FCC Certification Test Report

FCC Certification Test Report for Trafcon Industries, Inc. FCC ID: PTB50074

July 15, 2003

Prepared for:

Trafcon Industries, Inc.
81 Texaco Road
Mechanicsburg, PA 17055-2623

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
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FCC Certification Test Program

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for the
Trafcon Industries, Inc.
SmartFlash
FCC ID: PTB50074

July 15, 2003

WLL JOB# 7511

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Reviewed by: Michael Violette
President

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 Periodic Intentional Radiator under Part 15.249 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. SmartFlash Wireless Remote and Wireless Link.

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. SmartFlash Wireless Remote and Wireless Link comply with the limits for a Periodic Intentional Radiator device under Part 15.249 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Trafcon Industries, Inc. SmartFlash Wireless Remote and Wireless Link comply with the limits for a Periodic Intentional Radiator device under Part 15.249 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 1992 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 17055-2623
Purchase Order Number:	2579
Quotation Number:	60747

1.4 Test Dates

Testing was performed from March 31, 2003 to May 9, 2003.

1.5 Test and Support Personnel

Washington Laboratories, LTD Ken Gemmell

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 Trafcon Industries, Inc. SmartFlash is a remote control system for an electronic roadside programmable warning sign. The wireless SmartFlash system consists of a link and a remote. The remote controller provides commands to the link device that sends instructions to the sign controller to control the display on the warning sign.

The remote has status, display and control functions (ON/OFF, MODE SELECT, DIMMING, etc.) that are sent via RF to the link device, which connects into the sign electronics.

Both the Wireless Link and the Wireless Remote contain the same RF Transceiver. The RF transceiver used in both the Wireless Link and the Wireless Remote is the Nordic nRF903 single chip RF Transceiver.

Table 1. Device Summary: Wireless Link

ITEM	DESCRIPTION
Manufacturer:	Trafcon Industries, Inc.
FCC ID Number	PTB50074
EUT Name:	SmartFlash
Model Name:	Wireless Link
FCC Rule Parts:	§15.249
Frequency Range:	914-916MHz
Maximum Output Power:	N/A W
Modulation:	Pulsed
20 dB Bandwidth:	0.850 MHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Connector
Frequency Tolerance:	N/A ppm %
Emission Type(s):	Pulsed
Interface Cables:	None
Power Source & Voltage:	12Vdc

Table 2. Device Summary: Wireless Remote

ITEM	DESCRIPTION
Manufacturer:	Trafcon Industries, Inc.
FCC ID Number	PTB50074
EUT Name:	SmartFlash
Model Name:	Wireless Remote
FCC Rule Parts:	§15.249
Frequency Range:	914-916MHz
Maximum Output Power:	N/A W
Modulation:	Pulsed
20 dB Bandwidth:	1.256 MHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Connector
Frequency Tolerance:	N/A ppm %
Emission Type(s):	Pulsed
Interface Cables:	None
Power Source & Voltage:	12Vdc

2.2 Test Configuration

Both the SmartFlash Wireless Link and Wireless Remote were tested with the provided non-shielded I/O cable and were connected to a 12Vdc power source.

2.3 Testing Algorithm

The SmartFlash system was operated as follows:

Link: The EUT was powered up by a 12V power supply. It was configured to automatically transmit

Remote: The EUT was powered up by a 12V power supply. The ON button was selected to power up the unit, which transmitted continuously.

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 = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Site 1 List:

Equipment	Serial Number	Date Calibrated	Calibration Due
Sunol Science JB1 Biconilog Antenna	A090501	10/03/02	10/03/03
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 1)	2928A04750	7/02/02	7/02/03
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 1)	3303A01786	7/05/02	7/05/03
Hewlett-Packard RF Preselector: HP 85685A (Site 1)	3146A01296	7/02/02	7/02/03
Solar Electronics LISN 8012-50-R-24-BNC	8379493	6/20/02	6/20/03

4 Test Results

4.1 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for pulsed licensed and unlicensed devices.

On time = $N_1L_1 + N_2L_2 + \ldots + N_{N-1}L_{N-1} + N_NL_N$, where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.

- For Licensed Transmitters basic formula can be stated as 20log[Duty Cycle]
- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements compared to a 100 millisecond period
- i.e. duty cycle = on time/100 milliseconds or period, whichever is less
- Restating the basic formula:
    - Duty cycle = $(N_1L_1 + N_2L_2 + \ldots + N_{N-1}L_{N-1} + N_NL_N)/100$ or T, whichever is less

Where T is the period of the pulse train.

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Calculations of the duty cycle correction factor were obtained from time data provided by the plots.

4.1.1 Duty Cycle Calculation: Link

The calculation of the duty cycle involves measuring the maximum “ON” time per 100ms.

Figure 1 and Figure 2 shows the ON time for a Link data pulse.

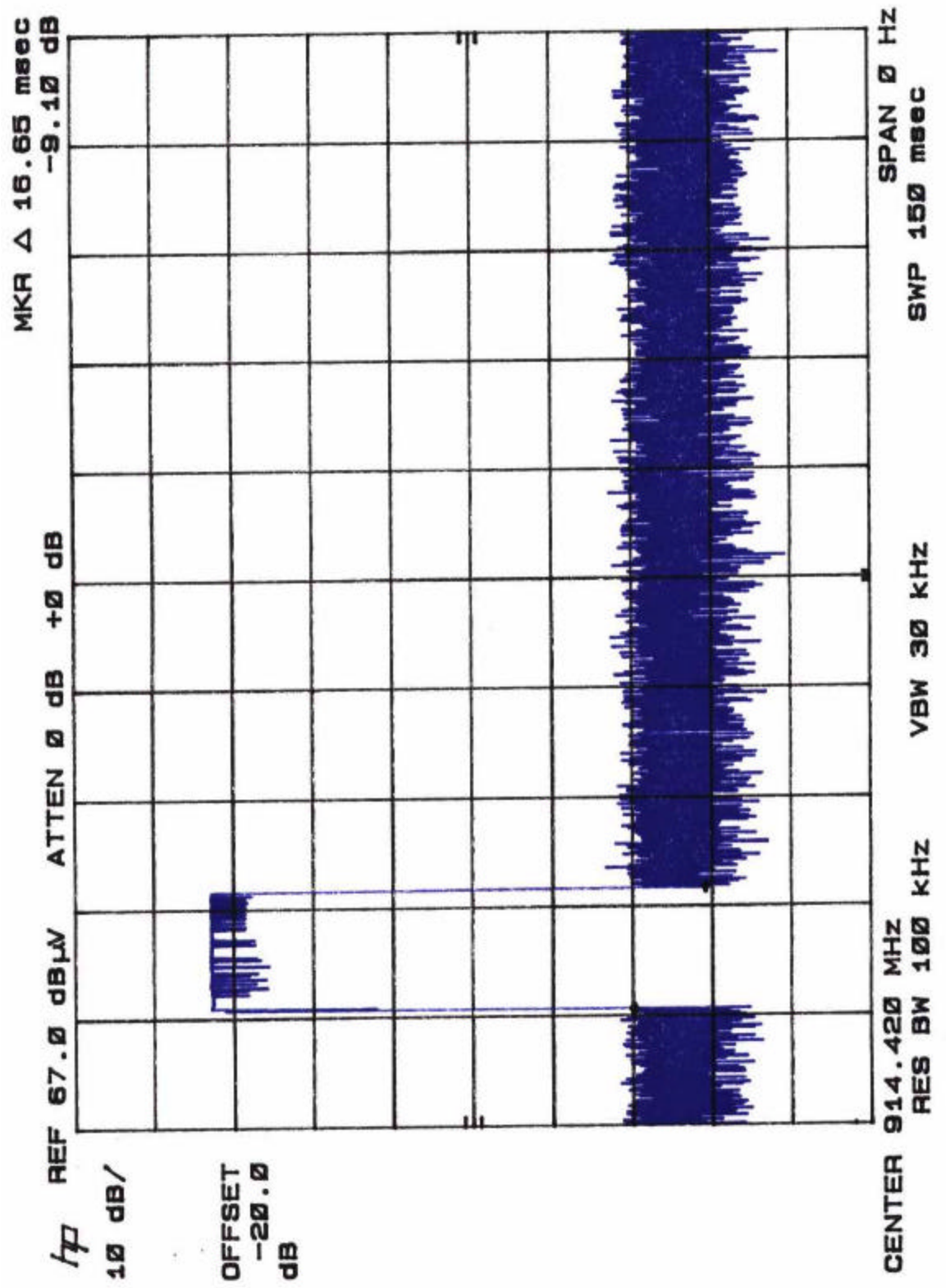

Figure 1. Duty Cycle Plots Full Period: Link

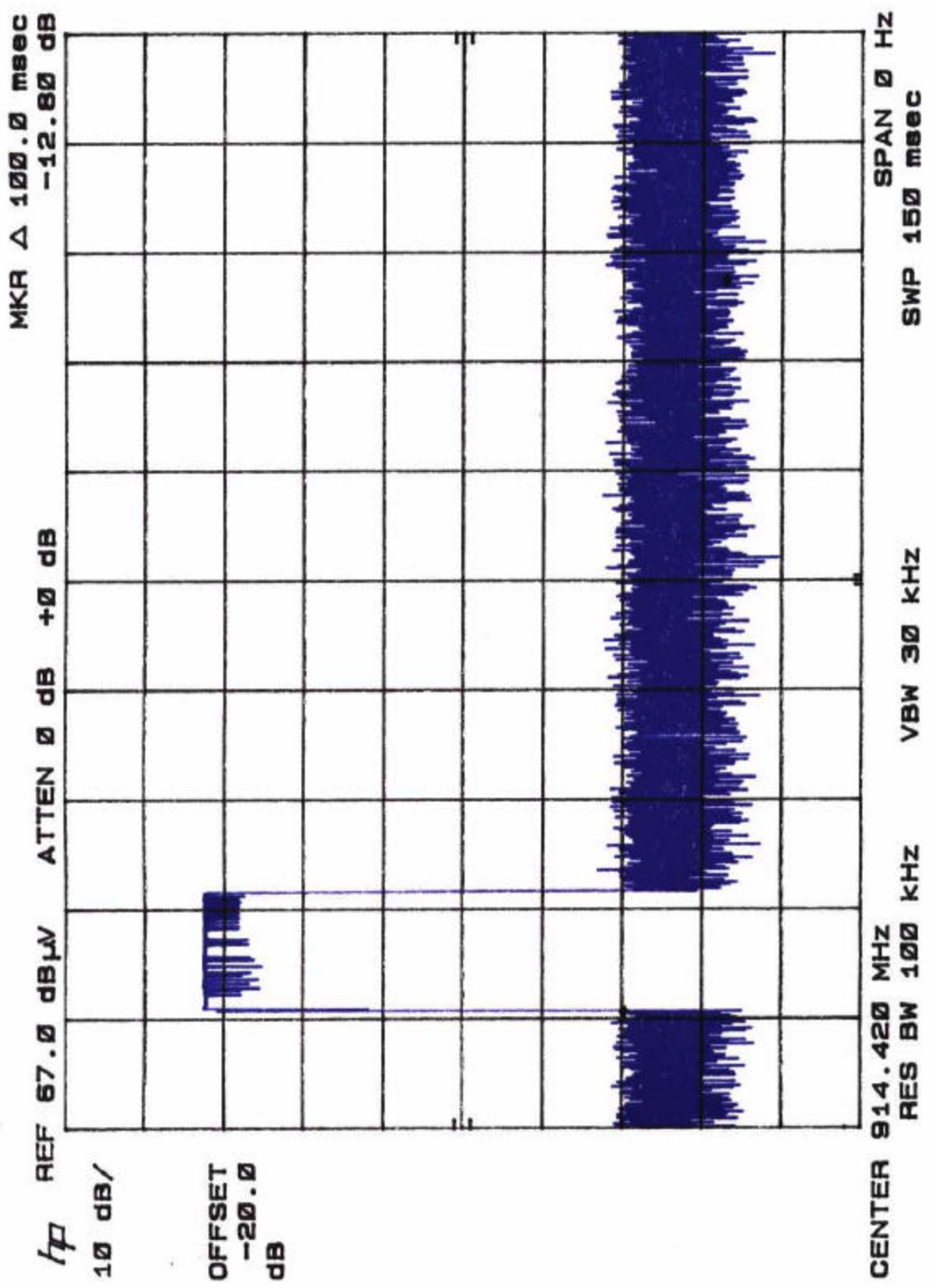

Figure 2. Duty Cycle Plots Full Period: Link

The data are summarized in the following table.

Table 4. Duty Cycle Correction

CLIENT: Trafcon DATE: 5/8/03

TESTER: Ken Gemmell JOB #: 7511

DEVICE: Link

EUT:	SmartFlash Wireless Link					
	Pulse 1	Pulse 2	Pulse 3	Pulse 4	Pulse 5	Pulse 6
Number	1	0	0	0	0	0
Pulse Width (microseconds)	16650		0	0	0	0
Total Time in (microseconds)	16650	0	0	0	0	0
Total Time in (ms)	16.65	0	0	0	0	0
Total time for both types Pulses			16.65			
Worst Case Percent of 100 ms			16.65%			
Duty Cycle Correction Factor			-15.6	dB		

4.1.2 Duty Cycle Calculation: Remote

The calculation of the duty cycle involves measuring the maximum “ON” time per 100ms.

Figure 3 and Figure 4 shows the ON time for a Remote data pulse.

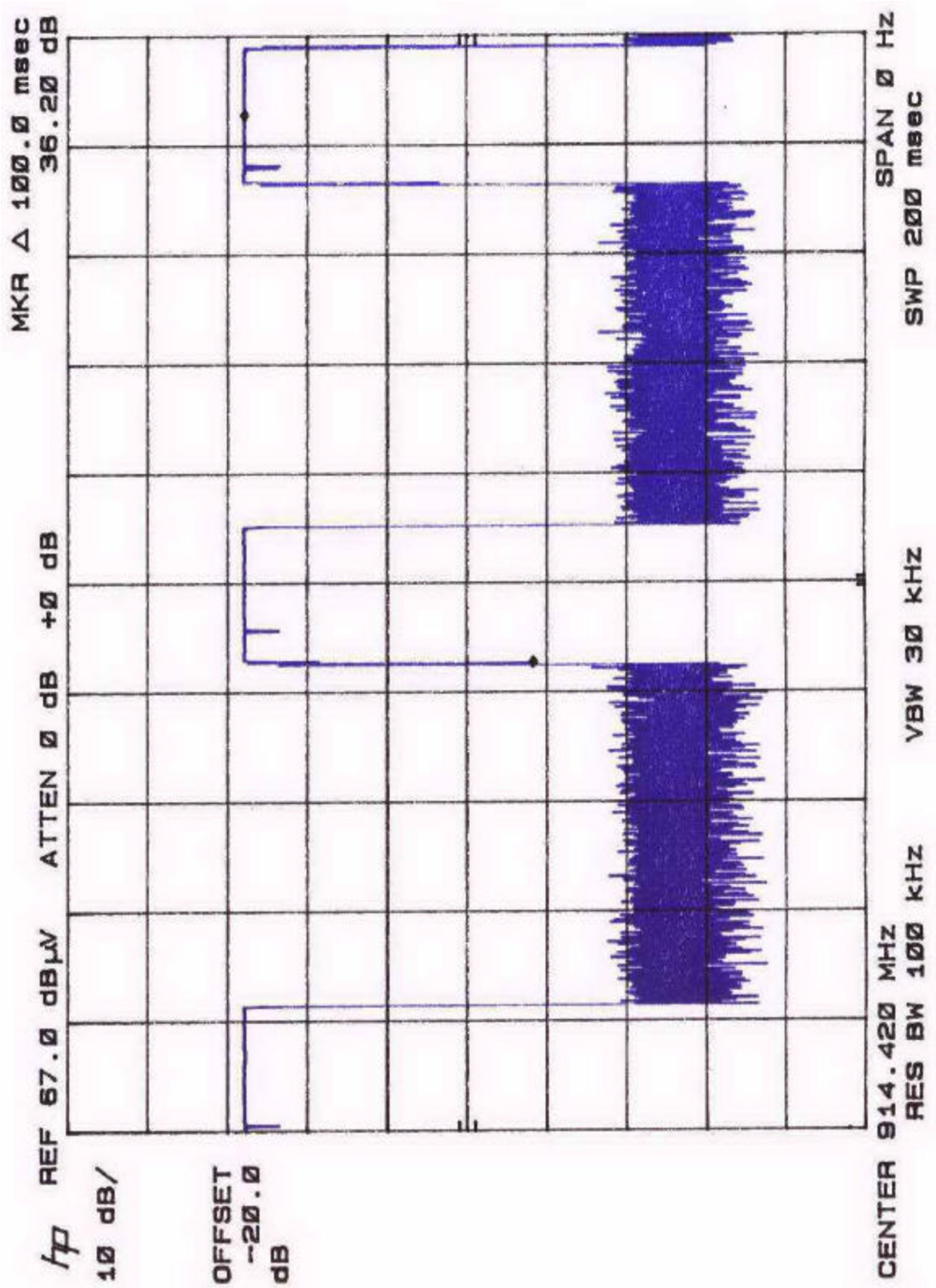

Figure 3. Duty Cycle Plots Full Period: Remote

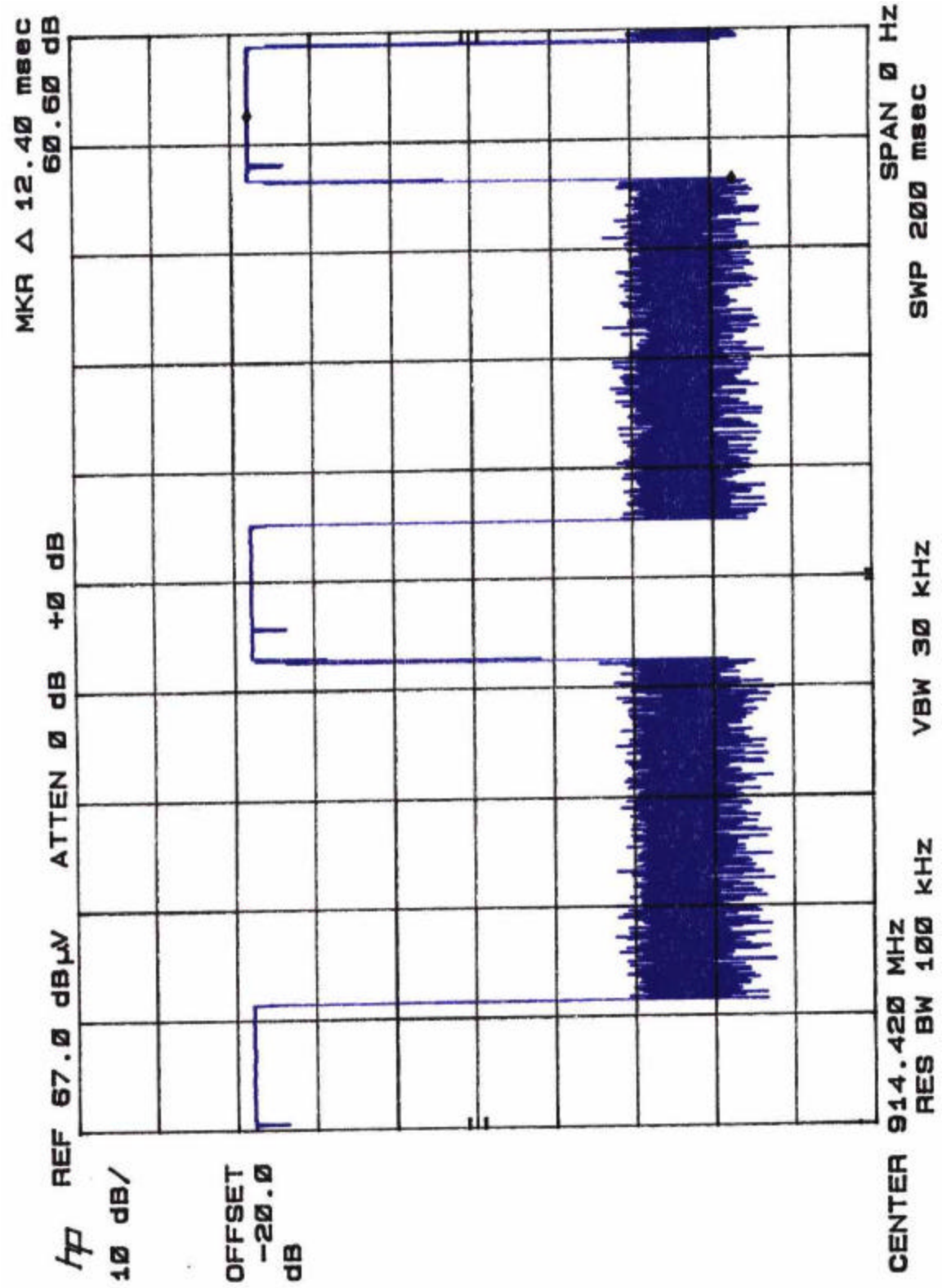

Figure 4. Duty Cycle Plots Full Period: Remote

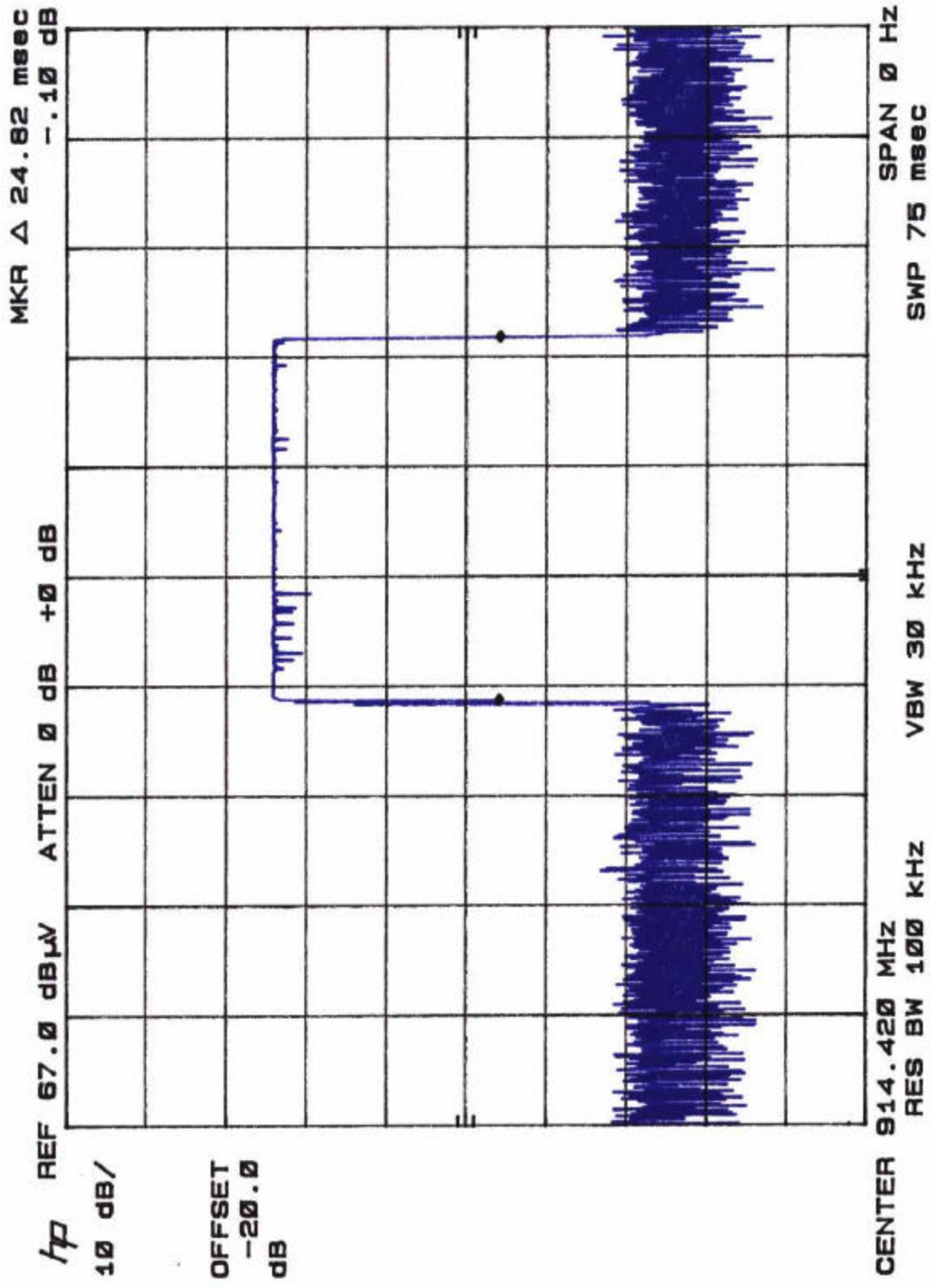

Figure 5. Duty Cycle Plots Full Period: Remote

The data are summarized in the following table.

Table 5. Duty Cycle Correction

CLIENT: Trafcon DATE: 5/8/03
TESTER: Ken Gemmell JOB #: 7511
DEVICE: Remote

	Pulse 1	Pulse 2	Pulse 3	Pulse 4	Pulse 5	Pulse 6
Number	1	1	0	0	0	0
Pulse Width (microseconds)	24820	12400	0	0	0	0
Total Time in (microseconds)	24820	12400	0	0	0	0
Total Time in (ms)	24.82	12.4	0	0	0	0
Total time for both types Pulses			37.22			
Worst Case Percent of 100 ms			37.22%			
Duty Cycle Correction Factor			-8.6	dB		

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by measuring the radiated output from the EUT. At full modulation, the occupied bandwidth was measured as shown:

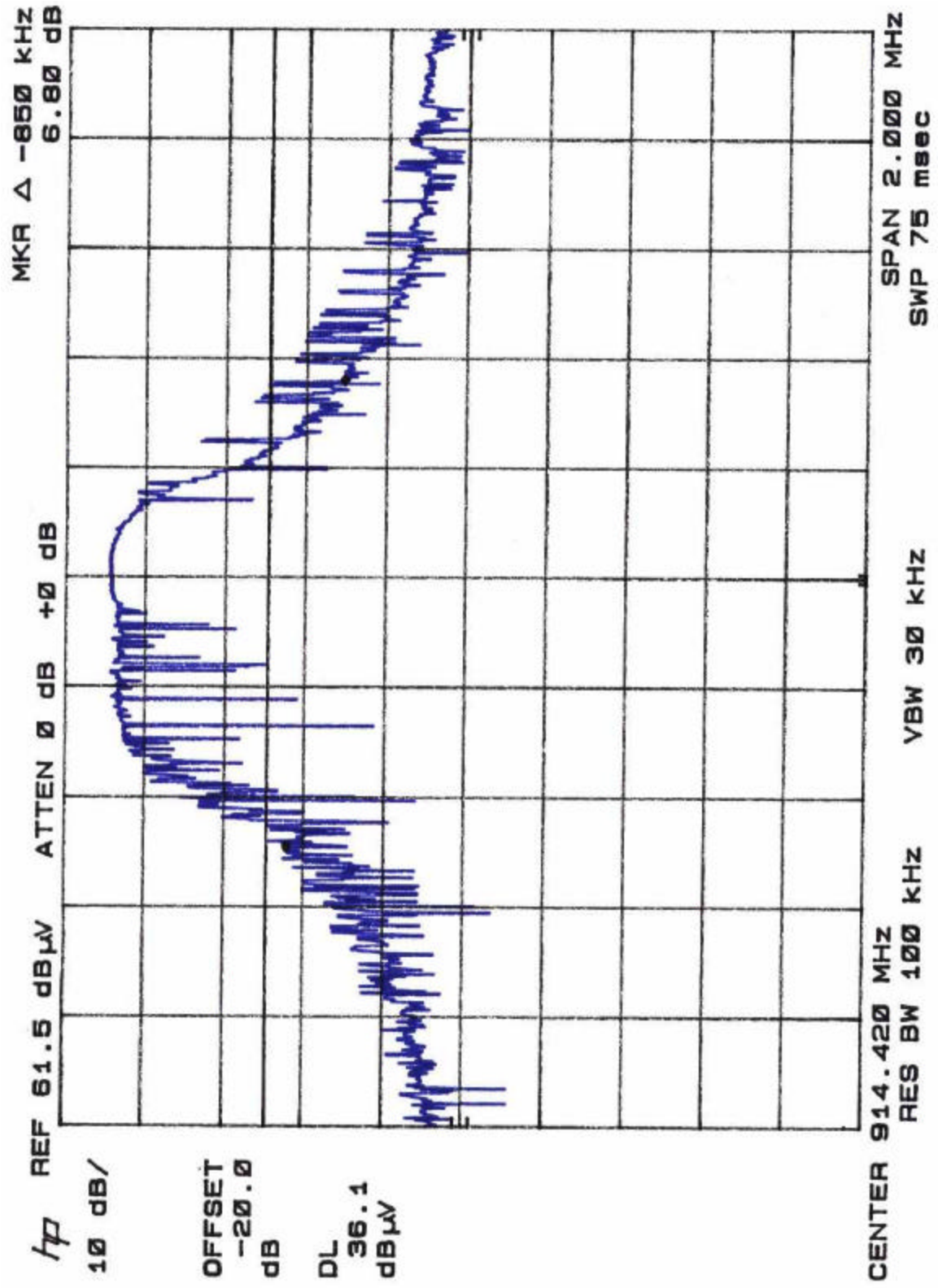

Figure 6. Occupied Bandwidth: Link

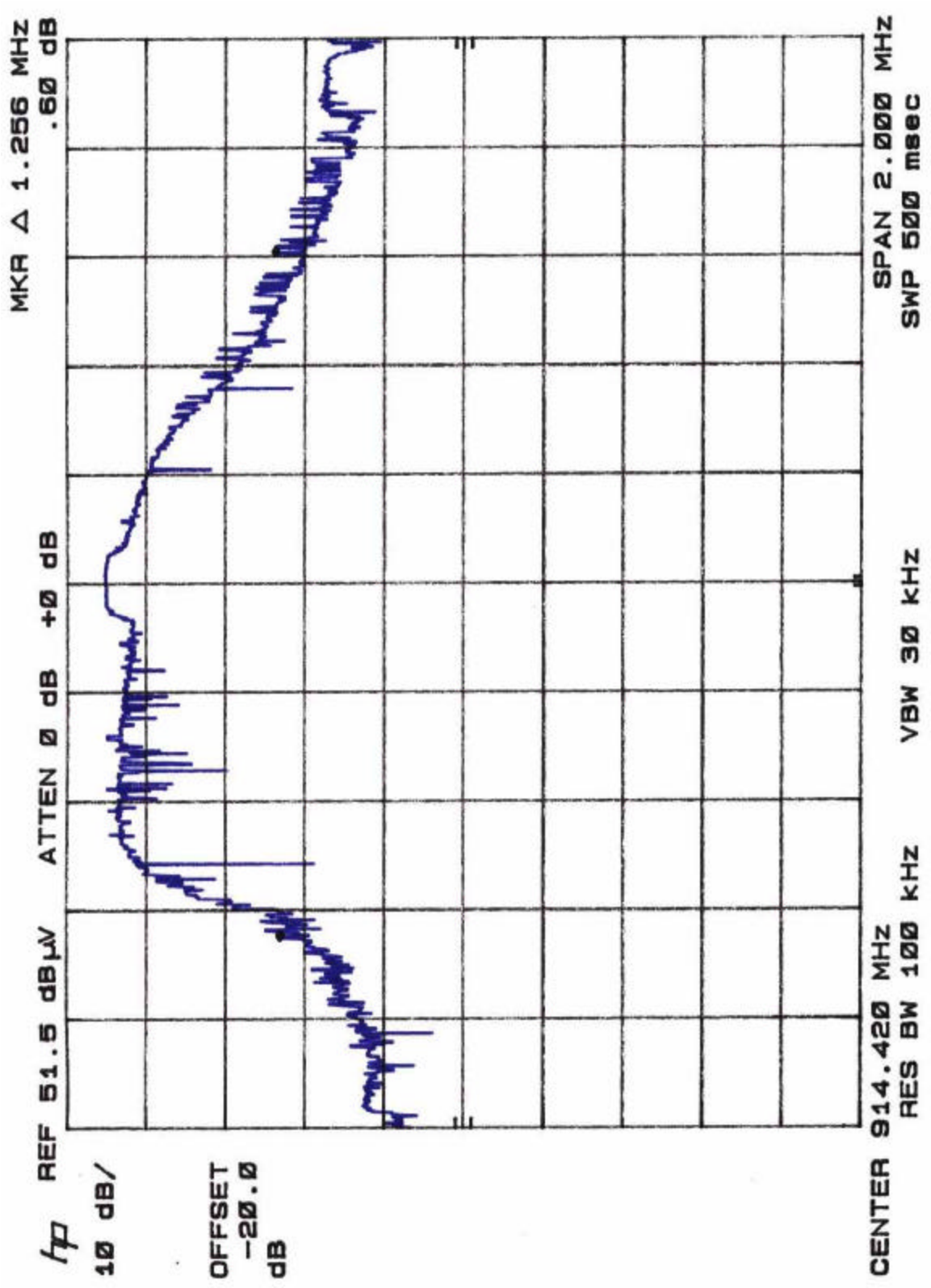

Figure 7. Occupied Bandwidth: Remote

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6. Occupied Bandwidth Results

Frequency	**Bandwidth**
Link	850 kHz
Remote	1.256MHz

4.3 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 7. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	50 mV/m	
Harmonics		500 uV/m

4.3.1 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 C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Table 8: Radiated Emission Test Data

CLIENT: Trafcon DATE: 5/8/03

TESTER: Ken Gemmell JOB #: 7511

DEVICE: Link

Frequency MHz	Pol H/V	Az Degree	Ant. Hght m	SA Level QP dBµV	Ant. Corr. dB/m	Cable Corr. dB	Amp Gain dB	Duty Cycle dB	Corr. Level dBµV/m	Corr. Level µV/m	Limit µV/m	Margin dB
914.44	V	180.0	1.0	55.1	22.1	7.5	0.0	0.0	84.7	17189	50000.0	-9.3
914.44	H	180.0	1.0	58.9	22.1	7.5	0.0	0.0	88.5	26624	50000.0	-5.5
1828.98	V	180.0	1.0	61.8	28.4	3.1	34.1	-15.6	43.7	152.5	500.0	-10.3
2743.41	V	180.0	1.0	52.5	30.3	2.9	34.4	-15.6	35.7	60.9	500.0	-18.3
3657.72	V	180.0	1.0	42.7	31.4	2.8	34.6	-15.6	26.7	21.6	500.0	-27.3
4572.15	V	180.0	1.0	42.5	32.5	3.8	34.5	-15.6	28.7	27.1	500.0	-25.3
5486.57	V	180.0	1.0	40.8	34.0	4.2	34.4	-15.6	29.1	28.4	500.0	-24.9
6401.14	V	180.0	1.0	41.2	36.1	4.2	34.6	-15.6	31.3	36.6	500.0	-22.7 a
7315.46	V	180.0	1.0	43.8	37.9	4.6	34.8	-15.6	35.9	62.4	500.0	-18.1 a
8229.88	V	180.0	1.0	43.2	38.5	4.9	34.2	-15.6	36.8	69.5	500.0	-17.1 a
9144.31	V	180.0	1.0	43.2	39.1	4.9	33.0	-15.6	38.7	86.2	500.0	-15.3 a
1828.98	H	180.0	1.0	56.3	28.4	3.1	34.1	-15.6	38.2	81.2	500.0	-15.8
2743.41	H	180.0	1.0	51.3	30.3	2.9	34.4	-15.6	34.5	53.2	500.0	-19.5
3657.72	H	180.0	1.0	42.5	31.4	2.8	34.6	-15.6	26.5	21.2	500.0	-27.5
4572.15	H	180.0	1.0	41.3	32.5	3.8	34.5	-15.6	27.5	23.7	500.0	-26.5
5486.57	H	180.0	1.0	41.8	34.0	4.2	34.4	-15.6	30.1	31.9	500.0	-23.9 a
6401.14	H	180.0	1.0	42.0	36.1	4.2	34.6	-15.6	32.1	40.3	500.0	-21.9 a
7315.46	H	180.0	1.0	42.8	37.9	4.6	34.8	-15.6	34.9	55.4	500.0	-19.1 a
8229.88	H	180.0	1.0	42.6	38.5	4.9	34.2	-15.6	36.3	65.1	500.0	-17.7 a
9144.31	H	180.0	1.0	44.7	39.1	4.9	33.0	-15.6	40.2	101.8	500.0	-13.8 a

a = ambient

Table 9: Radiated Emission Test Data

CLIENT: Trafcon DATE: 5/8/03

TESTER: Ken Gemmell JOB #: 7511

DEVICE: Remote

Frequency MHz	Polarity H/V	Az Degree	Ant. Hght m	SA Level QP dBµV	Ant. Corr. dB/m	Cable Corr. dB	Amp Gain dB	Duty Cycle dB	Corr. Level dBµV/m	Corr. Level µV/m	Limit µV/m	Margin dB
914.44	V	180.0	1.0	50.3	22.1	7.5	0.0	0.0	79.9	9891.8	50000.0	-14.1
914.44	H	180.0	1.0	54.7	22.1	7.5	0.0	0.0	84.3	16416.3	50000.0	-9.7
1828.98	V	180.0	1.0	62.2	28.4	3.1	34.1	-8.6	51.0	355.7	500.0	-3.0
2743.41	V	180.0	1.0	53.7	30.3	2.9	34.4	-8.6	43.9	155.8	500.0	-10.1
3657.72	V	180.0	1.0	48.2	31.4	2.8	34.6	-8.6	39.2	90.8	500.0	-14.8
4572.15	V	180.0	1.0	46.3	32.5	3.8	34.5	-8.6	39.5	94.2	500.0	-14.5
5486.57	V	180.0	1.0	42.5	34.0	4.2	34.4	-8.6	37.7	77.0	500.0	-16.2
6401.14	V	180.0	1.0	41.1	36.1	4.2	34.6	-8.6	38.2	81.2	500.0	-15.8 a
7315.46	V	180.0	1.0	43.2	37.9	4.6	34.8	-8.6	42.2	129.3	500.0	-11.7 a
8229.88	V	180.0	1.0	43.0	38.5	4.9	34.2	-8.6	43.7	152.3	500.0	-10.3 a
9144.31	V	180.0	1.0	44.2	39.1	4.9	33.0	-8.6	46.6	214.9	500.0	-7.3 a
1828.98	H	180.0	1.0	63.9	28.4	3.1	34.1	-8.6	52.8	434.1	500.0	-1.2 b
1828.98	H	180.0	1.0	62.8	28.4	3.1	34.1	-8.6	51.7	383.8	500.0	-2.3 c
2743.41	H	180.0	1.0	52.3	30.3	2.9	34.4	-8.6	42.5	133.1	500.0	-11.5
3657.72	H	180.0	1.0	56.3	31.4	2.8	34.6	-8.6	47.3	232.4	500.0	-6.7
4572.15	H	180.0	1.0	43.8	32.5	3.8	34.5	-8.6	37.0	70.6	500.0	-17.0
5486.57	H	180.0	1.0	41.2	34.0	4.2	34.4	-8.6	36.4	66.1	500.0	-17.6 a
6401.14	H	180.0	1.0	40.2	36.1	4.2	34.6	-8.6	37.3	73.0	500.0	-16.7 a
7315.46	H	180.0	1.0	42.7	37.9	4.6	34.8	-8.6	41.8	122.5	500.0	-12.2 a
8229.88	H	180.0	1.0	44.3	38.5	4.9	34.2	-8.6	45.0	176.9	500.0	-9.0 a
9144.31	H	180.0	1.0	44.3	39.1	4.9	33.0	-8.6	46.8	218.8	500.0	-7.2 a

a = ambient b = CW c = Pulsed