

849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA

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FCC 200-220MHz VHF PORTABLE PART 90 TEST REPORT

APPLICANT	TAIT LIMITED	
	535 Wairakei Road Christchurch 8140 NEW ZEALAND	
FCC ID	CASTPDCOA	
MODEL NUMBER	TPDCOA	
PRODUCT DESCRIPTION	VHF 5W PORTABLE TRANSCEIVER	
STANDARD APPLIED	CFR 47 Part 90	
DATE SAMPLE RECEIVED	8/3/2017	
DATE TESTED	8/6/2017	
TESTED BY	Tim Royer	
APPROVED BY	Sid Sanders	
TEST RESULTS	□ PASS □ FAIL	

Report	Version	Description	Issue Date
Number	Number		
1424AUT17TestReport_	Rev1	Initial Issue	8/15/2017
	Rev2	Updated Report	8/22/2017
	Rev3	Updated Report	8/29/2017
	Rev4	Added better information regarding product tested to page 6 and admin. Updates to pages 5 and 7	9/19/2017

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.



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GENERAL REMARKS

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Summary

The device under test does:

Fulfill the general approval requirements as identified in this test report

Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc. 849 NW State Road 45 Newberry, Fl. 32669



Name and Title: Tim Royer, Project Manager/Testing Engineer

Date: 8/14/2017

Reviewed and approved by: Name and Title: Sid Sanders Engineer

Date: 15 August 2017

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GENERAL INFORMATION EUT Specification

EUT Description	VHF 5W PORTABLE TRANSCEIVER	
FCC ID	CASTPDC0A	
Model Number	TPDC0A	
Operating Frequency	220-222MHz	
Test Frequencies	220.1 & 221.9MHz	
Type of Emission	7K60F2D/FXD/FXW, 11K0F3E	
Modulation	FM	
	☐ 110-120Vac/50- 60Hz	
EUT Power Source	☐ DC Power 7.5V	
	□ Battery Operated Exclusively	
	☐ Prototype	
Test Item	□ Pre-Production	
	Production	
	Fixed	
Type of Equipment	☐ Mobile	
	□ Portable	
Test Conditions	The temperature was 24-26°C with a relative humidity of 50-65%.	
Revision History to the EUT	None	
Test Exercise	The EUT was placed in continuous transmit mode.	
Applicable Standards	ANSI/TIA 603-C: 2004, FCC CFR 47 Part 90	
Test Facility	Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA.	

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EUT Specification Contd.

	Type Code	FCC ID	Product code	Serial Number
Portable	TPDC0A	CASTPDC0A	T03-00043-	25905515
			CJDB	

Hardware and Software: Portable:

Type	Code and Version
Hardware ID	TPDB1X-C000_0007
Boot Code	QPD1B_S00_3.01.03.0001
DSP	QPD1A_E00_2.15.01.0062
Radio Application	QPD1F_E00_2.15.01.0062
Firmware Package	QI93P_E00_2.15.01.0062
FPGA Image	QPD1G_S01_1.10.00.0003

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TEST RESULTS SUMMARY

Test Description	FCC RULE PART NO.	RESULT
Modulation Characteristics	2.1047(a)(b)	Pass
RF Power Output	2.1046(a), 90.541(d), 90.542(a)(7), 90.635(b)	Pass
Occupied Bandwidth	2.1049(c)(h), 90.210(b)(g)(h), 90.691	Pass
Spurious Emissions at Antenna Terminal	2.1051(a), 90.210(b)(g)(h), 90.691, 90.543(c)	Pass
Field Strength of Spurious Radiation	2.1053, 90.210(b)(g)(h), 90.691, 90.543(c)	Pass
Frequency Stability	2.1055, 90.213, 90.539(c)	Pass

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RF POWER OUTPUT

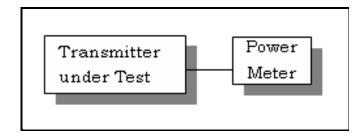
Rule Part No.: Part 2.1046(a), Part 90

Test Requirements: Manufacturer's Specification

Method of Measurement: RF power is measured by using a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage (if battery operated), or a properly adjusted power supply (if not battery operated), and the transmitter properly adjusted the RF output measures:

For the device with a fixed or integral antenna, the RF power is measured as ERP. The substitution method was used. The RF output measures:

Test Setup Diagram:



OUTPUT POWER:

	RF POWER (W)	RF POWER (W)
Tuned Frequency (MHz)	HI	LO
220.1	4.58	0.98
221.9	4.67	0.98

RF Power of the EUT can be set at 1W and 5 W.

Part 2.1033 (C) (8) DC Input into the final amplifier

FOR LOW POWER SETTING INPUT POWER: (7.5v) (0.66A) = 4.95 Watts FOR HIGH POWER SETTING INPUT POWER: (7.5v) (1.36A) = 10.2 Watts

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MODULATION CHARACTERISTICS

Part 2.1033(c)

Part 2.1033(c) (4) Type of Emission: 11K2F1D, 11K2F2D, and 11K2F3E

FCC Part 90.209 FCC Part 90.207 DMR TDMA

BANDWIDTH CALCUATION

Type of Emission: 11K0F3E

Bn = 2M + 2DK

M = 3000

D = 2500

K=1

Bn = 2(3000) + 2(2500) = 11k

And

Type of Emission: FXD/FXW

The standard emission bandwidth for a DMR type 2 signal is 7.6k

And

Type of Emission: 7K6F2D (6K45F2D)

From largest 99% occupied bandwidth plot.

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MODULATION CHARACTERISTICS

AUDIO FREQUENCY RESPONSE

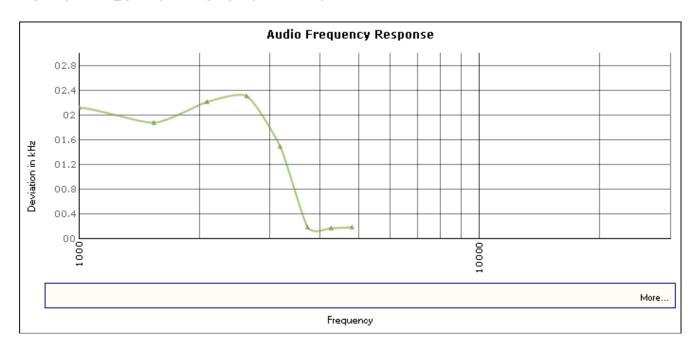
Rule Part No.: Part 2.1047(a) (b)

Test Requirements: Reporting Only

Method of Measurement: ANSI/TIA-603 § 2.2.6 Audio Frequency Response

TEST DATA:

AUDIO FREQUENCY RESPONSE - 12.5 kHz



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MODULATION CHARACTERISTICS

AUDIO INPUT VERSUS MODULATION

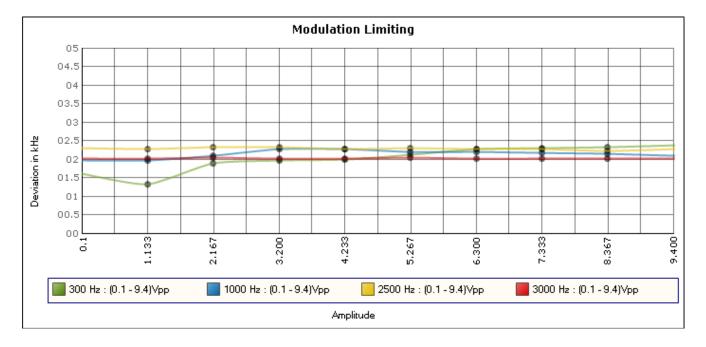
RULE PART NO: Part 2.1047(b) & 90

REQUIREMENT Modulation cannot exceed 100% of the rated FM deviation.

Method of Measurement: ANSI/TIA-603 § 2.2.3

Test data:

MODULATION LIMITING 12.5 kHz



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OCCUPIED BANDWIDTH

Part 2.1049(c) EMISSION BANDWIDTH:

Part 90.210(f) Emission Mask F For transmitters operating in the 220-222 MHz frequency band, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_o to the edge of the authorized bandwidth f_e : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 2 kHz up to and including 3.75 kHz: 30 + 20(f_d 2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
 - (3) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth f_d : At least 55 + 10 log (P) dB.

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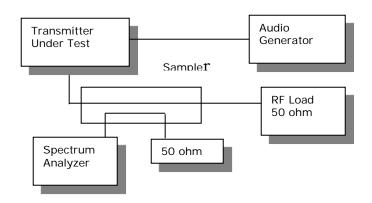
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Method of Measurement: ANSI/TIA 603-D: 2010

Test Setup Diagram:



Test Data: See the plots below

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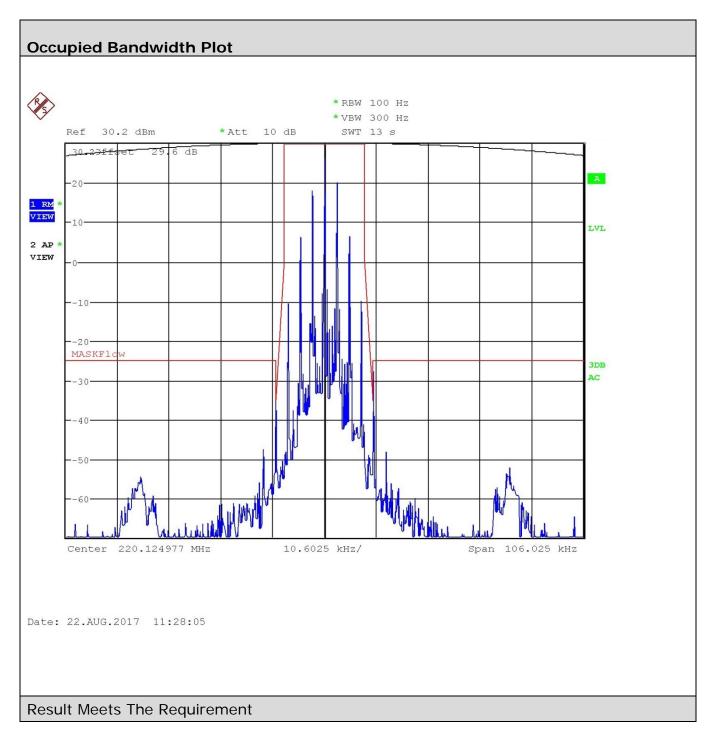
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OCCUPIED BANDWIDTH PLOTS: ANALOG

Part 90.210(f) Emission Mask F - ANALOG

Test Data: Low Power 220.100 MHz



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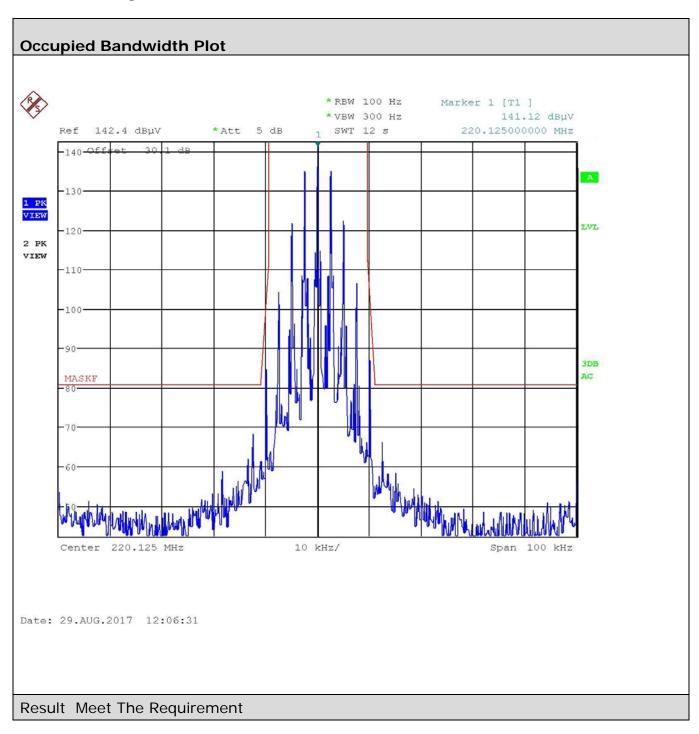
FCC ID: CASTPDCOA



OCCUPIED BANDWIDTH PLOTS: ANALOG

Part 90.210(f) Emission Mask F - ANALOG

Test Data: High Power 220.100 MHz



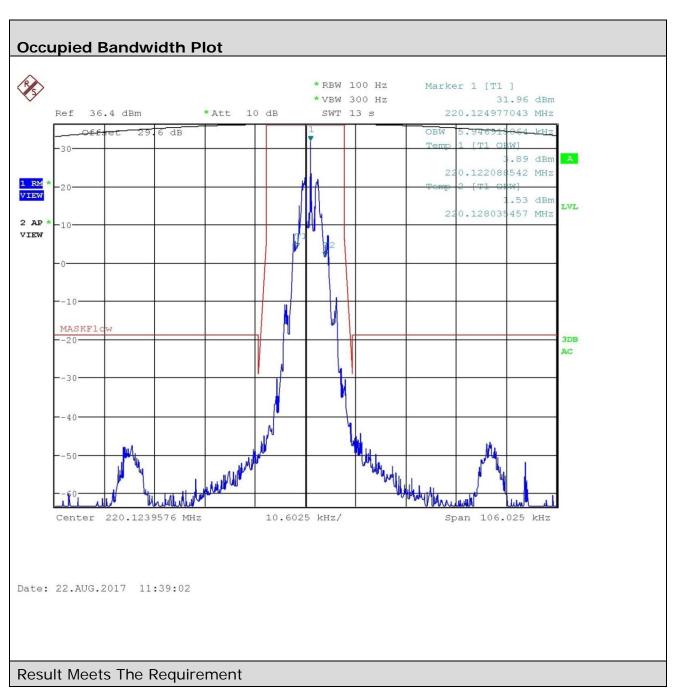
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Part 90.210(f) Emission Mask F - FFSK

Test Data: Low Power 220.100 MHz



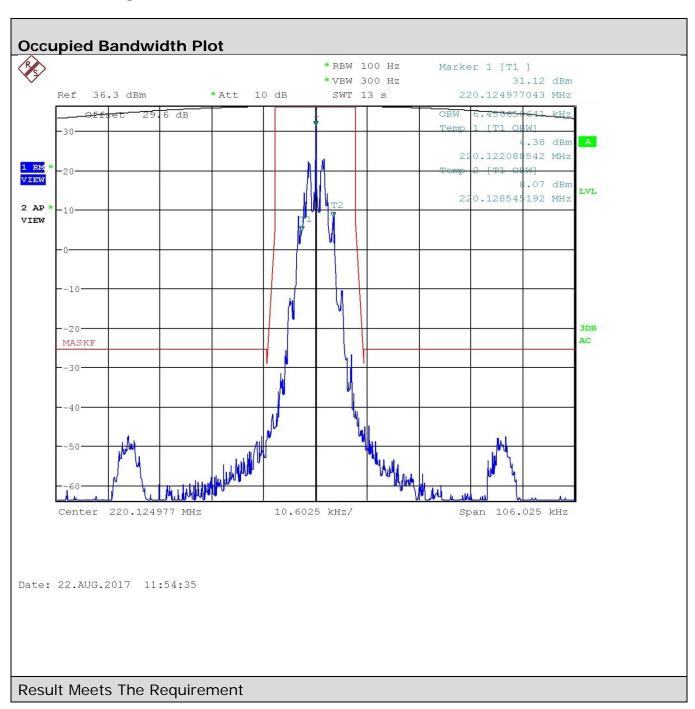
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Part 90.210(f) Emission Mask F - FFSK

Test Data: High Power 220.100 MHz



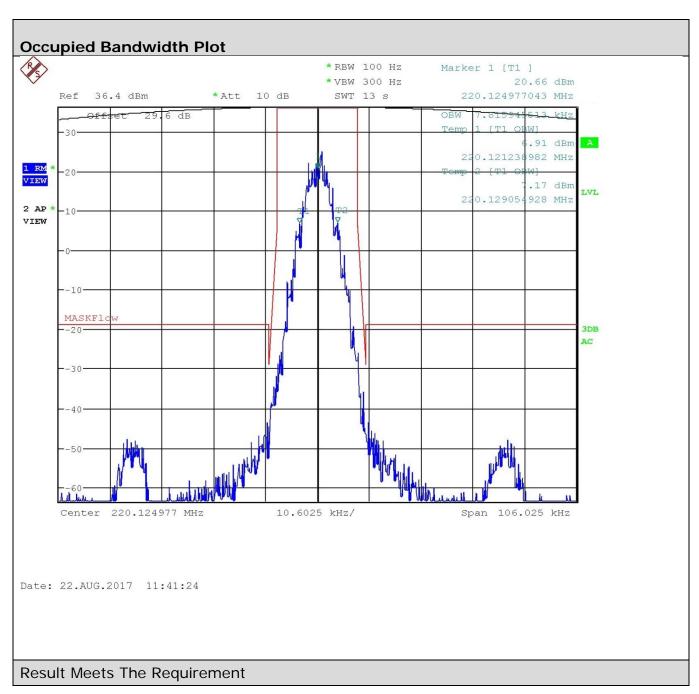
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Part 90.210(f) Emission Mask F - DMR

Test Data: Low Power 220.100 MHz



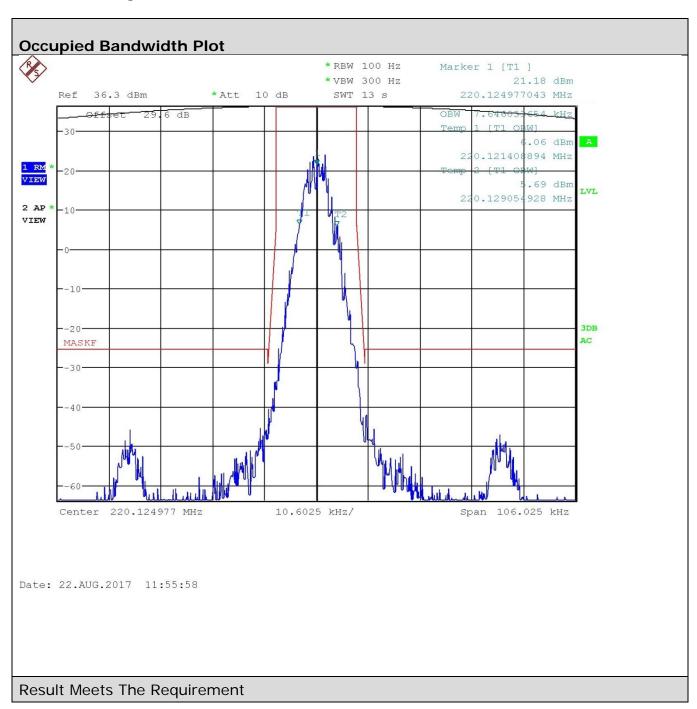
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Part 90.210(f) Emission Mask F - DMR

Test Data: High Power 220.100 MHz



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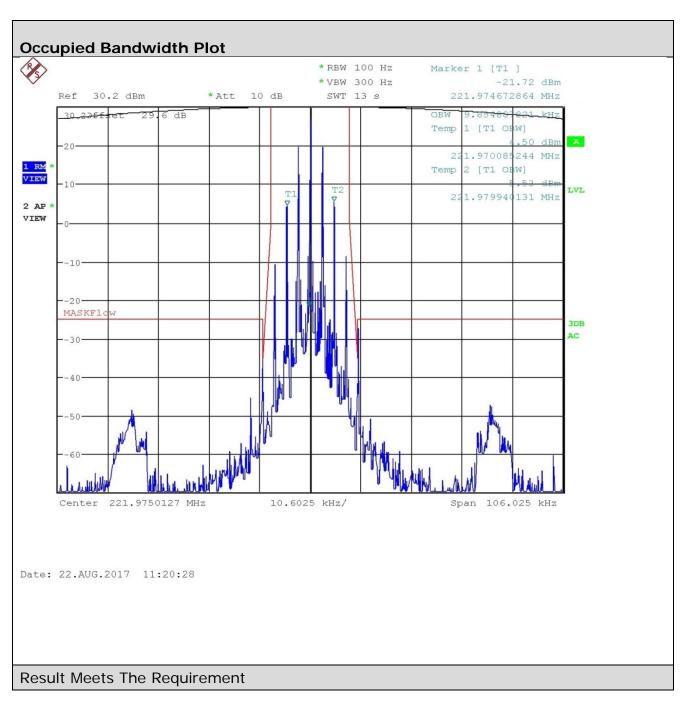
FCC ID: CASTPDCOA



OCCUPIED BANDWIDTH PLOTS: ANALOG

Part 90.210(f) Emission Mask F - ANALOG

Test Data: Low Power 221.900 MHz



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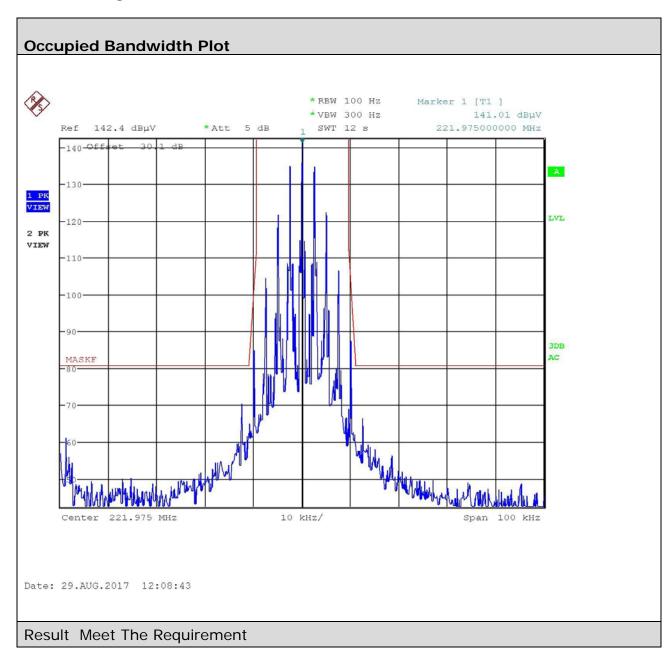
FCC ID: CASTPDCOA



OCCUPIED BANDWIDTH PLOTS: ANALOG

Part 90.210(f) Emission Mask F - ANALOG

Test Data: High Power 220.100 MHz



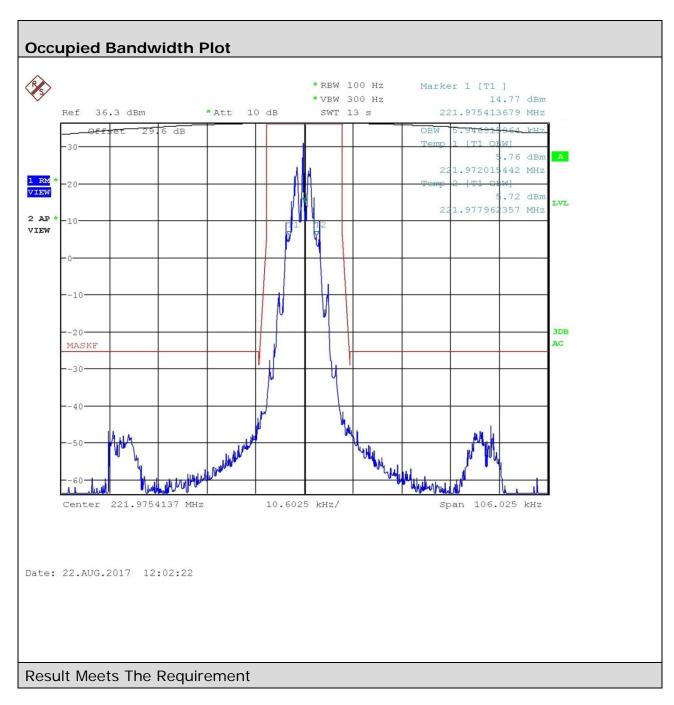
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Part 90.210(f) Emission Mask F - FFSK

Test Data: Low Power 221.900 MHz



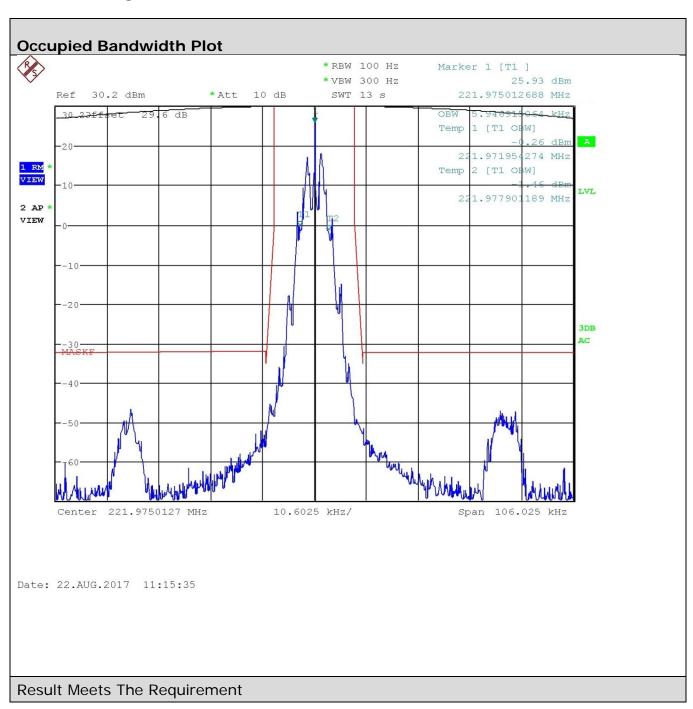
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Part 90.210(f) Emission Mask F - FFSK

Test Data: High Power 221.900 MHz



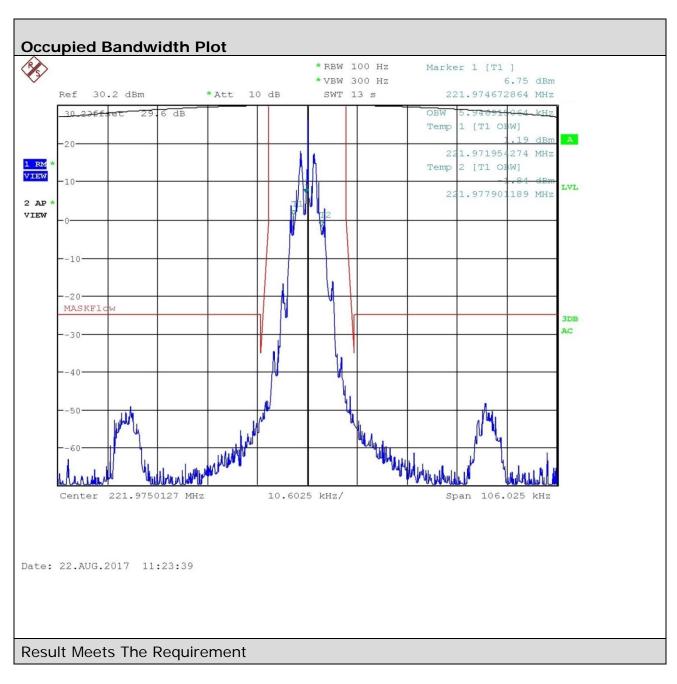
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Part 90.210(f) Emission Mask F - DMR

Test Data: Low Power 221.900 MHz



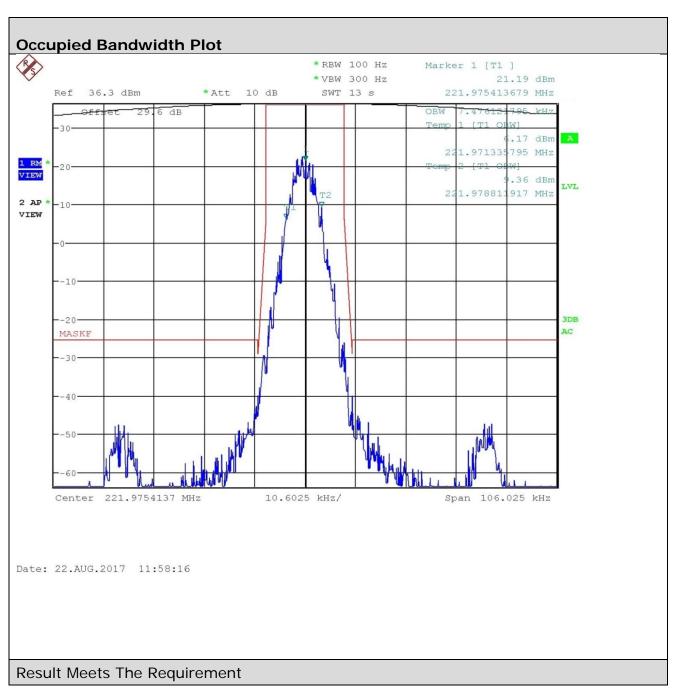
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Part 90.210(f) Emission Mask F - DMR

Test Data: High Power 221.900 MHz



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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

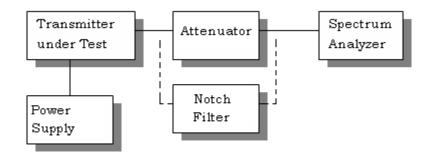
Rule Part No.: Part 2.1051(a)

Requirements:

12.5 kHz Channel Spacing = $50+10 \log (25.0) = 64.0 dBc$ (high power) 12.5 kHz Channel Spacing = $50+10 \log (5.0) = 57.0 dBc$ (low power)

Method of Measurement: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10^{th} harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz. The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from the lowest frequency generated to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-D: 2010.

Method of Measuring Conducted Spurious Emissions: ANSI/TIA-603 § 2.2.13 Unwanted Emissions: Conducted Spurious



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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: High Power 220.100 MHz

Power Output	dBm	Watts	Limit (dB)
	36.35	4.32	61.35

Frequency		dBc	Margin
220.100		0.00	0.00
440.200		113.93	88.93
660.300		124.92	99.92
880.400	*	131.46	106.46
1100.500	*	131.46	106.46
1320.600	*	131.46	106.46
1540.700	*	131.46	106.46
1760.800	*	131.46	106.46
1980.900	*	131.46	106.46
2201.000	*	131.46	106.46

^{*} Indicates only the noise floor was present

RESULTS: MEET REQUIREMENTS

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: Low Power 220.100 MHz

Power Output	dBm	Watts	Limit (dB)
	30.04	1.01	55.04

Frequency		dBc	Margin
220.100		0.00	0.00
440.200		110.45	85.45
660.300		122.57	97.57
880.400	*	125.15	100.15
1100.500	*	125.15	100.15
1320.600	*	125.15	100.15
1540.700	*	125.15	100.15
1760.800	*	125.15	100.15
1980.900	*	125.15	100.15
2201.000	*	125.15	100.15

^{*} Indicates only the noise floor was present

RESULTS: MEET REQUIREMENTS

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: High Power 221.900 MHz

Power Output	dBm	Watts	Limit (dB)
	36.65	4.62	61.65

Frequency		dBc	Margin
221.900		0.00	0.00
443.800		114.92	89.92
665.700		126.76	101.76
887.600	*	131.76	106.76
1109.500	*	131.76	106.76
1331.400	*	131.76	106.76
1553.300	*	131.76	106.76
1775.200	*	131.76	106.76
1997.100	*	131.76	106.76
2219.000	*	131.76	106.76

^{*} Indicates only the noise floor was present

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: Low Power 221.900 MHz

Power Output	dBm	Watts	Limit (dB)
	30.04	1.01	55.04

Frequency		dBc	Margin
221.900		0.00	0.00
443.800		110.08	85.08
665.700		122.61	97.61
887.600	*	125.15	100.15
1109.500	*	125.15	100.15
1331.400	*	125.15	100.15
1553.300	*	125.15	100.15
1775.200	*	125.15	100.15
1997.100	*	125.15	100.15
2219.000	*	125.15	100.15

^{*} Indicates only the noise floor was present

RESULTS: MEET REQUIREMENTS

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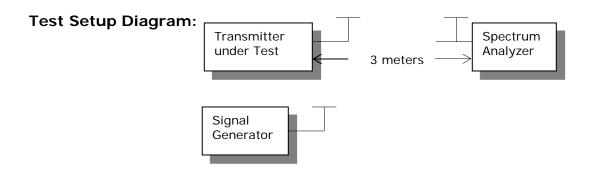


FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: Part 2.1053

Requirements: 12.5 kHz Channel Spacing = 50+10log (OP) = 64.0 dBc

METHOD OF MEASUREMENT: The test procedure used was ANSI/TIA 603-D: 2010, using a Rohde & Schwarz – EMI test receiver. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-D: 2010 using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.



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Test Data: High Power

Power Output	dBm
	36.35

Watts	Limit (dB)
4.32	61.35

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin
220.10	218.56	V	-72.28	47.28
220.10	219.50	V	-66.70	41.70
220.10	219.50	Н	-69.37	44.37
220.10	221.46	Н	-72.25	47.25
220.10	222.50	Н	-69.59	44.59
220.10	222.50	Н	-71.11	46.11
220.10	440.20	V	-50.63	25.63
220.10	440.20	Н	-52.45	27.45
220.10	660.30	V	-62.31	37.31
220.10	660.30	Н	-58.74	33.74
220.10	880.40	Н	-59.28	34.28
220.10	880.40	V	-61.26	36.26
220.10	1100.50	V	-42.42	17.42
220.10	1100.50	Н	-44.33	19.33
220.10	1320.60	Н	-42.95	17.95
220.10	1320.60	V	-42.51	17.51
220.10	1540.70	V	-43.68	18.68
220.10	1540.70	Н	-44.07	19.07
220.10	1760.80	Н	-41.22	16.22
220.10	1760.80	V	-41.03	16.03
220.10	1980.90	V	-38.32	13.32
220.10	1980.90	Н	-38.37	13.37
220.10	2201.00	Н	-38.93	13.93
220.10	2201.00	V	-39.22	14.22

RESULTS: MEET REQUIREMENTS

Applicant: TAIT LIMITED FCC ID: CASTPDCOA



Test Data: High Power

Power Output	dBm
Power Output	36.65

Watts	Limit (dB)
4.62	61.65

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	Margin
221.90	443.80	V	-55.30	30.30
221.90	665.70	Н	-59.63	34.63
221.90	665.70	V	-56.84	31.84
221.90	887.60	V	-60.21	35.21
221.90	887.60	Н	-59.74	34.74
221.90	1109.50	Н	-43.72	18.72
221.90	1109.50	V	-44.32	19.32
221.90	1331.40	V	-41.35	16.35
221.90	1331.40	Н	-41.94	16.94
221.90	1553.30	Н	-43.07	18.07
221.90	1553.30	V	-42.65	17.65
221.90	1775.20	V	-41.13	16.13
221.90	1775.20	Н	-41.58	16.58
221.90	1997.10	Н	-38.28	13.28
221.90	1997.10	V	-38.77	13.77
221.90	2219.00	V	-38.67	13.67
221.90	2219.00	Н	-37.18	12.18

RESULTS: MEET REQUIREMENTS

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FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.

Voltage Variation +, -15%

±2.5 PPM

Method of Measurements: ANSI/TIA 603-D: 2010.

Test Data:

Method of Measurements: Was in accordance with test procedures detailed in the standard list above.

Test Data: 200 - 220 MHz Band

	Frequency		
Temperature	MHz	Hz	PPM
25°C (reference)	220.12476		
-30°C	220.12472	-40	-0.182
-20°C	220.1247	-60	-0.273
-10°C	220.12471	-50	-0.227
0°C	220.12473	-30	-0.136
10°C	220.12473	-30	-0.136
20°C	220.12474	-20	-0.091
30°C	220.12477	10	0.045
40°C	220.12479	30	0.136
50°C	220.12479	30	0.136
Battery Voltage	Frequency	Hz	PPM
-15%	220.12476	0	0.000
15%	220.12477	10	0.045

RESULTS: MEET REQUIREMENTS

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STATE OF THE MEASUREMENT UC

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: "Uncertainty in EMC Measurements" and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
RF Frequency Accuracy	± 49.5 Hz	(1)
RF Conducted Power	±0.93dB	(1)
Conducted spurious emission	±1.86dB	
of transmitter valid up to		
40GHz		
Occupied Bandwidth	±2.65%	
Audio Frequency Response	±1.86dB	
Modulation limiting	±1.88%	
Radiated RF Power	±1.4dB	
Maximum frequency deviation:		
Within 300 Hz and 6kHz of		
audio freq.	±1.88%	
Within 6kHz and 25kHz of		
audio Freq.	±2.04%	
Rad Emissions Sub Meth up to		
26.5GHz	±2.14dB	
Rad Emissions Sub Meth up to		
18-40 GHz	±2.04%	
Adjacent channel power	±1.47dB	(1)
Transient Frequency Response	±1.88%	
Temperature	±1.0°C	(1)
Humidity	±5.0%	

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
DC Power	HP	6286A	1744A03842	N/A	N/A
Supply					
Antenna:	Eaton	94455-1	1096	08/01/17	08/01/19
Biconical 1096					
Antenna: Log-	Electro-Metrics	LPA-25	1122	07/26/17	07/26/19
Periodic 1122					
DC Power	HP	6286A	2411A09414	N/A	N/A
Supply					
Antenna:	Systron	DBG-520-20	Not Serialized	N/A	N/A
Standard Gain	Donner				
Horn 8.2-12.5					
GHZ	Panashield	21/4	NI/A	04/25/1/	10/01/17
CHAMBER		3M	N/A	04/25/16	12/31/17
Antenna:	ETS-Lindgren	3117	00041534	03/01/17	03/01/19
Double-Ridged Horn/ETS Horn					
2					
EMI Test	Rohde &	ESIB 40	100274	08/16/16	08/16/18
Receiver R & S	Schwarz	LOID 40	100274	00/10/10	00/10/10
ESIB 40	Scriwarz				
Screen Room					
Software:	Timco	N/A	Version	N/A	N/A
Field Strength			4.10.7.0		
Program					
Antenna:	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
Active Loop	3				
EMI Test	Rohde &	ESU 40	100320	04/01/16	04/01/18
Receiver R & S	Schwarz				
ESU 40					
Chamber					
Coaxial Cable	Semflex	LISN Cable	BMBM-1000-	01/05/17	01/05/18
- BMBM-1000-			00		
00 Silver					
Coaxial Cable	Micro-Coax	Chamber 3	KMKM-0244-	08/09/16	08/09/18
- Chamber 3		cable set	01; KMKM-		
cable set		(Primary)	0670-00;		
(Primary)			KFKF-0198-01		
Bore-sight	Sunol Sciences	TLT2	N/A	N/A	N/A
Antenna					
Positioning					
Tower					

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT

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