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FCC PART 90

TEST REPORT

APPLICANT	Funkwerk Security Communications GmbH
	John-F.-Kennedy-Straße 43-53, D-38228
	Salzgitter D-38228 GERMANY
FCC ID	2AAYTFT41C
MODEL NUMBER	FT4 S_1c ig, FT4 S Ex_1c C ig
PRODUCT DESCRIPTION	HANDHELD UHF TRANSCEIVER
DATE SAMPLE RECEIVED	6/18/2013
DATE TESTED	7/2/2013
TESTED BY	Nam Nguyen
APPROVED BY	Nam Nguyen
TIMCO REPORT NO.	1074AUT13TestReport.docx
TOTAL PAGES	18 pages
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

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 requirements.

Testing Certificate # 0955-01

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

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

Authorized Signatory Name:

Nam Nguyen
Project Manager/Testing Technician

Date: July 11, 2013

GENERAL INFORMATION

DUT Specification

DUT Description	HANDHELD UHF TRANSCEIVER
FCC ID	2AAYTFT41C
Model Number	FT4 S_1c ig, FT4 S Ex_1c C ig
Operating Frequency	450 – 470 MHz
Type of Emission	21K0D1W
Modulation	π/4-DQPSK
DUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power 12V
	☒ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☐ HANDHELD UHF
	☒ Portable
Test Conditions	The temperature was 26°C with a relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	10/28/11	10/28/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	10/28/11	10/28/13
Antenna: Biconnical	Eaton	94455-1	1096	05/10/13	05/10/15
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/09/13	05/09/15
Horn Antenna	ETS	3117	35923	12/7/11	12/7/13
Notch Filter	Microlab	HA-10N		5/17/13	5/17/15
Notch Filter	Microlab	HA-20N		5/17/13	5/17/15
Power Meter	Boonton Electronics	4531	11793	1/9/13	1/9/15
Sensor	Boonton	51072A	34647	01/19/13	01/19/15
Frequency Counter	HP	5385A	2730A03025	08/17/11	08/17/13
Signal Generator	HP	8640B	2308A21464	02/23/12	02/23/14
Hygro-Thermometer	Extech	445703	0602	06/15/13	06/15/15
Digital Multimeter	Fluke	77	35053830	09/09/11	09/09/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	10/28/11	10/28/13
Attenuator	Narda	769-30	10267	3/15/13	3/15/15
EMI Receiver	Rohde & Schwarz	ESIB40	100274	3/16/12	3/16/14
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	07/03/12	07/03/14
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/11	12/31/13
DC Power Supply	Astron	VS-50M	9001191	01/19/13	01/19/15

TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C:2004, using a 50uH LISN. Both lines were observed with the UUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: 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 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI/TIA 603-C:2004, using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum ANSI/TIA 603-C:2004, 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 ambient temperature of the UUT was 76°F with a humidity of 55%.

RF POWER OUTPUT

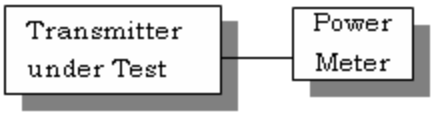
Rule Part No.: Part 2.1046(a), Part 90

Test Requirements:

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:



Test Data: The RF power of the EUT can be set at 1.0W, 0.32W, 0.10W, or 0.03W.

OUTPUT POWER: For the highest and lowest power setting.

	RF POWER (W)	
Tuned Frequency (MHz)	HI	LOW
450.25	0.83	0.03
460.00	0.81	0.03
469.75	0.82	0.03

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

FOR LOW POWER SETTING INPUT POWER: (3.8V)(0.72A) = 2.74 Watts
FOR HIGH POWER SETTING INPUT POWER: (3.8V)(0.85A) = 3.23Watts

MODULATION CHARACTERISTICS

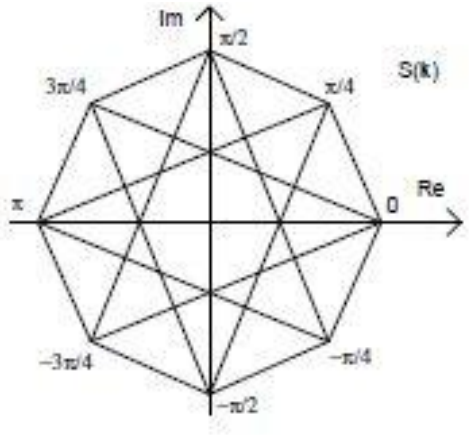
Part 2.1033(c) (4) Type of Emission: 21K0D1W
FCC Part 90.209
FCC Part 90.207

The FT4 S_1c ig and FT4 S Ex_1c C ig Digital functions comply with TETRA (Terrestrial Trunked Radio).

Format: 4-slot TDMA
Modulation: π/4-DQPSK
Modulation rate: 36 kbps
Bandwidth: 25 kHz
Data rate: 7,200bps (bit per second) per slot.
Voice: ACELP Codec (Algorythmic Code Excited Linear Prediction) 4,800bps

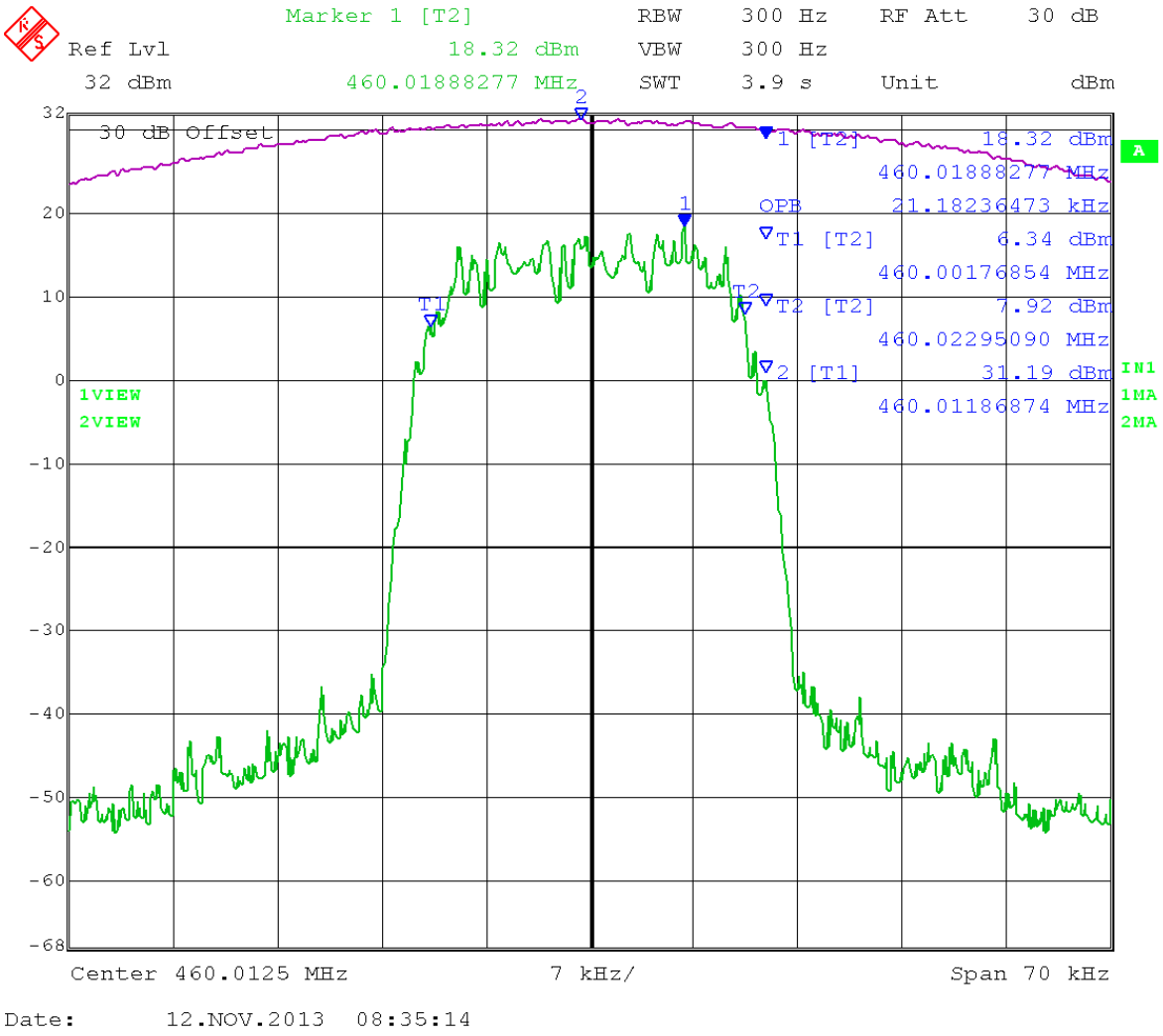
The Phase transition for π/4-DQPSK modulation is:

B(2k-1)	B(2k)	Dφ(k)
1	1	-3π/4
0	1	+3π/4
0	0	+π/4
1	0	-π/4



The modulation filter is a square root raised cosine with a roll-off factor of 0.35

OCCUPIED POWER BANDWIDTH



99% OCCUPIED BANDWIDTH = 21.18 kHz (460.01 MHz)

OCCUPIED BANDWIDTH

Part 2.1049(c) EMISSION BANDWIDTH:
Part 90.210(b) 25kHz Channel Spacing

Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43 + 10log(P)dB.

Part 90.210(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz but not more than10 kHz: At least 83 log (fd/5) dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least 29 log(fd2/11)dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least 43+10 log(Po)dB.

Part 90.210(d) Emission Mask D - 12.5 kHz channel BW equipment.
For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

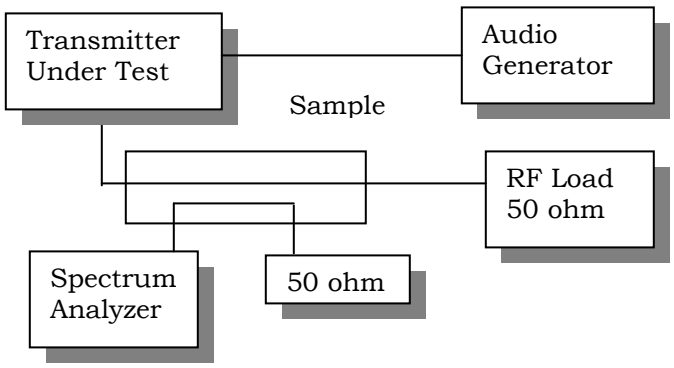
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.
For transmitters designed to operate with a 6.25 kHz bandwidth, 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 f0 to 3.0 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd – 3.0 kHz) or 55 + 10 Log(P) or 65, whichever us the lesser attenuation.
(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least 55 + 10log(P) dB or 65 dB, whichever is the lesser attenuation.

Method of Measurement: ANSI/TIA 603-C: 2004

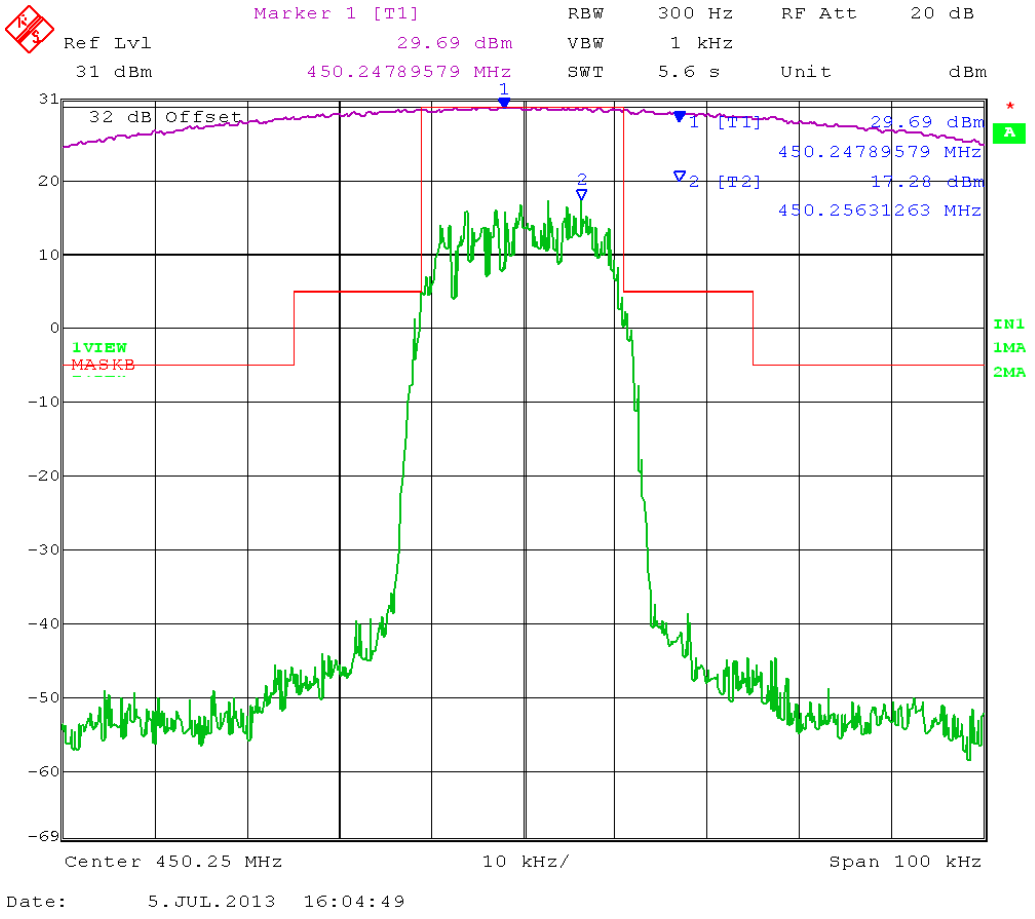
Test Setup Diagram:

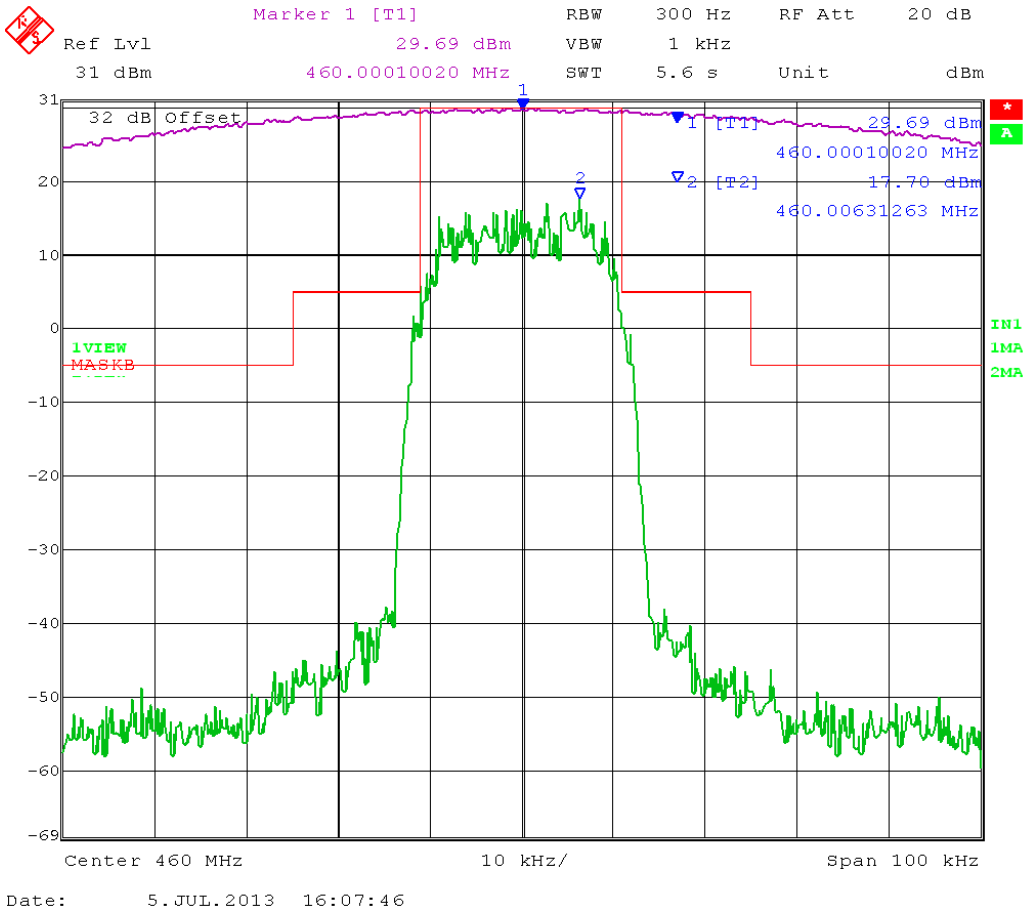


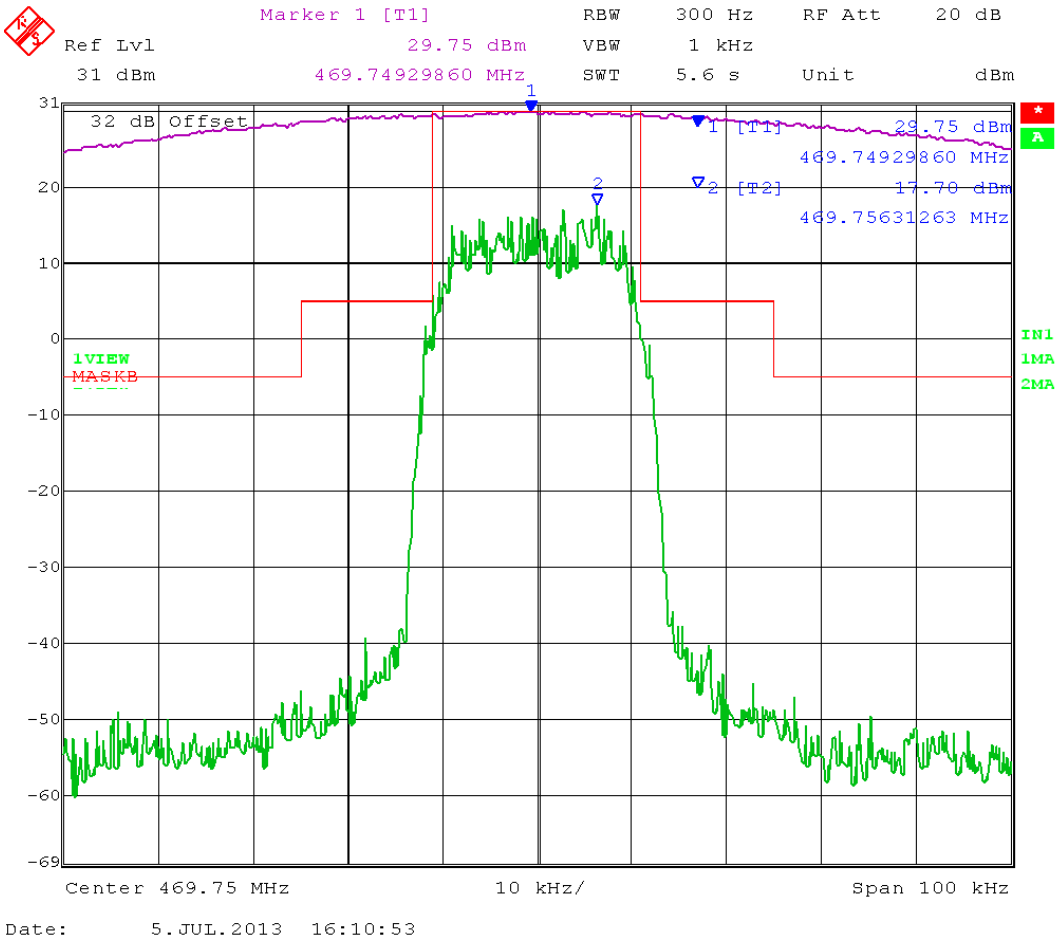
Test Data: See the plots below

OCCUPIED BANDWIDTH PLOTS

Part 90.210(b) 25kHz Channel Spacing




Marker 1 [T1]
RBW 300 Hz
RF Att 20 dB
Ref Lvl
29.69 dBm
VBW 1 kHz
31 dBm
460.00010020 MHz
SWT 5.6 s
Unit dBm
32 dB Offset
1 [T1] 29.69 dBm
460.00010020 MHz
2 [T2] 17.70 dBm
460.00631263 MHz
1VIEW
MASKB
IN1
1MA
2MA
Center 460 MHz
10 kHz/
Span 100 kHz
Date: 5.JUL.2013 16:07:46


Marker 1 [T1]
RBW 300 Hz
RF Att 20 dB
Ref Lvl
29.75 dBm
VBW 1 kHz
31 dBm
469.74929860 MHz
SWT 5.6 s
Unit dBm
32 dB Offset
1 [T1] 29.75 dBm
469.74929860 MHz
2 [T2] 17.70 dBm
469.75631263 MHz
1VIEW
MASKB
IN1
1MA
2MA
Center 469.75 MHz
10 kHz/
Span 100 kHz
Date: 5.JUL.2013 16:10:53

ADJACENT CHANNEL POWER

Part 90.221 (a) (b) For the frequency bands 450 – 470 MHz, operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

Test Data: The EUT has the RF output power is less than 1W.

Frequency testing (MHz)	Offset from center frequency (kHz)	Measurement bandwidth (kHz)	ACP Measurement Reading (dBc)		Limit ACP (dBc)
			UPPER	LOWER	
460.01	25	18	61.6	61.4	-55
	50	18	72.8	71.6	-70
	75	18	72.9	73.8	-70

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements:

25kHz Channel Spacing = 43+10log(1.00) = 43.0 dBc
25kHz Channel Spacing = 43+10log(0.03) = 28.0 dBc

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C: 2004.

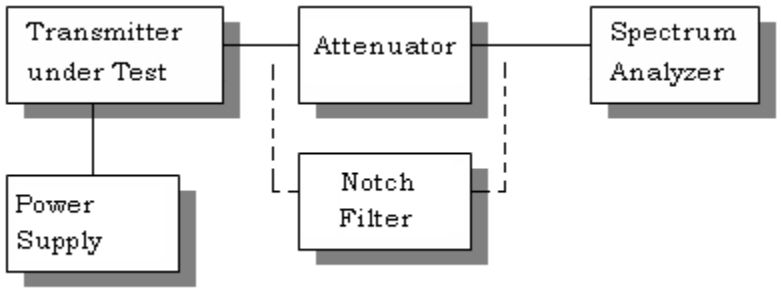
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
450.25	900.50	72.1		450.25	900.50	83.8
	1350.75	83.8			1350.75	99.2
	1801.00	94.2			1801.00	99.1
	2251.25	93.8			2251.25	NE
	2701.50	95.5			2701.50	NE
	3151.75	94.8			3151.75	NE
	3602.00	96.3			3602.00	98.6
	4052.25	95.5			4052.25	NE
	4502.50	93.2			4502.50	88

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
460.00	920.00	71.1		460.00	920.00	84.6
	1380.00	85.9			1380.00	99
	1840.00	95.3			1840.00	98.7
	2300.00	95.1			2300.00	NE
	2760.00	94.2			2760.00	NE
	3220.00	93.6			3220.00	NE
	3680.00	94.9			3680.00	100.8
	4140.00	92.3			4140.00	NE
	4600.00	92.6			4600.00	88.3

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
469.75	939.50	71.7		469.75	939.50	83.8
	1409.25	84.2			1409.25	99.4
	1879.00	92.5			1879.00	98.6
	2348.75	93.1			2348.75	NE
	2818.50	95.1			2818.50	NE
	3288.25	94			3288.25	NE
	3758.00	93.7			3758.00	102.9
	4227.75	94.1			4227.75	NE
	4697.50	94.3			4697.50	93.9

Method of Measuring Conducted Spurious Emissions



FIELD STRENGTH OF SPURIOUS EMISSIONS

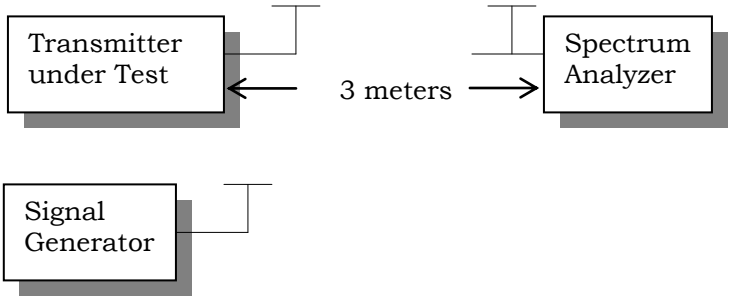
Rule Parts. No.: Part 2.1053

Requirements:

25kHz Channel Spacing = 43+10log(1.00) = 43.0 dBc
25kHz Channel Spacing = 43+10log(0.03) = 28.0 dBc

METHOD OF MEASUREMENT: 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-C: 2004 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.

Test Setup Diagram:



Test Data:

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
450.25	0	0
900.50	V	88.0
1350.75	V	84.6
1801.00	H	87.9
2251.25	V	83.7
2701.50	V	83.9
3151.75	V	84.7
3602.00	H	84.7
4052.25	H	84.6
4502.50	V	77.4

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
450.25	0	0
900.50	V	80.5
1350.75	H	73.5
1801.00	V	69.0
2251.25	H	72.7
2701.50	V	69.3
3151.75	V	69.9
3602.00	V	67.5
4052.25	V	68.8
4502.50	V	60.8

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
460.00	0	0
920.00	V	89.2
1380.00	V	85.0
1840.00	H	88.1
2300.00	V	89.7
2760.00	V	87.4
3220.00	H	85.6
3680.00	V	75.6
4140.00	V	83.3
4600.00	V	82.4

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
460.00	0	0
920.00	V	80.9
1380.00	H	76.7
1840.00	H	73.7
2300.00	V	74.0
2760.00	H	73.8
3220.00	H	69.0
3680.00	V	60.3
4140.00	H	68.2
4600.00	V	67.5

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
469.75	0	0
939.50	V	90.1
1409.25	V	86.1
1879.00	V	87.2
2348.75	H	88.7
2818.50	V	87.1
3288.25	V	84.6
3758.00	H	77.1
4227.75	H	83.6
4697.50	H	83.1

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
469.75	0	0
939.50	V	80.3
1409.25	V	75.6
1879.00	H	72.0
2348.75	V	72.3
2818.50	V	72.2
3288.25	V	69.8
3758.00	V	60.6
4227.75	H	69.2
4697.50	H	67.2

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-C: 2004.

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		**460.012488**
Temperature (°C)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-30	460.012630	0.31
-20	460.012507	0.04
-10	460.012502	0.03
0	460.012441	-0.10
+10	460.012556	0.15
+20	460.012552	0.14
+30	460.012428	-0.13
+40	460.012338	-0.33
+50	460.012312	-0.38

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery	**Frequency (MHz)**	**Frequency Stability (PPM)**
-15%	460.012481	-0.02
0	460.012488	0.00
+15%	460.012493	0.01