -30.1 -40.1 -50.1 -70.1 -70.1 -80.1 -80.1 -	Ref /div Ref	Alyzer - Swept SA 50 Ω AC 700000000 Offset 20.91 dl f 9.91 dBm	CORREC	PNO: Fast Gain:Low	SENSE:INT		IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 Ti	р.т. Мау 04, 2016 RACE 11 23 4 5 6 DET P NNNN DET P NNNN -20.00 dBm
Stop 10 dB -0.09 -0.09 -10.1 -20.1 -30.1 -30.1 -40.1 - -50.1 - -50.1 - -50.1 - -50.1 - -50.1 - - - - - - - - - - - - -	Spectrum An	Alyzer - Swept SA 50 Ω AC 700000000 Offset 20.91 dl 9.91 dBm	CORREC	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	p.m. May 04, 2016 FACE [] 2 3 4 5 6 DET [] 2 3 5 6 DET [] 2 3 5 5 6 DET [] 2 3
Stop 10 dB -0.09 -0.09 -10.1 - -20.1 - -30.1 - -50.1 - -60.1 - -70.1 - -80.1 - Start #Res	<u>جامعات المحمد المحم محمد المحمد المحمد محمد المحمد المحم محمد المحمد محمد محمد المحمد المحمد المحمد المحمد المحمد المحمد المحم محمد المحمد المحمد المحمد المحمد المحمد المحمد المح</u>	المركز Store <	CORREC	PNO: Fast Gain:Low	SENSE:INT	Run B	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:49:13 T	p.m. May 04, 2016 RACE [] 2 3 4 5 6 PERMIT NINN N DET NNNN N -20.00 dBm

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CF	R 2.1051	RSS-119 5.8
12.5 kHz Channel Spacing	450.1 MHz @ 40 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)
Emission Frequency (MHz) ~	Level (dBm) ~	Level (dBc) ~
Emission Frequency (MHz) ~ No emissions were	Level (dBm) ~ detected at a level greater than 20	Level (dBc) ~) dB below the limit.



Agiler I <mark>XI</mark> Mar	nt Spectrum ker 1 9	n Anal RF	<mark>yzer - Swept S/</mark> 50 Ω AC 20000000	CORREC		SENSE:INT	AL	IGN AUTO Avg Type:	Log-Pwr	02:19:30 TF	p.m. May 04, 2016 RACE 1 2 3 4 5 6
				l IF	PNO: Fast G Gain:Low	Trig: Free #Atten: 20	Run dB	Avg Hold: 8	8/100	Milend Of	
10 di Log	3/div	Ref C Ref	offset 29.84 d 20.00 dBm	IB I						-51.	967 dBm
10.0											
0.00											
-10.0											
20.0											-20.00 dBm
-20.0											
-30.0											
-40.0							1				
-50.0	un and the second	havr	mhluwaaaqardaa	m.	autor and a second	Munulan		Nuturi walika da ana	halfertraktik	hallertherester	white the state of
-60.0											
-70.0											
Star #Re	t 800.0 s BW 1	MH2 0 kH	z 17		#VE	SW 30 kHz	~		SW	Stop ′ veep 1.91 s	1.0000 GHz
MSG		•	-					STATUS			(1001 ptc)
Agilen	t Spectrum	n Analy	yzer - Swept SA								
Agilen <mark>W</mark> Stop	t Spectrum	RF	yzer - Swept SA 50 Ω AC	GHz			AL	IGNAUTO Avg Type:	Log-Pwr	02:46:56 Ti	p.m. May 04, 2016 RACE 1 2 3 4 5 6 TYPE M WAAAAAAA
Agilen <mark>1,XI</mark> Stop	t Spectrum Freq	RF 4.70	yzer - Swept SA 50 Ω AC 300000000	CORREC GHz IF	PNO: Fast G	SENSE:INT Trig: Free #Atten: 6 d	Run IB	IGNAUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:46:56 Ti	p.m. May 04, 2016 RACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N N
Agilen (X) Stor 10 dE	t Spectrum Freq 3/div	Analy RF 4.70 Ref 0 Ref 9	yzer - Swept SA 50 Ω AC 000000000 000000000 0000000000000000	GHz F B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d	Run IB	IGNAUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:46:56 Ti	p.m. May 04, 2016 RACE 1 2 3 4 5 6 TYPE M WWWWW DET P N N N N N
Agilen (X) Stor 10 dE Log	t Spectrum	Analy RF 4.70 Ref 0 Ref 9	yzer - Swept SA 50 Ω AC 200000000 9.91 dBm	GHz F B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 o	Run IB	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:46:56 Ti	р.т. Мау 04, 2016 RACE 1 2 3 4 5 6 ТРЕ М УМУМИ DET P NNNN
Agilen (X) Stor -0.09 -10.1	spectrum Freq 3/div	Analy RF 4.70 Ref 0	yzer - Swept SA 50 Ω AC 00000000 0ffset 20.91 d 9.91 dBm	GHz F B	PNO: Fast Gain:Low	SENSE:INT	Run BB	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:46:56 T	р.т. Мау 04, 2016 КАСЕ [1] 2 3 4 5 6 ТҮРЕ МИМИИИИ DET P N N N N
Agilen (X) Stop 10 dE -0.09 -10.1 -20.1	t Spectrum	RF 4.70 Ref O Ref 9	yzer - Swept SA 50 Ω AC 00000000 Iffset 20.91 d 9.91 dBm	GHz F B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 o	Run IB	IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:46:56 T	р.т. Мау 04, 2016 Таксе 11 2 3 4 5 е Туке Миничини Det P N N N N N -20.00 dBm
Agilen: 310 dE -0.09 -10.1 -20.1 -30.1	t Spectrum	Analy RF 4.70 Ref 0 Ref 9	yzer - Swept SA 50 Ω AC 00000000 iffset 20.91 d 9.91 dBm	GHz F B	PN0: Fast Gain:Low	SENSE:INT	Run IB	IGN AUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:46:56	p.m. May 04, 2016 TACE 11 2 3 4 5 6 TYPE MANYAWA DET P N N N N -20.00 dBm
Agilen: (X) Stor -0.09 -10.1 -20.1 -30.1 -40.4	t Spectrum	Analy RF 4.70 Ref 0 Ref 1	yzer - Swept SA 50 Ω AC 00000000 Mfset 20.91 d 9.91 dBm	GHz F B	PN0: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 d		IGNAUTO Avg Type: Avg Hold>	Log-Pwr 100/100	02:46:56 T	p.m. May 04, 2016 TACE 11 2 3 4 5 6 TYPE M WWWWW DET P NNNN -20.00 dBm
Agilen 20 20 -0.09 -10.1 -20.1 -30.1 -40.1 20 4	t Spectrum	Ref O	yzer - Swept SA 50 Ω AC 00000000 iffset 20.91 d 9.91 dBm	GHz F F B	PNO: Fast Gain:Low	SENSE:INT Trig: Free #Atten: 6 o		IGNAUTO Avg Type: AvgjHold>	Log-Pwr 100/100	02:46:56	p.m. May 04, 2016 AACE 11 2 3 4 5 6 TYPE M WWWW DET P N N N N ET P N N N N -20.00 dBm
Agilen Agilen Stop -0.09 -10.1 -20.1 -30.1 -40.1 -50.1	t Spectrum	RF 4.70 Ref O Ref S	vzer - Swept SA 50 ג AC 00000000 ffset 20.91 d 9.91 dBm	CORREC GHz F IF B	PNO: Fast Gain:Low	SENSE:INT		IGN AUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:46:56 T	р.т. Мау 04, 2016 RACE 11 2 3 4 5 6 ТҮРЕ МИЛИИИИ DET P N N N N -20.00 dBm -20.00 dBm
Agilen 3 5 10 dE -0.09 -10.1 -20.1 -30.1 -40.1 -50.1	t Spectrum	Analy RF 4.70 Ref 9	yzer - Swept SA 50 Ω AC 000000000 ffset 20.91 d 9.91 dBm	GHz F F B	PNO: Fast Gain:Low	SENSE:INT	Run IB	IGN AUTO Avg Type: Avg Hold:>	Log-Pwr 100/100	02:46:56	p.m. May 04, 2016 RACE 11 2 3 4 5 6 TYPE MWWWW DET P N N N N -20.00 dBm
Agilen (X) Stor -0.09 -10.1 -20.1 -30.1 -40.1 -50.1 -60.1 -70.1	L Spectrum	Analy RF 4.70 Ref 9	yzer - Swept SA 50 ג AC 000000000 ffset 20.91 d 9.91 dBm	GHz F F B	PNO: Fast Gain:Low	SENSE:INT	Run IB	IGN AUTO	Log-Pwr 100/100	02:46:56	р.т. Мау 04, 2016 КАСЕ 11 2 3 4 5 6 Тучер Миличини DET P N N N N -20.00 dBm
Agilen XI Stor -0.09 -10.1 -20.1 -30.1 -40.1 -50.1 -60.1 -70.1 -80.1	syderium	<u>R</u> F 4.70 Ref O Ref S	yzer - Swept SA 50 ג AC 000000000 fffset 20.91 d 9.91 dBm	GHz F F B	PNO: Fast Gain:Low	SENSE:INT		IGN AUTO	Log-Pwr 100/100	02:46:56	p.m. May 04, 2016 TACE 11 2 3 4 5 6 TYPE M MANANAN DET P N N N N -20.00 dBm
Agilen XI Stor -0.09 -10.1 -20.1 -30.1 -50.1 -50.1 -60.1 -70.1 -80.1 -80.1 -80.1	t 1.000	GHz	yzer - Swept SA 50 ג AC 000000000 fffset 20.91 d 9.91 dBm	GHz F IF B	PNO: Fast Gain:Low	SENSE:INT		IGN AUTO	Log-Pwr 100/100	02:46:56	р.т. Мау 04, 2016 TVPE [1] 2 3 4 5 6 TVPE [MMMMMMM DET P NNNN -20.00 dBm -20.00 dBm

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFF	R 2.1051	RSS-119 5.8
12.5 kHz Channel Spacing	459.9 MHz @ 40 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	459.9 MHz @ 2 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were	detected at a level greater than 20) dB below the limit.

Agilen	t Spectrum A	nalyzer - Swept	SA							
L)XI	R	F 50 Ω 🧥 D	C CORREC		SENSE:INT		ALIGN AUTO		02:09:0	9 p.m. May 04, 2016
Mar	ker 1 459	9.9000000	00 MHz	PNO: Fast G	⊃ Trig: Free F #Atten: 30 c	Run 18	Avg Type Avg Hold:	: Log-Pwr 3/100		TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N N
10 dE	Re Bidiv R e	f Offset 29.84 ef 49.84 dB	dB m						Mkr1 4 45	159.9 MHz 977 dBm
9						Ţ	1			
39.8										_
29.8				~						
19.8										
9.84				-						
-0.16										
-10.2			_							
-20.2										-20.00 dBm
-30.2						-				
-40.2										
	anter and the second second	helelintrankalaipeana	munihalin	Manhamman Manhath	www.water	ration to the second second	and the strategy of the	http://wingra.in/paan	manny	wergely all an and a
Star #Res	t 10 kHz s BW 10 l	kHz		#VB	W 30 kHz			s	Sto weep 7.65	p 800.0 MHz s (1001 pts)
MSG	een oortoon - a-bet ke	949 (1999 - 1979 ⁻ 1979 -			n men kölden köllö		STATUS 🤱	DC Coupled		799999 • • • • • • • • • • • • • • • • •

Agilent Spectrum Analyzer - Swept S	SA	and and		
KM RF 50 Ω A	C CORREC	SENSE:INT	ALIGNAUTO	02:20:47 p.m. May 04, 2016
Marker 1 919.8000000	DU MHZ PNO: Fast IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Type: Log-Pw Avg Hold: 24/100	
Ref Offset 29.84 10 dB/div Ref 20.00 dBr	dB n			Mkr1 919.8 MHz -50.373 dBm
10.0				
0.00				
-10.0				
-20.0				-20.00 dBm
-30.0				
-40.0				
-50.0				
-60 0	hariy have a service and a light and a light	พระสารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สารที่สา	plum in the states and the	alienerte vongeleitenten on potationalistation
-70.0				
Start 800.0 MHz #Pes BM 10 kHz)A(30 kHz		Stop 1.0000 GHz
MSG	#VD	WY JU KIIZ	STATUS	aweep i.ars (1001 pts)



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFF	R 2.1051	RSS-119 5.8	
12.5 kHz Channel Spacing	469.9 MHz @ 40 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)	
~	~	~	
No emissions were detected at a level greater than 20 dB below the limit.			

RF 50 Ω <u>A</u> DC Iarker 1 469.900000000	CORREC SEN: MHZ PNO: Fast F IEGain: Low	SE:INT A Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Type: Log-Pwr Avg Hold: 2/100	02:09:52 p.m. May 04, 2016 TRACE 1 2 3 4 5 1 TYPE MWWWWW DET P N N N N
Ref Offset 29.84 dE 0 dB/div Ref 49.84 dBm	3			Mkr1 469.9 MH: 46.055 dBn
39.8			/1	
29.8				
19.8				
3.84				
J.16				
10.2				
20.2				-20.00 dE
30.2				
www.wall.		Langelogener typer labor water the	Walter agent from a lot a frank from the start of the sta	an a
itart 10 kHz Res BW 10 kHz	#VBW	30 kHz	Sv	Stop 800.0 MH veep 7.65 s (1001 pts

Agiler	nt Spectru	m Analy	zer - Swept S/	CORREC		CENCEINIT		ALT			02:22:05	n m May 04, 2014
Mar	ker 1	939.8	0000000	0 MHz			Dun	ALI	Avg Type:	Log-Pwr 4/400	U2;22:06 Ti	P.m. May 04, 2010 RACE 1 2 3 4 5 6
					IFGain:Low	#Atten: 20	dB		ringh lord. 2			DET PNNNN
10 dl	B/div	Ref Of Ref 2	ffset 29.84 c 2 0.00 dB m	B							Mkr1 9 -51.	39.8 MHz 188 dBm
LUG												
10.0												
0.00												
-10.0												
10.0												
-20.0												-20.00 dBm
-30.0												
-40.0										1		
-50.0			Ada abbat ya uma	ատարահերություն	an amanatakis	hank to all have a set the second	يد و الشريع	المراجع مر		' 	به عامله العام	
-60.0	դուրա օպ ւ	QATHY~44	An Daugh an Line and Albertalian	-OLA LALADOUR	ala (1939 - an an an An An	a and the last of	. an indefinition	outer unterfacet	a Mondrata Managa Ing	anore elateratural	angu di Juh . Ardire	المرابع معرفا المريمية
-70.0												
Star	L 800.0) MHz									Stop	1.0000 GHz
#Re	s BW ′	10 kH2	Z		#V	BW 30 kHz				Sv	veep 1.91	s (1001 pts
MSG									STATUS			
gilent	Spectrun	n Analyz	er - Swept SA	CORREC		CENCEJINE		01.2			00.40-00	
Stop	Freq	4.700	0000000	GHZ .	PNO: Fast	Trig: Free	Run	ALI	Avg Type: Avg Hold:>	Log-Pwr 100/100	02:48:08	TRACE 1 2 3 4 5 TYPE MWWWW DET P N N N N
				I	FGain:Low	#Atten: 6 d	D					serp.



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

RSS-119 5.8

LIMITS:

FCC 47 CFR 90.210

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing 50 + 10 Log ₁₀ (P _{Watts})	
40 W	-20 dBm	dBc
2 W	-20 dBm	dBc

TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA-102.CAAA-C 2.2.6

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.
- 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 6th 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.
- 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: See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing	406.2 MHz @ 40 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)		
~	~	~		
No emissions were detected at a level greater than 20 dB below the limit.				

Tx FREQUENCY: 418.1 MHz

12.5 kHz Channel Spacing	418.1 MHz @ 40 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing	418.1 MHz @ 2 W	Emission Mask D		
Emission Frequency (MHz)	Level (dBm)	Level (dBc)		
~	~	~		
No emissions were detected at a level greater than 20 dB below the limit.				

Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing	429.9 MHz @ 40 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)

 ~
 ~
 ~

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

Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing 450.1 MHz @ 40 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)		
~	~	~		
No emissions were detected at a level greater than 20 dB below the limit.				

Tx FREQUENCY: 459.9 MHz

12.5 kHz Channel Spacing	459.9 MHz @ 40 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

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

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

 ~
 ~
 ~

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

Tx FREQUENCY: 469.9 MHz

12.5 kHz Channel Spacing	469.9 MHz @ 40 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)
~	~	~
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS: FCC CFR 2.1053

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing 50 + 10 Log ₁₀ (P _{Watts})	
40 W	-20 dBm	dBc
2 W	-20 dBm dBc	

Tx Radiated Emissions - Continued

Open Area Test Site Results:

12.5 kHz Channel Spacing	450.1 MHz @ 40 W	Emission Mask D
Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
900.200000	-48.42	-94.42
1350.300000	-55.93	-101.93
1800.400000	-66.86	-112.86
2250.500000	-77.13	-123.13
2700.600000	-67.42	-113.42

Photo: OATS Setup



TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

GUIDE: TIA-102.CAAA-C 2.2.18

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.

2. Measurements and plots were made following the TIA procedure.

MEASUREMENT RESULTS: See the tables and plots on the following pages for 12.5 kHz channel spacings.

LIMIT CLAUSES: FCC 47 CFR 90.214

RSS-119 5.9

Transient Frequency Behaviour

SPECIFICATION:	FCC 47 CFR 90.214	RSS-119 5.9

Tx FREQUENCY: 406.2 MHz

40 W

12.5 kHz Channel Spacing

406.2 MHz @ 40 W Tx

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL		
PERIOD	Key ON (kHz)	Key OFF (kHz)	
t1	-0.6	N/A	
t2	-0.5	N/A	
t3	N/A	0.2	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	\checkmark	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	1	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	1	

LIMIT:

FCC 47 CFR 90.214

	FREQUENCY RANGE		
TRANSIENT 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	

LIMIT: RSS-119 5.9

Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
	Maximum Frequency	FREQUENCY RANGE	
TRANSIENT FERIODS	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.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214		RSS-119 5.9	
Tx FREQUENCY:	406.2 MHz	40 W	12.5 kHz Channel Spacing



Transient Frequency Behaviour

SPECIFICATION:	FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing

418.1 MHz @ 40 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL		
	Key ON (kHz)	Key OFF (kHz)	
t1	0.4	N/A	
t2	0.3	N/A	
t3	N/A	-0.5	

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

LIMIT: FCC 47 CFR 90.214

	FREQUENCY RANGE		
TRANSIENT 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			
	Maximum Frequency	FREQUENCY RANGE	
TRANSIENT PERIODS	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,

Transient Frequency Behavior



FCC ID: CASTBDH5G IC : 737A-TBDH5G

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY:	429.9 MHz	40 W	12.5 kHz Channel Spacing
---------------	-----------	------	--------------------------

429.9 MHz @ 40 W Tx

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	0.4	

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	\checkmark	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	1	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	\checkmark	

LIMIT:

FCC 47 CFR 90.214

	FREQUENCY RANGE		
TRANSIENT 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 DEDIODS Maximum Frequency FREQUENCY RANGE			NCY RANGE
TRANSIENT FERIODS	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,

Transient Frequency Behavior



Transient Frequency Behaviour

SPECIFICATION	FCC 47 CFR 90 214
OI LOII IOATION.	100 47 01 1 30.214

450.1 MHz @ 40 W Tx

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

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.	1	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	1	

LIMIT:

FCC 47 CFR 90.214

	FREQUENCY RANGE				
TRANSIENT 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			

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,

Transient Frequency Behavior



Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 459.9 MHz

40 W

12.5 kHz Channel Spacing

459.9 MHz @ 40 W Tx

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL				
PERIOD	Key ON (kHz)	Key OFF (kHz)			
t1	0.4	N/A			
t2	-0.2	N/A			
t3	N/A	0.7			

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	1	
Confirm that during the period t2 the frequency difference does	YES	NO
not exceed half a channel separation.	1	
Confirm that during the period t2 to t3 the frequency difference	YES	NO
does not exceed the frequency error limit.	1	

LIMIT:

FCC 47 CFR 90.214

	FREQUENCY RANGE				
TRANSIENT 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			

LIMIT: RSS-119 5.9

Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels							
	Maximum Frequency	FREQUE	NCY RANGE				
TRANSIENT FERIODS	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,

Transient Frequency Behavior



Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY:	469.9 MHz	40 W	12.5 kHz Channel Spacing
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469.9 MHz @ 40 W Tx

TRANSIENT RESPONSE	CARRIER PEAK VARIATION FROM NORMAL				
PERIOD	Key ON (kHz)	Key OFF (kHz)			
t1	-0.4	N/A			
t2	-0.2	N/A			
t3	N/A	0.7			

Confirm that during periods t1 and t3 the frequency difference	YES	NO
does not exceed the value of one channel separation.	\checkmark	
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.	\checkmark	

LIMIT:

FCC 47 CFR 90.214

	FREQUENCY RANGE				
TRANSIENT 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,

Transient Frequency Behavior



FCC ID: CASTBDH5G IC : 737A-TBDH5G Report Revision: 2 Issue Date: 01-June-2016

TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

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

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 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 $+50^{\circ}$ 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 & 25.0 kHz channel spacings.

°C	406.20	00MHz	418.10	000MHz	429.90	00MHz	450.10	00MHz	459.90	00MHz	469.900	0MHz
	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm
-30	-96	-0.24	-93	-0.22	-100	-0.23	-101	-0.22	-103	-0.22	-112	-0.24
-20	-18	-0.04	-10	-0.02	-27	-0.06	-27	-0.06	-21	-0.05	-26	-0.06
-10	-62	-0.15	-44	-0.11	-59	-0.14	-62	-0.14	-70	-0.15	-64	-0.14
0	-62	-0.15	-50	-0.12	-62	-0.14	-69	-0.15	-72	-0.16	-66	-0.14
10	-19	-0.05	-14	-0.03	-19	-0.04	-26	-0.06	-22	-0.05	-20	-0.04
20	5	0.01	7	0.02	-3	-0.01	4	0.01	0	0	-1	0
30	-3	-0.01	0	0	-8	-0.02	-13	-0.03	-5	-0.01	-6	-0.01
40	-13	-0.03	-3	-0.01	-6	-0.01	-17	-0.04	-10	-0.02	-11	-0.02
50	5	0.01	26	0.06	-1	0	7	0.02	1	0	2	0

LIMIT: FCC 47 CFR 90.213	RSS-119 5.3
Channel Spacing (kHz)	Frequency Error (ppm)
12.5	2.5
25.0	5.0

Transmitter Frequency Stability - Temperature



TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 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 85% to 115%.
- 3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESUL	TS:		40W
Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		12.5 kHz
	406.2 MHz	418.1 MHz	429.9 MHz
13.8V _{DC}	0.01	-0.02	0.01
11.7V _{DC}	0.00	-0.03	0.00
15.9 V _{DC}	-0.01	-0.01	0.02
Max Frequency ppm	0.01	-0.03	0.02

40W

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		
	450.1 MHz	459.9 MHz	469.9 MHz
13.8V _{DC}	-0.01	0.00	-0.01
11.7V _{DC}	0.00	-0.02	-0.03
15.9 V _{DC}	0.00	-0.02	-0.01
Max Frequency ppm	-0.01	-0.02	-0.03

L	_IMIT CLAUSES: FCC 47 CFR 90.213	RSS-119 5.3
	Channel Spacing (kHz)	Frequency Error (ppm)
	12.5	5.0

RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up diagram.

- 2. The frequency range examined was from 30 MHz to 3 times highest tunable frequency.
- 3. Spurious emissions which were attenuated more than 20 dB below the limit were not recorded.

406.2 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

418.1 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

429.9 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

450.1 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

459.9 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~	~	~	
No emissions were detected within 20 dB of Limit.			

469.9 MHz Receive (Receiver Input Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

LIMIT CLAUSE:	RSS-Gen 6(b)		
	30 → 1000 MHz	2 nW	- 57 dBm
	> 1000 MHz	5 nW	- 53 dBm

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

MEASUREMENT PROCEDURE:

4. Refer Annex A for Equipment set up diagram.

- 5. The frequency range examined was from 30 MHz to 3 times highest tunable frequency.
- 6. Spurious emissions which were attenuated more than 20 dB below the limit were not recorded.

406.2 MHz Transmitter Standby (Transmitter RF Output Port)			
Emission Frequency (MHz) Level (nW) Level (dBm)			
~ ~ ~			
No emissions were detected within 20 dB of Limit.			

418.1 MHz Transmitter Standby (Transmitter RF Output Port)			
Emission Frequency (MHz)	Level (nW)	Level (dBm)	
~	~	~	
No emissions were detected within 20 dB of Limit.			

429.9 MHz Transmitter Standby (Transmitter RF Output Port)			
Emission Frequency (MHz)	Level (nW)	Level (dBm)	
~	~	~	
No emissions were detected within 20 dB of Limit.			

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

450.1 MHz Transmitter Standby (Transmitter RF Output Port)		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
~	~	~
No emissions were detected within 20 dB of Limit.		

459.9 MHz Transmitter Standby (Transmitter RF Output Port)			
Emission Frequency (MHz)	Level (nW)	Level (dBm)	
~	~	~	
No emissions were detected within 20 dB of Limit.			

469.9 MHz Transmitter Standby (Transmitter RF Output Port)			
Emission Frequency (MHz)	Level (nW)	Level (dBm)	
~	~	~	
No emissions were detected within 20 dB of Limit.			

LIMIT CLAUSE:	RSS-Gen 6(b)		
LIMIT	30 → 1000 MHz	2 nW	- 57 dBm
	> 1000 MHz	5 nW	- 53 dBm
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TEST EQUIPMENT LIST

Equipment Type	Information	Manufacturer	Model No	Serial No# Tait ID		Cal Due
Signal Generator	Analog 3.2GHz	Hewlett Packard	HP8648C	3443U00543	E3558	16-Oct-16
Environ. Chamber	Chest	Contherm	Chest	E3397	E3397	1-Aug-17
Power Supply	TREVA2 60V/25A	Agilent	N5767A	US09F4901H	E4656	18-Oct-17
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	14-Apr-19
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	29-Apr-19
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	29-Apr-19
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	6-Jul-16
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	29-Sep-16
Filter Notch		Tait		N/A	-	
RF	1040 1500/	Wainschol	F7 10 24		52674	19 Oct 16
RF	1008 15000	weinschei	57-10-34	LB390	E3074	10-000-10
Attenuator RF	10dB 50W	Weinschel	24-10-34	AZ0401	E3388	18-UCT-16
Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	15-Oct-16
RF Load	150W	Bird	8166	524	E3625	
Coax Cable	3m Blue	Suhner	Sucoflex 104A	44611/4A	E4620	18-Oct-16
Oscilloscope	400MHz	Tektronics	TDS380	B017095	E3782	13-Oct-17
Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	20-Oct-16
Signal Generator	TREVA2 Analog 3.3GHz	Rohde & Schwarz	SML03 1090.3000.13	3 100597	E4050	18-Oct-16
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	_	E4084	
ISN	CISPR22 2006	TESEQ	ISN T800	27956	E4658	29-Nov-15
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/20	000 TeltestBlack5	E4850	16-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/20	000 TeltestBlack6	E4849	16-Oct-16
Power Meter	TREVA2 Power Head for HP8901	Hewlett Packard	HP11722A	2716A02037	1575	20-Oct-16
Antenna	and Balun	Schwarzbeck	FBAB 9177,VHA 9103	9104-2459	E4616	5-Aug-16
LISN		Schwarzbeck	NNBM 8125	8125-1127	E4618	19-Oct-16
LISN		Schwarzbeck	NNBM 8125	8125-1505	E4654	19-Oct-16
TREVA 2		Teltest	-	2	-	5-May-17
Coax Cable	2.5m Blue	Suhner	Sucoflex 104A	33449/4PEA	E4997	18-Oct-16
RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Temp & Humidity						
datalogger		Норо	U21-011	10134276	E4981	14-Aug-16
OATS	FCC Listing Registration			837095		12-May-16
Coax Cable	OATS Turntable Cable 2	Intelcom	RG215	OATS3	E4995	20-Oct-16

FCC ID: CASTBDH5G IC : 737A-TBDH5G Report Revision: 2 Issue Date: 01-June-2016

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NOTE: Items without calibration dates are calibrated immediately before use, or set using calibrated instruments.

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ANNEX A – TEST SETUP DETAILS



All other testing is performed using the Teltest Radio EVAluation 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.

