FCC Certification Test Report

FCC Certification Test Report for Trafcon Industries, Inc. NB31033

March 12, 2004

Prepared for:

Trafcon Industries, Inc.
81 Texaco Road
Mechanicsburg, PA 17050

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC Certification Test Report
for the
Trafcon Industries, Inc.
Traffic Wizard Alert & Information Radio System
NB31033

March 12, 2004

WLL JOB# 7871

Prepared by: 

Brian J. Dettling
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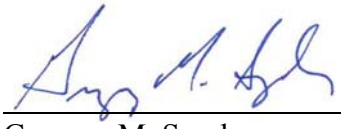
Reviewed by: 

Gregory M. Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Trafcon Industries, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Citizens Band (CB) radio under Part 95 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Trafcon Industries, Inc. Traffic Wizard Alert & Information Radio System.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Trafcon Industries, Inc. Traffic Wizard Alert & Information Radio System complies with the limits for a Citizens Band (CB) radio device under Part 95 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Trafcon Industries, Inc. Traffic Wizard Alert & Information Radio System complies with the limits for a Citizens Band (CB) radio device under Part 95 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for spurious radiated and conducted emissions were performed. All measurements were performed according to the 2001 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Trafcon Industries, Inc. 81 Texaco Road Mechanicsburg, PA 17050
Purchase Order Number:	3183
Quotation Number:	60764

1.4 Test Dates

Testing was performed from November 28, 2003 to December 24, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Client Representative	Dave Johnson

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The TRAFFIC WIZARD is a safety device which broadcasts prerecorded traffic alert and warning voice messages to the motoring public to prevent accidents and improve traffic flow. It employs the Citizens Band radio to air these messages. The messages are transmitted at regular fixed intervals of 30, 60, or 90 seconds as determined by the operator of the WIZARD. Three messages - each with a length of up to 15 seconds - may be recorded for transmission. A typical message takes 12 seconds.

A UNIDEN (brand) Citizens Band transceiver model PRO 510 XL as produced by the manufacturer is used as the transmitter for the WIZARD. The FCC ID number for this transceiver is AMW3K2-317. Please refer to the appropriate documents for this make and model of transceiver for details on the operation of this device.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Trafcon Industries, Inc.
FCC ID Number	NB31033
EUT Name:	Alert & Information Radio System
Model:	Traffic Wizard
FCC Rule Parts:	§95
Frequency Range:	26.96 MHz to 27.41 MHz
Maximum Output Power:	4W
Modulation:	AM, SSB
Necessary Bandwidth:	8 kHz
Keying:	Manual/Automatic
Type of Information:	Voice
Number of Channels:	40
Power Output Level	Fixed
Antenna Type	Connector
Frequency Tolerance:	0.005%
Emission Type(s):	A3E
Interface Cables:	None
Power Source & Voltage:	12VDC

2.2 Test Configuration

The Traffic Wizard was configured with a client-provided antenna. The antenna provided was a commercially available CB antenna.

2.3 Testing Algorithm

The Traffic Wizard was operated by keying the microphone for continuous transmission.

The transmitter was modulated with a 2500 Hz sine wave, at an input level 16 dB greater than that to produce 50% modulation at 1000 Hz. For radiated emissions, the antenna port was terminated into a 50Ω load. Worst-case emission levels are provided in the test results data.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Manufacturer	Model/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/07/04
HP	85650A	Quasi-Peak Adapter	3303A01786	7/08/04
Solar	8012-50-R-24BNC	LISN	8379493	6/20/04
ARA	LPB-2520	BiconiLog Antenna	1044	6/19/04
EMCO	3146A	Log Periodic Antenna	8912-1129	6/20/04
HP	85685A	RF Preselector	3221A01395	7/03/04
ARA	DRG-118/A	Horn Antenna	1010	1/30/04
ARA	DRG-118/A	Horn Antenna	1236	9/27/04
HP	8563A	Spectrum Analyzer	3003A00168	4/4/04
HP	8593A	Spectrum Analyzer	3009A00739	6/25/04
HP	8449B	Pre-Amplifier	3008A00729	2/11/04
HP	8672A	Signal Generator	2311A03131	3/17/04
Racal-Dana		Frequency Counter	2806	4/30/04
Kikusui	PCR200L	AC/DC Power Supply	15030820	8/6/04
TekTronics	TDS220	Oscilloscope	B025304	8/18/04
HP	8648C	Signal Generator	3347A00242	4/30/04
Agilent	8474B	Crystal Detector	2905A04196	NCR
HP	438A	Power Meter	00394	3/10/2004
HP	8482B	RF Power Head	00392	4/29/2004

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

The output from the transmitter was connected to a directional coupler and the forward power was read with a power meter.

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel (1) 26.965 MHz	3.96 Watts	4 Watts	Pass
Mid Channel (20) 27.205 MHz	3.79 Watts	4 Watts	Pass
High Channel (40) 27.405 MHz	3.67 Watts	4 Watts	Pass

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

FCC Part 95.633 states that the Authorized bandwidth of the modulated carrier shall be 8 kHz.

Three Citizen's Band Channels were tested, Channel 1 (26.96 MHz), Channel 20 (27.20 MHz), and Channel 40 (27.40 MHz). The unit was supplied with a 2500Hz audio signal that was set to a level 16dB above that needed to produce 50% modulation. The occupied bandwidth was measured as reported in Table 4 with the emissions plots shown in Figure 1, Figure 2 and Figure 3:

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel 26.96 MHz	5.80 kHz	8 kHz	Pass
Mid Channel 27.20 MHz	5.82 kHz	8 kHz	Pass
High Channel 27.40 MHz	5.80 kHz	8 kHz	Pass

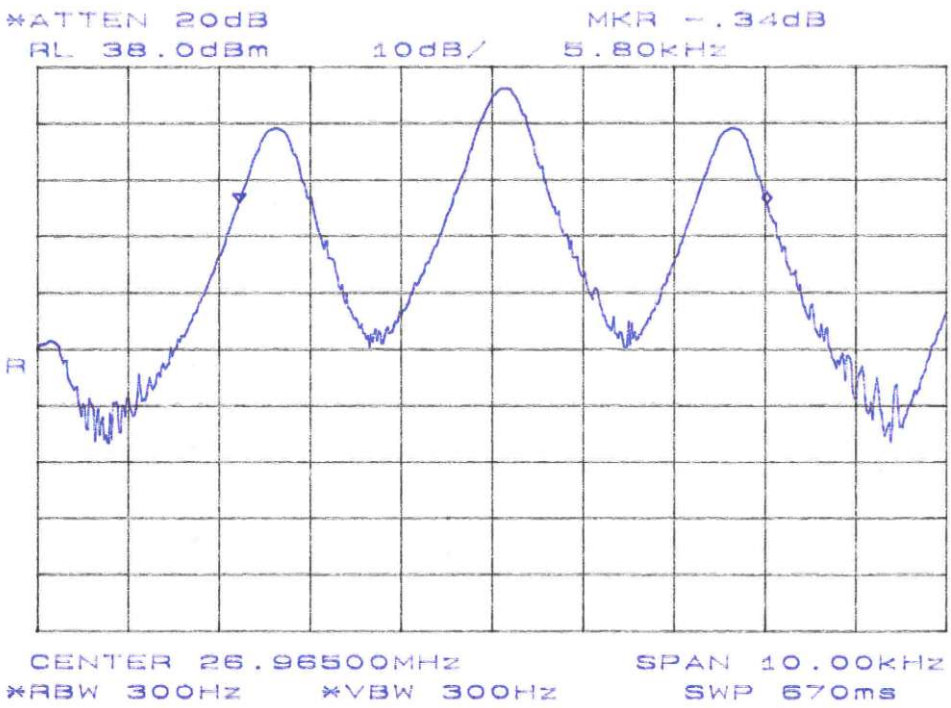

Figure 1. Occupied Bandwidth, Channel 1 (26.96 MHz)

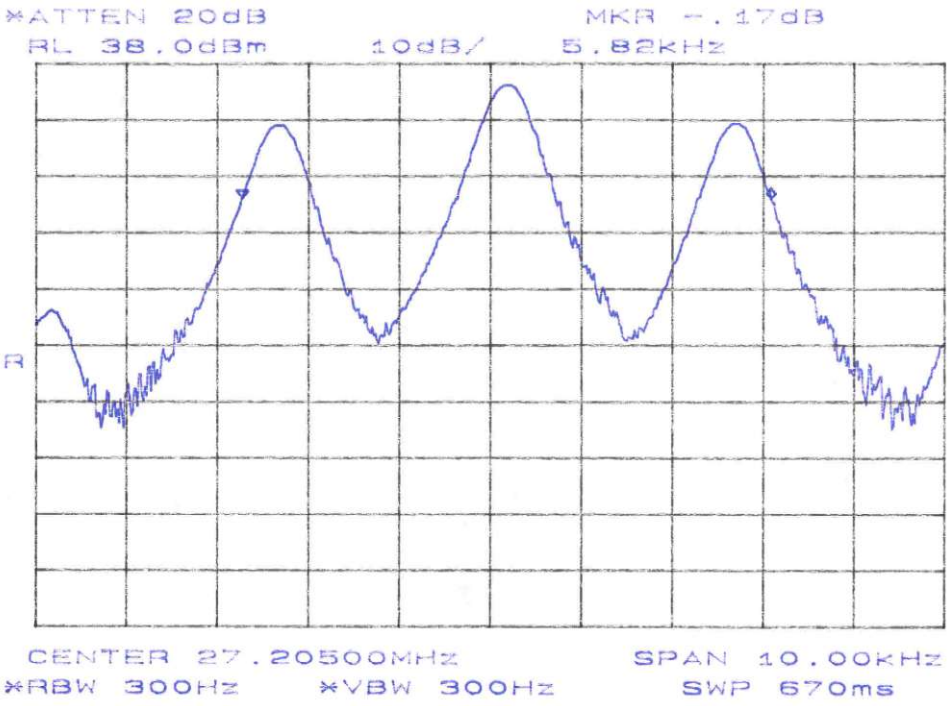

Figure 2. Occupied Bandwidth, Channel 20 (27.20 MHz)

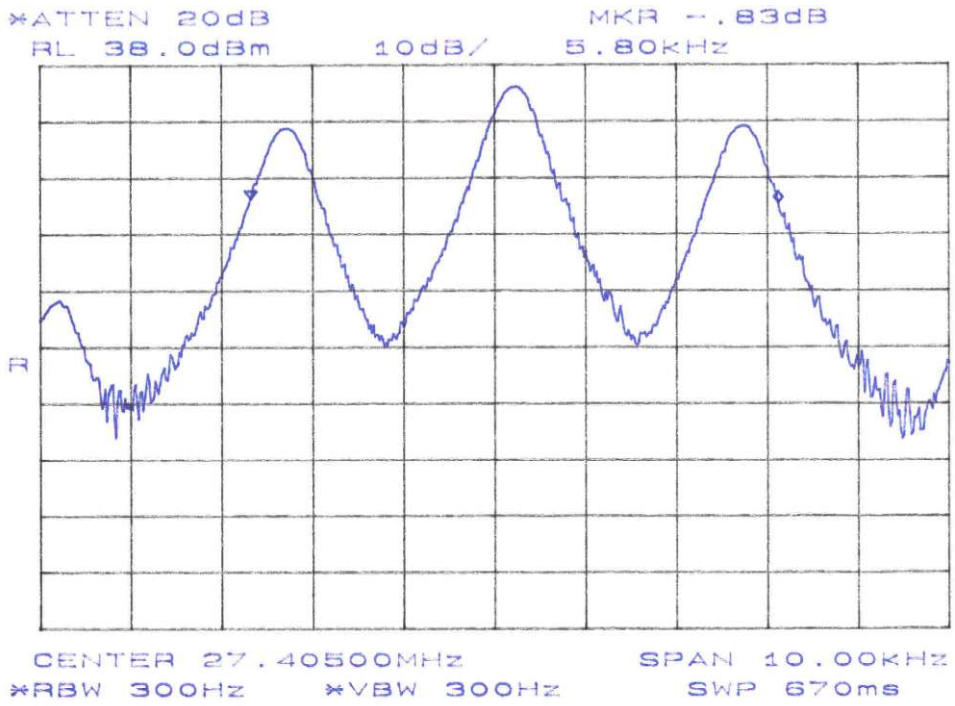

Figure 3. Occupied Bandwidth, Channel 40 (27.40 MHz)

4.3 Spurious Emissions at Antenna Terminals (FCC Part §2.1051

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits are shown in the following table.

Table 5. Conducted Spurious Emission Limits

Frequency	Fundamental	Harmonic Limit (-dBc)
Low Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc
Mid Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc
High Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc

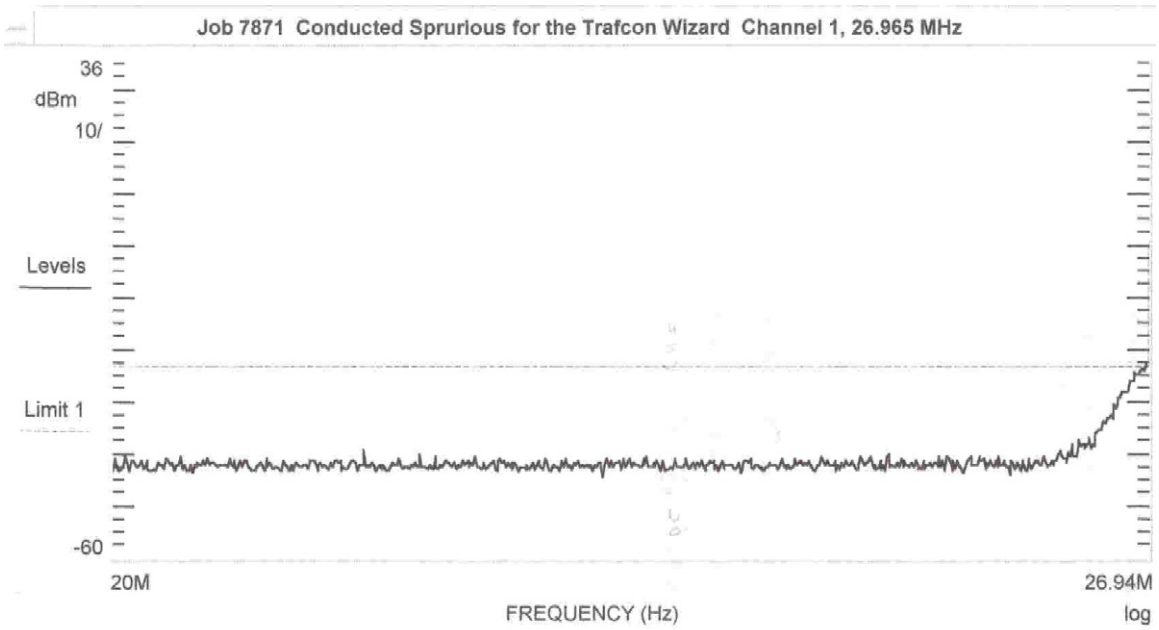

Figure 4. Conducted Spurious Emissions: CH 1 20 - 26.94MHz

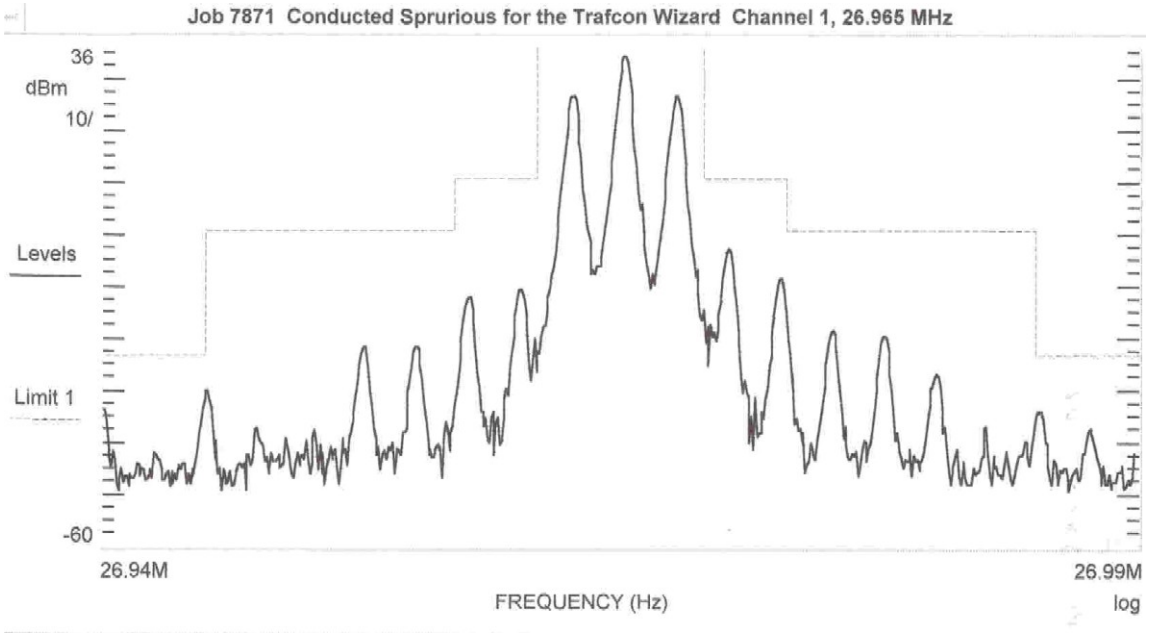

Figure 5. Conducted Spurious Emissions: CH 1 26.94 - 26.99MHz

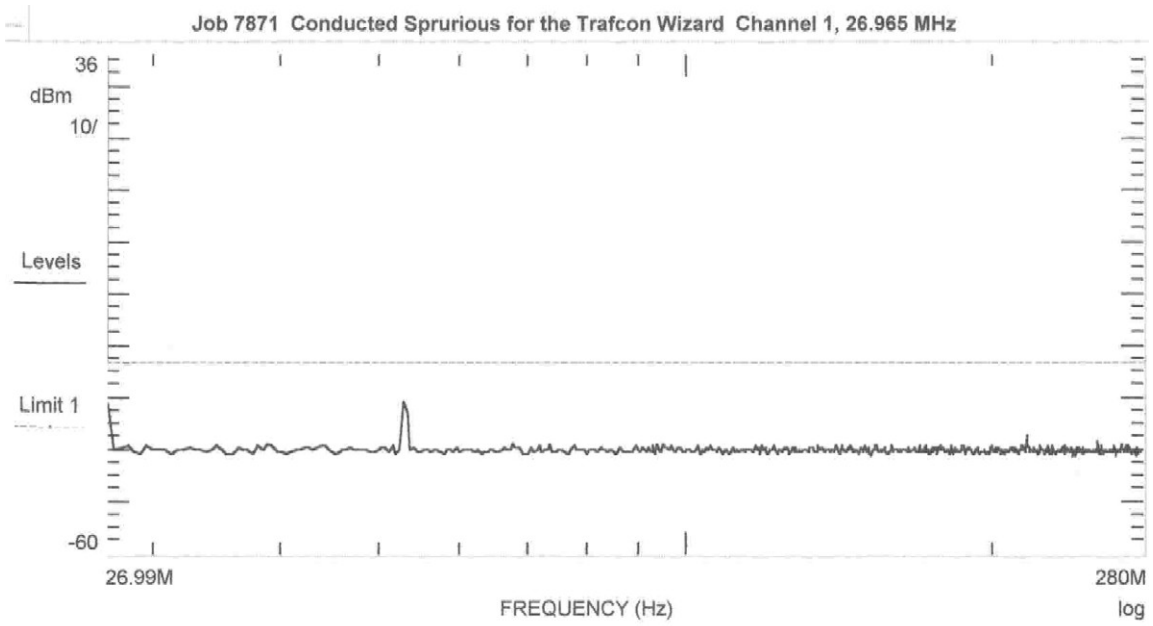

Figure 6. Conducted Spurious Emissions: CH 1 26.99 - 280MHz

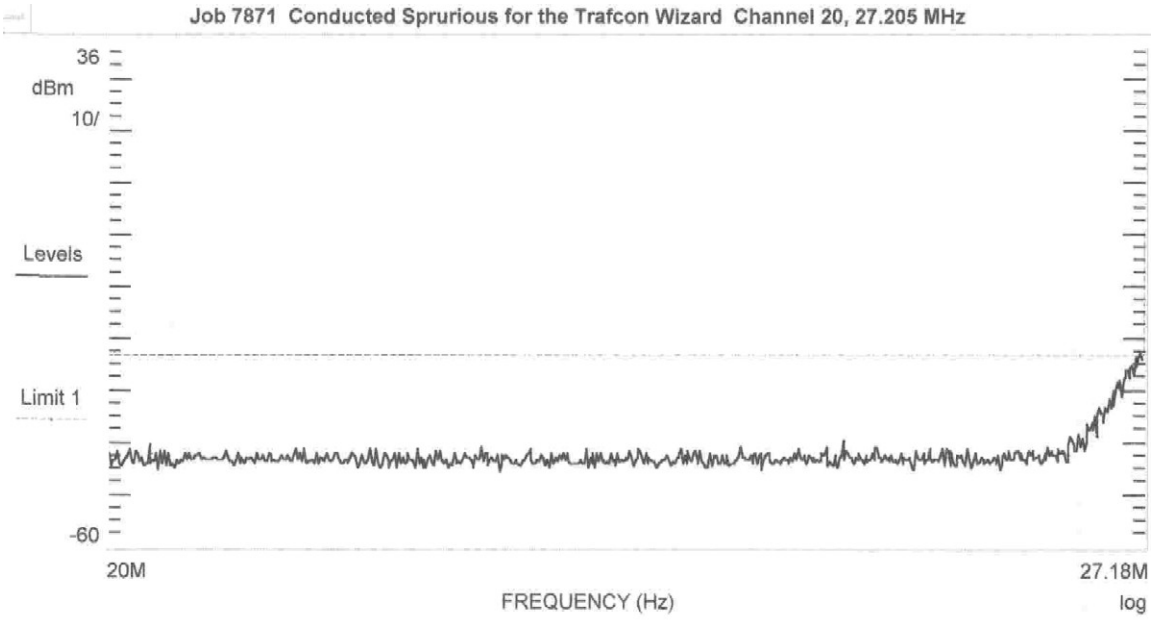

Figure 7. Conducted Spurious Emissions: CH 20, 20 - 27.18MHz

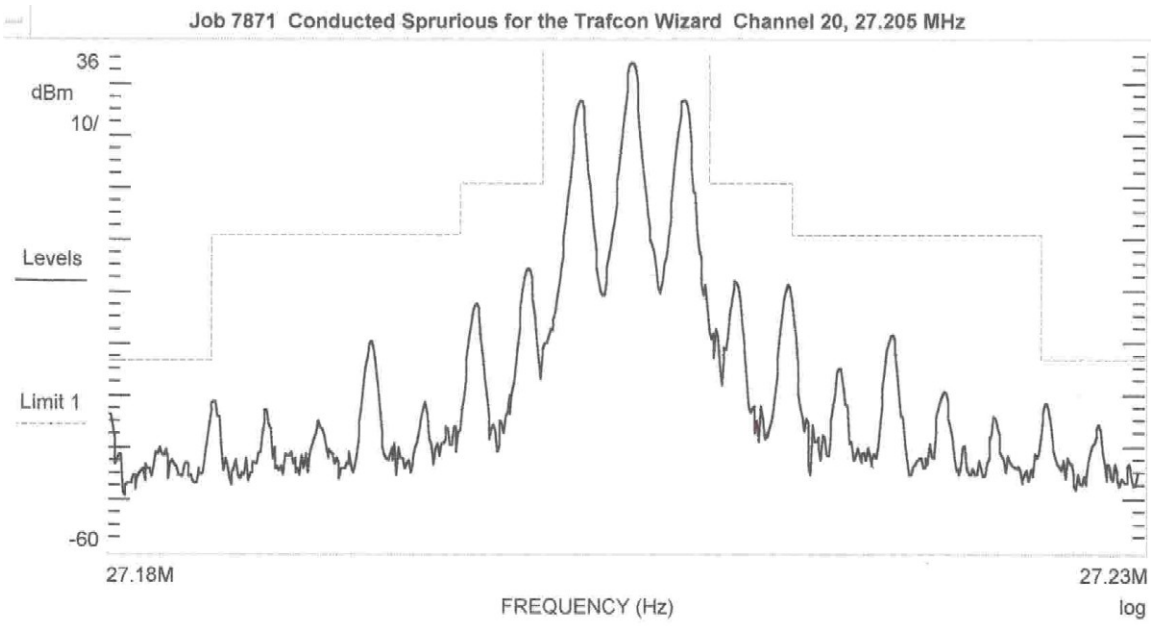

Figure 8. Conducted Spurious Emissions: CH 20, 27.18 - 27.23MHz

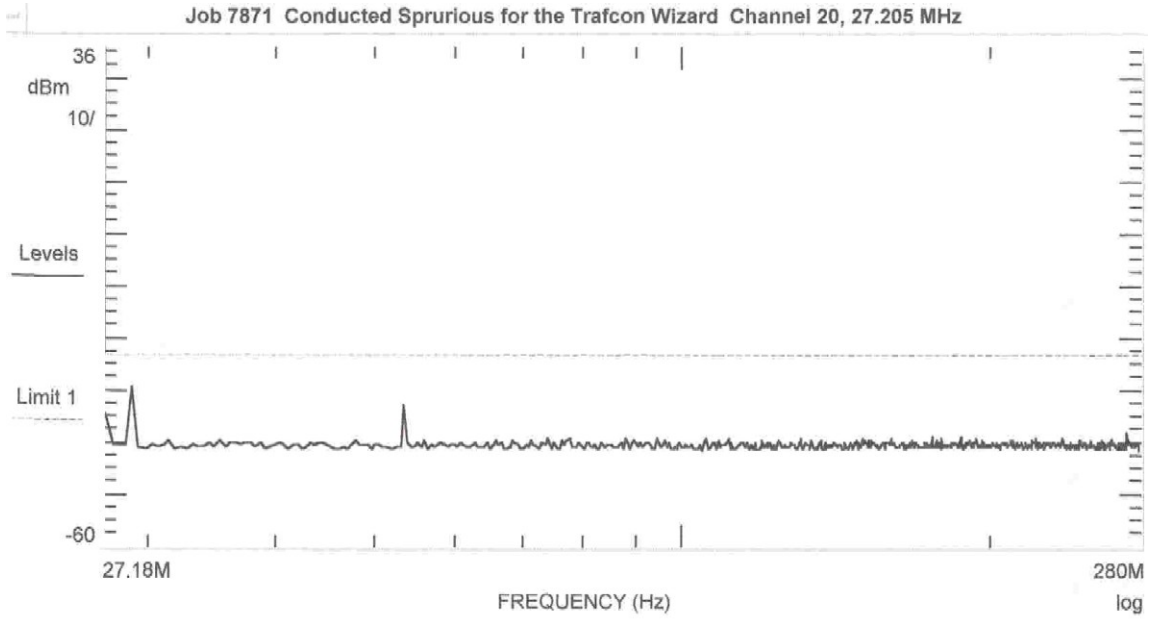

Figure 9. Conducted Spurious Emissions: CH 20, 27.18 - 280MHz

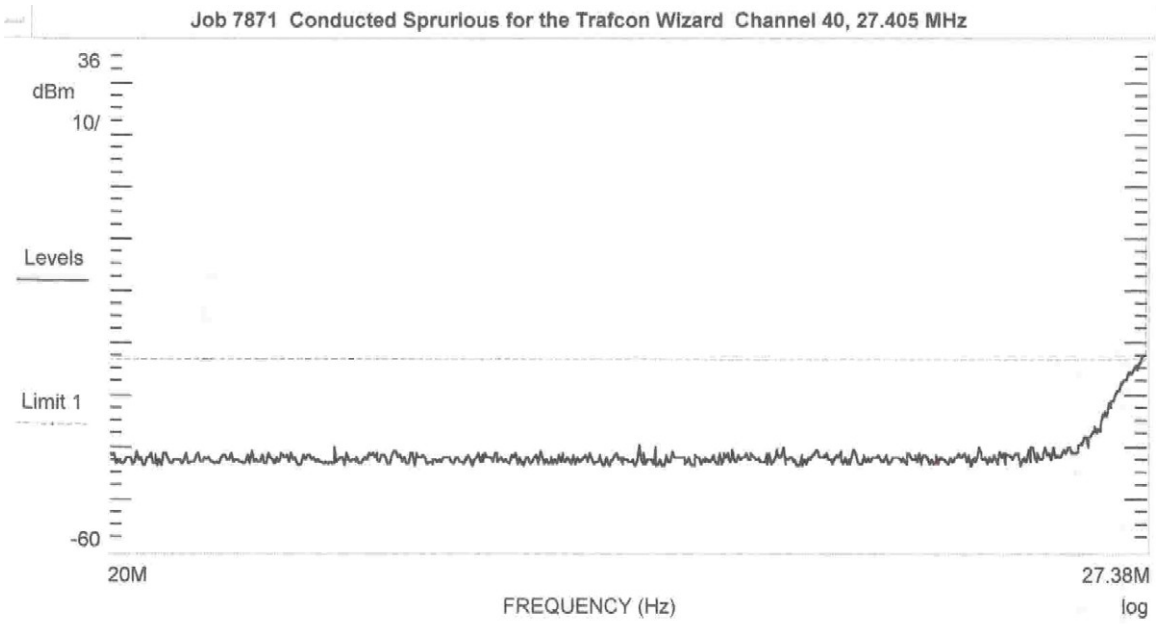

Figure 10. Conducted Spurious Emissions: CH 40, 20MHz - 27.38MHz

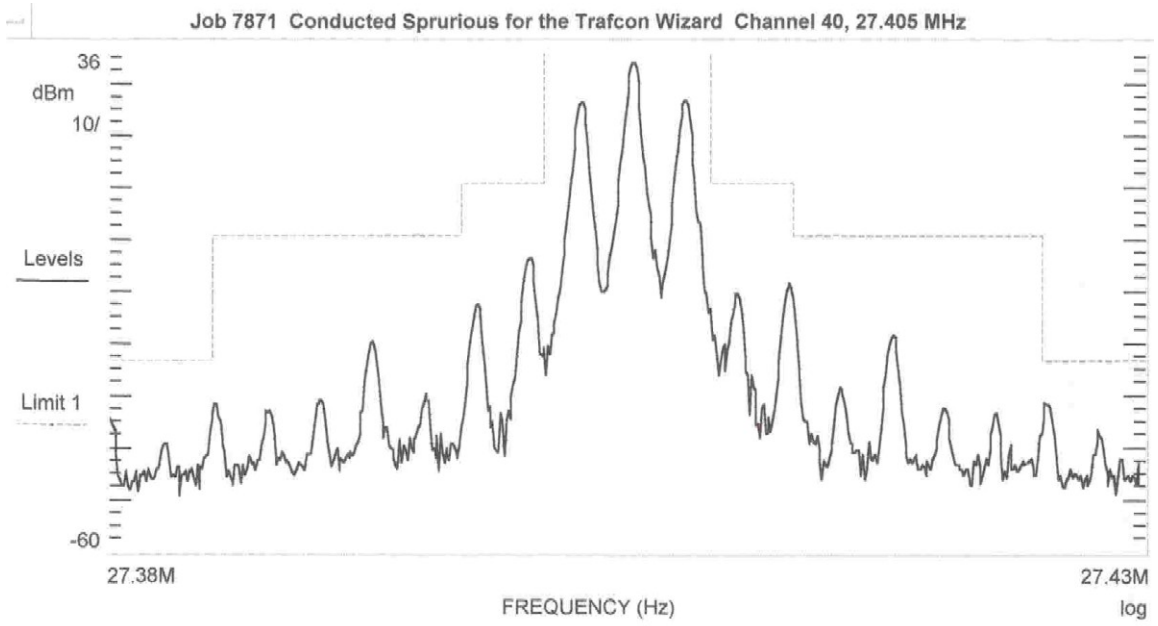

Figure 11. Conducted Spurious Emissions: CH 40, 27.38 - 27.43MHz

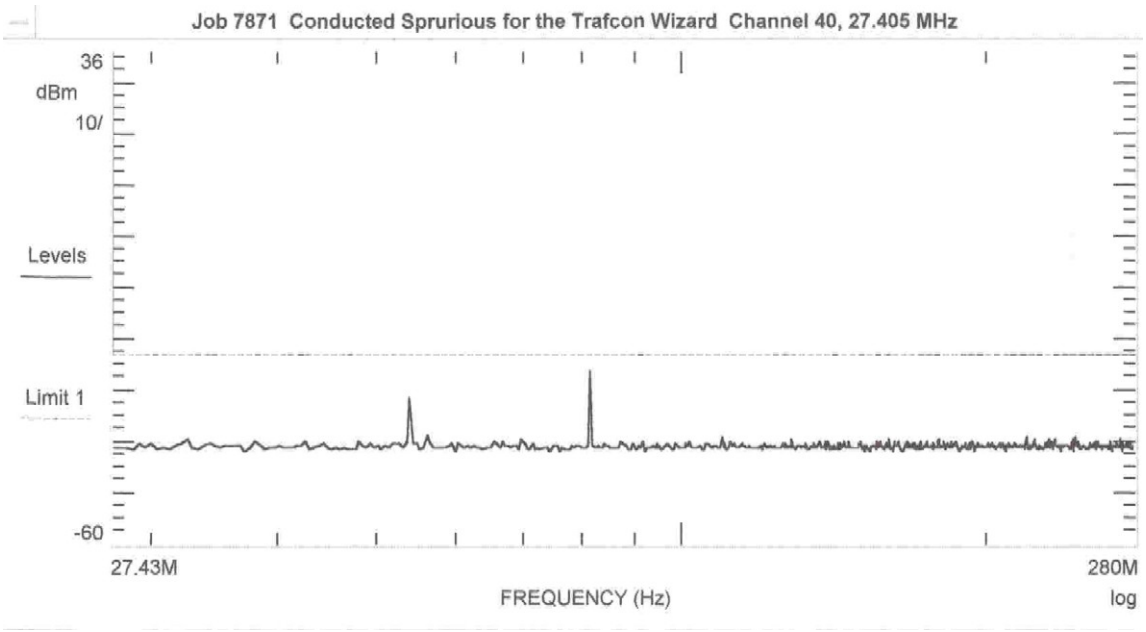

Figure 12. Conducted Spurious Emissions: CH 40, 27.43 - 280MHz

4.4 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 6. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	36 dBm	
Harmonics		-60 dBc (-24 dBm)
FCC Mask		95.635(b)

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The received levels of any detected spurious emissions are recorded in the data sheet. The EUT is then replaced with a transmit antenna and signal generator. Output power of the signal generator was increased until the same received level was indicated on the spectrum analyzer for the emission under investigation. Radiated power of the emission was then determined by adding the power supplied to the substitution antenna with the gain of the substitution antenna and comparing the result to the limit.

Table 7: Radiated Emission Test Data, Channel 1

CLIENT:	Trafcon	DATE:	12/24/03
TESTER:	James Ritter	JOB #:	7871
EUT:	Traffic Wizard CH.1		
CONFIGURATION:	Modulated 16 db above 50% @ 2500Hz		
Test Equipment/Limit:		**Test Requirements:**	
ANTENNA:	A_00382	TEST STANDARD:	Pt 95
CABLE:	CSITE1_3m	DISTANCE:	3m
LIMIT:	Pt 95	CLASS:	EIRP
TEST SITE:	2	AMPLIFIER (dB)	0.0

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBuV)	EIRP SIG Gen (dB/m)	Antenna Gain (dB)	Corr. Level (dBm)	Limit (dBm)	Margin dB
26.97	V	90.0	1.0	57.2					
53.94	V	270.0	1.0	46.8	-34.1	-6.9	-41.0	-24.0	-17.0
80.91	V	0.0	1.0	45.3	-35.4	1.5	-33.9	-24.0	-9.9
107.87	V	190.0	1.0	49.8	-33.7	-3.3	-37.0	-24.0	-13.0
134.84	V	250.0	1.5	46.8	-29.2	0.0	-29.2	-24.0	-5.2
161.80	V	90.0	1.5	45.2	-28.3	-1.0	-29.3	-24.0	-5.3
188.77	V	90.0	1.4	47.3	-28.9	-1.5	-30.4	-24.0	-6.4
215.74	V	250.0	1.0	54.8	-27.3	0.5	-26.8	-24.0	-2.8
242.71	V	65.0	1.3	52.3	-30.1	3.0	-27.1	-24.0	-3.1
269.67	V	180.0	1.2	51.2	-26.4	0.0	-26.4	-24.0	-2.4
26.97	H	350.0	1.0	33.8					
53.94	H	350.0	1.0	44.9	-34.1	-6.9	-41.0	-24.0	-17.0
80.91	H	270.0	3.0	57.5	-35.4	1.5	-33.9	-24.0	-9.9
107.87	H	90.0	3.3	51.8	-26.9	-3.3	-30.2	-24.0	-6.2
134.84	H	90.0	2.6	52.7	-28.2	0.0	-28.2	-24.0	-4.2
161.80	H	85.0	2.5	57.3	-25.6	-1.0	-26.6	-24.0	-2.6
188.77	H	0.0	2.0	55.1	-28.9	-1.5	-30.4	-24.0	-6.4
215.74	H	85.0	1.3	56.0	-27.3	0.5	-26.8	-24.0	-2.8
242.71	H	120.0	1.3	54.5	-30.1	3.0	-27.1	-24.0	-3.1
269.67	H	90.0	1.3	46.8	-32.1	0.0	-32.1	-24.0	-8.1

Table 8: Radiated Emission Test Data, Channel 20

CLIENT:	Trafcon	DATE:	12/24/03
TESTER:	James Ritter	JOB #:	7871
EUT:	Traffic Wizard CH.20		
CONFIGURATION:	Modulated 16 db above 50% @ 2500Hz		
Test Equipment/Limit:		**Test Requirements:**	
ANTENNA:	A_00382	TEST STANDARD:	Pt 95
CABLE:	CSITE1_3m	DISTANCE:	3m
LIMIT:	Pt 95	CLASS:	EIRP
TEST SITE:	2	AMPLIFIER (dB)	0.0

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBuV)	EIRP SIG Gen (dB/m)	Antenna Gain (dB)	Corr. Level (dBm)	Limit (dBm)	Margin dB
27.21	V	250.0	1.0	50.1					
54.41	V	180.0	1.3	44.7	-37.1	-6.4	-43.5	-24.0	-19.5
81.64	V	0.0	2.2	51.8	-32.5	1.5	-31.0	-24.0	-7.0
108.82	V	245.0	1.4	53.3	-23.9	-3.7	-27.6	-24.0	-3.6
136.03	V	350.0	1.4	49.1	-28.3	0.2	-28.1	-24.0	-4.1
163.23	V	90.0	1.3	54.0	-26.4	-0.9	-27.3	-24.0	-3.3
190.44	V	0.0	1.3	51.5	-25.8	-1.5	-27.3	-24.0	-3.3
217.64	V	90.0	1.5	52.5	-27.0	0.9	-26.1	-24.0	-2.1
244.85	V	45.0	1.4	55.9	-29.8	2.9	-26.9	-24.0	-2.9
272.05	V	0.0	1.5	48.2	-29.6	-0.3	-29.9	-24.0	-5.9
27.21	H	245.0	3.4	34.9					
54.41	H	350.0	3.4	46.2	-32.5	-6.4	-38.9	-24.0	-14.9
81.64	H	90.0	2.3	57.7	-28.8	1.5	-27.3	-24.0	-3.3
108.82	H	110.0	3.0	52.0	-31.0	-3.7	-34.7	-24.0	-10.7
136.03	H	90.0	3.0	53.3	-28.5	0.2	-28.3	-24.0	-4.3
163.23	H	0.0	2.5	54.5	-28.1	-0.9	-29.0	-24.0	-5.0
190.44	H	45.0	1.5	53.7	-26.7	-1.5	-28.2	-24.0	-4.2
217.64	H	270.0	1.5	54.0	-28.9	0.9	-28.0	-24.0	-4.0
244.85	H	280.0	1.5	55.6	-30.0	2.9	-27.1	-24.0	-3.1
272.05	H	90.0	3.4	47.8	-34.8	-0.3	-35.1	-24.0	-11.1

Table 9: Radiated Emission Test Data, Channel 40

CLIENT:	Trafcon	DATE:	12/24/03
TESTER:	James Ritter	JOB #:	7871
EUT:	Traffic Wizard CH.20		
CONFIGURATION:	Modulated 16 db above 50% @ 2500Hz		
Test Equipment/Limit:		**Test Requirements:**	
ANTENNA:	A_00382	TEST STANDARD:	Pt 95
CABLE:	CSITE1_3m	DISTANCE:	3m
LIMIT:	Pt 95	CLASS:	EIRP
TEST SITE:	2	AMPLIFIER (dB)	0.0

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBuV)	EIRP SIG Gen (dB/m)	Antenna Gain (dB)	Corr. Level (dBm)	Limit (dBm)	Margin dB
27.41	V	180.0	1.0	51.1					
54.81	V	180.0	1.2	45.5	-32.5	-6.5	-39.0	-24.0	-15.0
82.22	V	125.0	1.0	47.8	-35.6	1.4	-34.2	-24.0	-10.2
109.64	V	325.0	1.0	53.7	-23.0	-4.0	-27.0	-24.0	-3.0
137.03	V	325.0	1.0	50.6	-28.0	0.3	-27.7	-24.0	-3.7
164.46	V	90.0	1.4	53.0	-28.8	-0.8	-29.6	-24.0	-5.6
191.84	V	0.0	1.5	51.0	-28.2	-1.5	-29.7	-24.0	-5.7
219.27	V	90.0	1.3	55.1	-29.2	1.1	-28.1	-24.0	-4.1
246.67	V	45.0	1.4	53.0	-29.3	2.5	-26.8	-24.0	-2.8
274.05	V	180.0	1.5	46.5	-32.0	-0.6	-32.6	-24.0	-8.6
27.41	H	350.0	1.6	41.2					
54.81	H	0.0	3.5	47.2	-30.0	-6.5	-36.5	-24.0	-12.5
82.22	H	270.0	3.5	55.4	-28.0	1.4	-26.6	-24.0	-2.6
109.64	H	0.0	2.4	52.4	-26.4	-4.0	-30.4	-24.0	-6.4
137.03	H	90.0	2.0	54.4	-26.8	0.3	-26.5	-24.0	-2.5
164.46	H	90.0	2.3	55.6	-29.2	-0.8	-30.0	-24.0	-6.0
191.84	H	270.0	1.6	55.7	-25.1	-1.5	-26.6	-24.0	-2.6
219.27	H	290.0	1.9	56.2	-28.1	1.1	-27.0	-24.0	-3.0
246.67	H	200.0	1.5	54.3	-29.6	2.5	-27.1	-24.0	-3.1
274.05	H	350.0	1.3	53.1	-26.5	-0.6	-27.1	-24.0	-3.1

5 MPE Calculations

5.1 FCC § 1.1307, Radio Frequency Exposure

The EUT described in this report has been evaluated to the MPE limits for **General Population/Uncontrolled Environment**. As the manufacturer does not specify or sale any antenna with the radio the MPE calculations are based on commercially available CB antennas.

According to Section 1.1310 of the FCC rules, the uncontrolled RF exposure limit for this frequency range is $180/f^2$ (mW/cm^2). To comply with the exposure limits for this section, humans must not be too close to the transmit antenna. The following formula was used to calculate the minimum safe distance from the antenna that must be maintained during use (no time averaging was used):

$S = (PG)/(4\pi R^2)$

Where,

S = Power Density
P = Output Power at the Antenna Terminals in mW
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna in cm

For this device, the calculation is as follows: (Based on worst case power and frequency)

S = FCC Limit = $180/(26.9848)^2$ mW/ cm^2 = 0.25 mW/ cm^2
P = Output Power = 3960 mW
G* = Antenna Gain = 2.15 dBi = INVLOG(2.15/10) = 1.64

*Antenna Gain based on an ideal ½-wave dipole.

Therefore:

$$R = \sqrt{(3960mW \times 1.64\ ) \div (4 \times \pi \times 0.25)}$$

R = 45cm (Continuous operation)

From this calculation, the minimum safe distance is 45 cm for continuous operation. Based on the worst-case usage of the device the source-based time averaging would be a 40% duty cycle. This would reduce the minimum safe distance to be 18 cm.

R = 18 cm (Source-based time-averaging)

The antenna for this radio is either located on top of a construction trailer roof or on top of a road construction vehicle and will be located greater than 18cm from personnel. For this reason the minimum safe distance is met by the typical mounting of the antenna.