FCC Certification Test Report

FCC Certification Test Report
for
May & Scofield Limited
FCC ID: PRY088TX

August 24, 2001

Prepared for:

May & Scofield Limited
Stroudley Road, Daneshill Industrial Estate
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Prepared By:

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FCC Certification Test Program

FCC Certification Test Report
for the
May & Scofield Limited
315 MHz Transmitter
FCC ID: PRY088TX

August 24, 2001

WLL JOB# 6599

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Abstract

This report has been prepared on behalf of May & Scofield Limited to support the attached Application for Equipment Authorization. The test report and application are submitted for a Periodic Intentional Radiator under Part 15.231 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a May & Scofield Limited Model 088Tx Transmitter.

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 May & Scofield Limited 088Tx Transmitter complies with the limits for a Periodic Intentional Radiator device under Part 15.231 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The May & Scofield Limited 088Tx Transmitter (FCC ID: PRY088TX) complies with the limits for a Periodic Intentional Radiator device under Part 15.231 of the FCC Rules and Regulations.

1.2 Test Scope

Testing for radiated emissions was 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:	Reflex Projects Limited 8 Allwoods Close Alcester, Warwickshire England B49 5EL On behalf of: May & Scofield Limited Stroudley Road, Daneshill Industrial Estate Basingstoke, Hampshire England RG24 8UG
Quotation Number:	59112

1.4 Test Dates

Testing was performed on July 3, 2001.

1.5 Test Personnel

Washington Laboratories, LTD	Santo Lavorata
	Michael Violette

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 May & Scofield 088Tx transmitter is a keyfob device for auto security applications. Upon depressing the signal button, the transmitter signals the receiver, mounted in the automobile, to operate a keyless entry system. The device operates at 315MHz.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	May & Scofield Limited
FCC ID Number	PRY088TX
EUT Name:	Transmitter
Model:	088Tx
FCC Rule Parts:	§15.231
Frequency Range:	315 MHz
Maximum Output Power:	<1mW
Modulation:	Pulsed
Necessary Bandwidth:	44 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1

Power Output Level	Fixed
Antenna Type	Integral
Frequency Tolerance:	N/A
Emission Type(s):	Pulsed
Interface Cables:	None
Power Source & Voltage:	3Vdc Battery

2.2 Test Configuration

The 088Tx was configured to continuously transmit. It was tested in all three orthogonal planes.

2.3 Testing Algorithm

The 088Tx was operated continuously by depressing and holding the control button.

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

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB.

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

Equipment	Serial Number	Date Calibrated	Calibration Due
Antenna Research Associates, Inc. Biconical Log PeriodicAntenna LPB-2520A (Site 2)	1118	5/15/01	5/15/02
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 2)	2634A02888	6/29/01	6/29/02
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 2)	2811A01283	6/29/01	6/29/02
Hewlett-Packard RF Preselector: HP 85685A (Site 2)	3221A01395	6/29/01	6/29/02
Hewlett-Packard Spectrum Analyzer: HP 8564E	3643A00657	4/11/01	4/11/02
Hewlett-Packard Preamplifier: HP 8449B	3008A00729	12/07/00	12/07/01
Hewlett-Packard Preamplifier: HP 8449B	3008A00385	09/07/00	9/07/01
Antenna Research Associates, Inc. Horn Antenna DRG-118/A	1010	9/10/99	9/10/01

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.

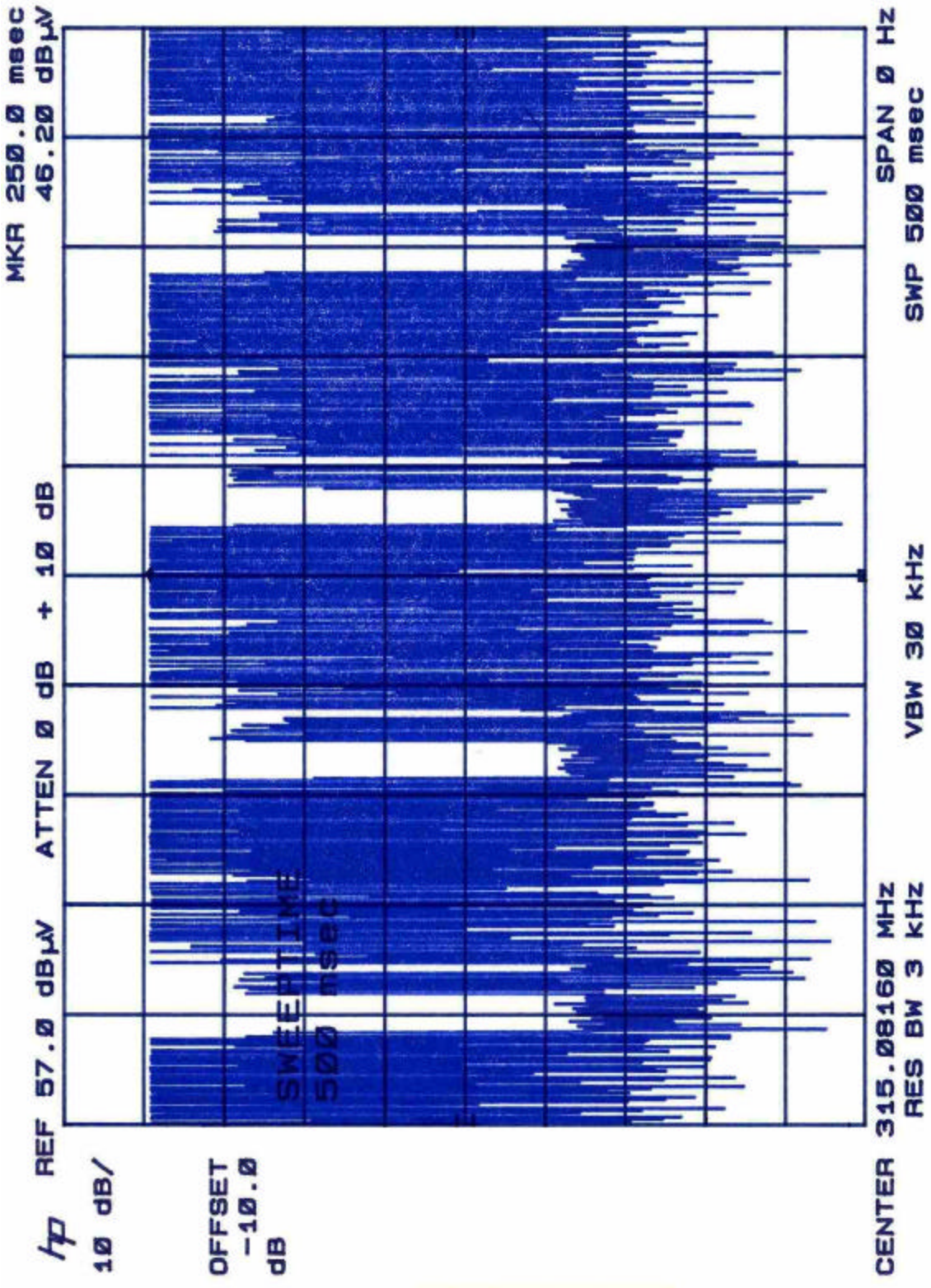

Figure 1. Duty Cycle Plots Full Period

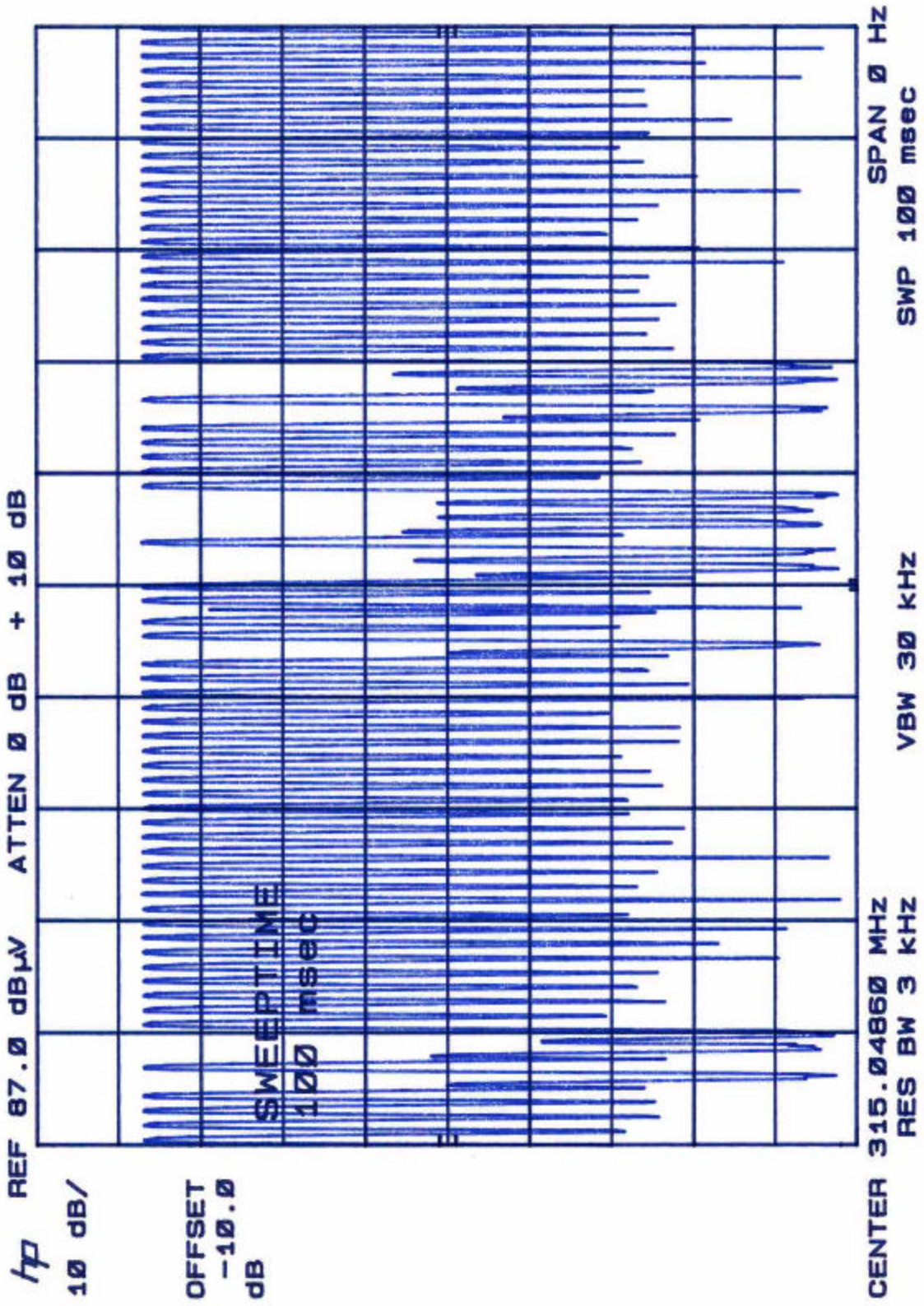

Figure 2. Duty Cycle Plot "On Time" for 100mS

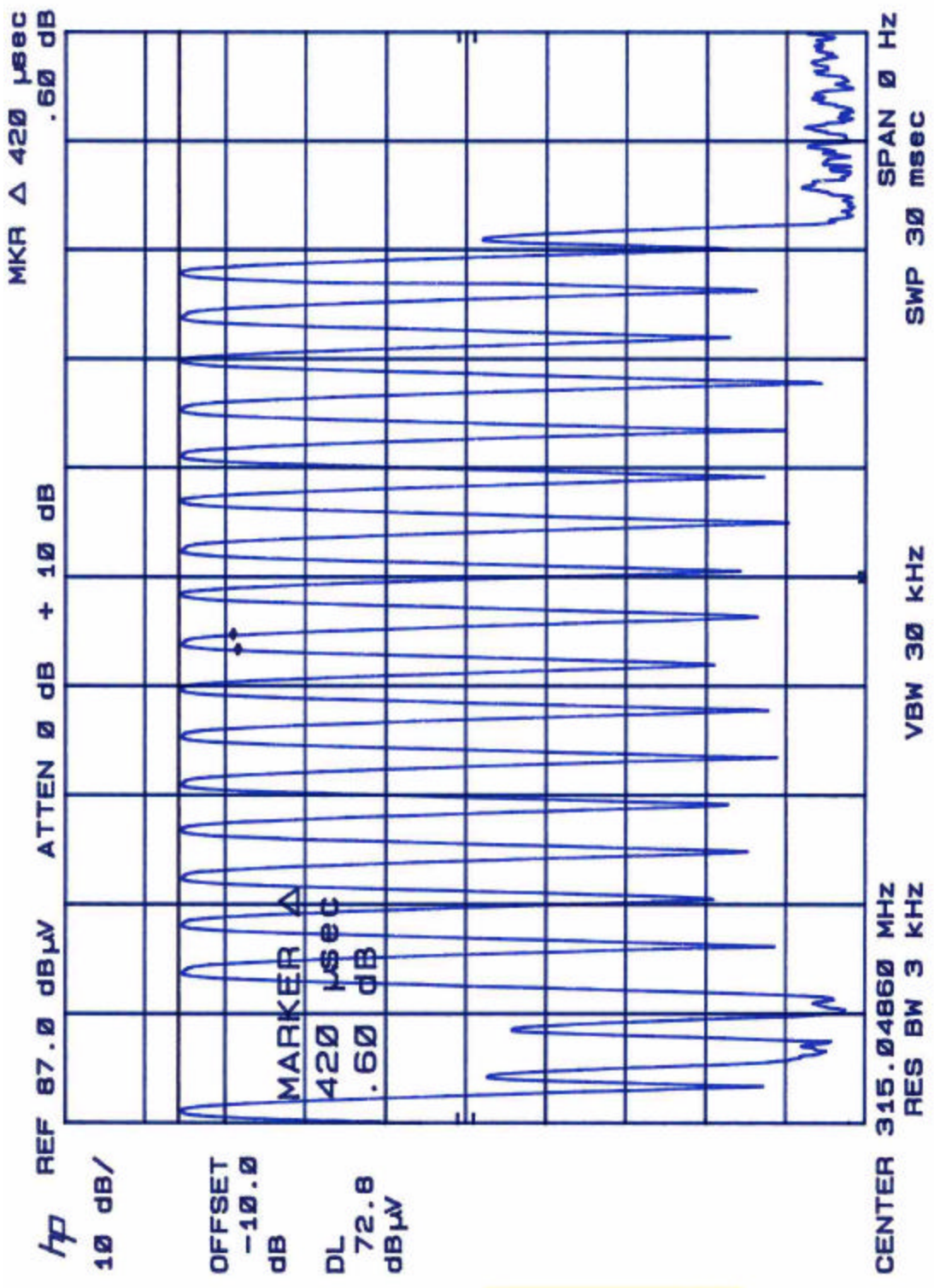

Figure 3. Duty Cycle Plot "On Time"

From the data in Figure 1, Figure 2, and Figure 3 the following calculations are made.

On Time Per Pulse: 420 us

Total Averaging Time: 100ms

Total Number of Pulses per 100ms (worst-case): 80

Total ON time per 100 ms: 420 X 80 pulses: 33.6 ms

Duty Cycle: 33.6ms/100ms = 0.336

Duty Cycle Correction: 20 Log10(0.336) = -9.47 dB

The data are summarized in the following table.

Table 3. Duty Cycle Correction

Measurement Time	Total ON Time	Duty Cycle (%)	Duty Cycle Correction (dB)
100 ms	33.6 ms	33.6%	9.47

4.2 RF Power Output: (FCC Part §2.1046)

Not applicable.

4.3 Modulation Characteristics: (FCC Part §2.1047); Audio Frequency Response

Not applicable.

4.4 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 15.231 states that the 20 dB bandwidth of the modulated carrier shall be no greater than the limits shown in the following Table.

Frequency Range (MHz)	Occupied Bandwidth Limit
70-900 MHz	0.25% of f_c
> 900 MHz	0.5% of f_c

At full modulation, the occupied bandwidth was measured as shown:

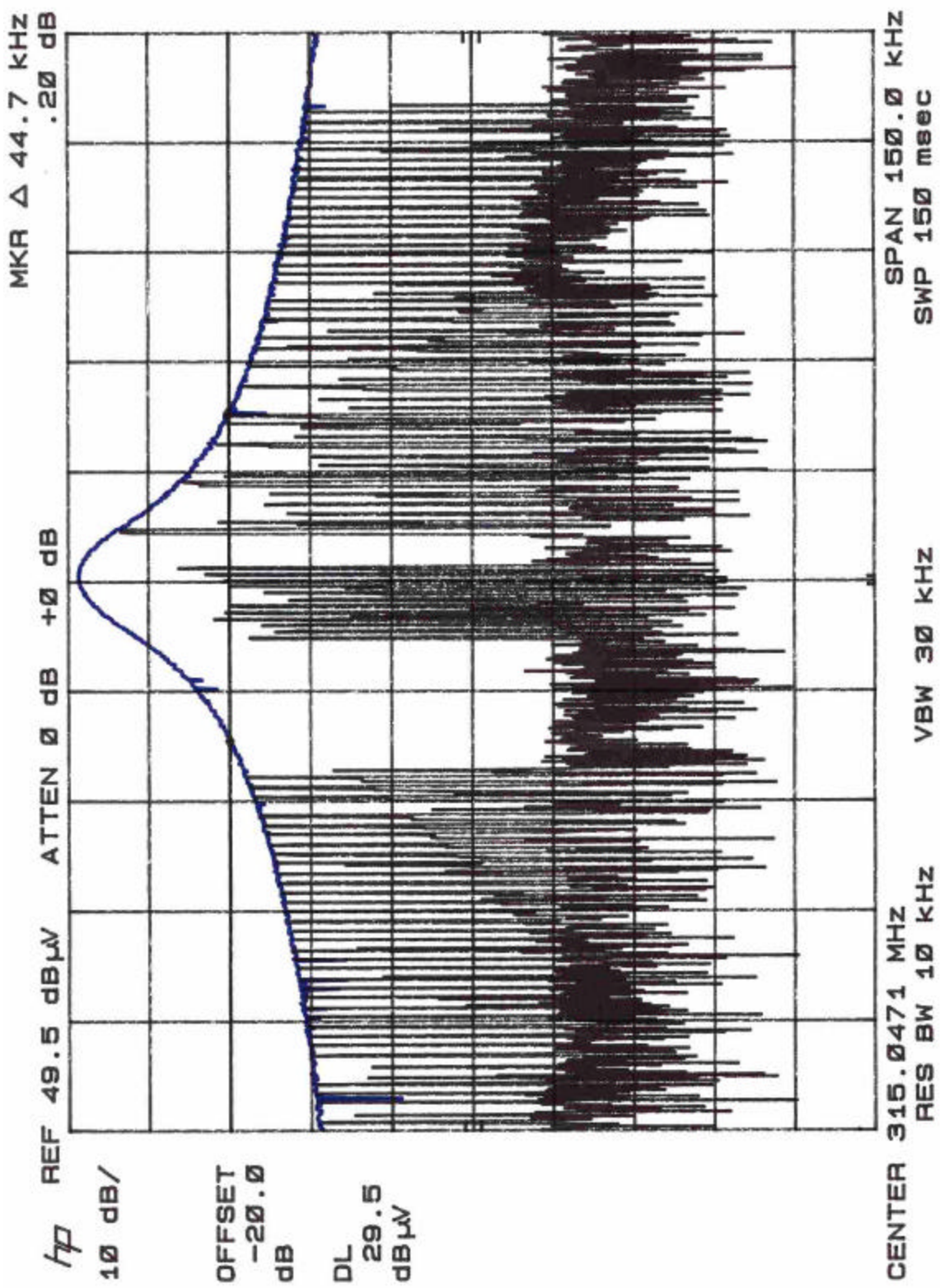

Figure 3. Occupied Bandwidth

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
315 MHz	44.7 kHz	787.5 kHz	Pass

4.5 Spurious Emissions at Antenna Terminals (FCC Part §2.1051

Not applicable.

4.6 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 5. Radiated Spurious Emissions Limits

Frequency	Fundamental uV/m	Harmonic Level uV/m
Fundamental	6042.9	
Harmonics		604.3
Restricted Band Emissions		500
FCC Mask	None	None

4.6.1 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 6: Radiated Emission Test Data

CLIENT: REFLEX PROJECT
MODEL NO: 088Tx Transmitter
TYPE/PART: FCC Part 15.231 Periodic
DATE: August 22, 2001
BY: Santo Lavorata
JOB #: 6599
Tx Frequency: 315.03 (MHz)
Orientation: X-Axis

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (Peak) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	E-Field uV/m	Limit uV/m	Margin dB
315.01	V	225	2	55	0	55.2	9.5	193.4	6041.7	-29.9
630.02	V	292	1	9	0	8.5	9.5	0.9	604.2	-56.6
945.02	V	90	2	4	0	4.0	9.5	0.5	604.2	-61.1
315.03	H	180	2	58	16.5	74.2	9.5	1721.6	6041.7	-10.9
630.06	H	180	2	9	24.1	33.1	9.5	15.2	604.2	-32.0
945.02	H	180	2	11	28.8	39.3	9.5	31.0	604.2	-25.8

Peak Measurements Above 1 GHz (X-Axis)

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (PEAK) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	Average E-Field uV/m	Limit uV/m	Margin dB	
1260.03	V	270	1.0	54.0	-10.6	43.4	9.5	49.8	604.2	-21.7	
1575.04	V	248	1.0	53.2	-8.5	44.7	9.5	58.0	500.0	-18.7	
1890.05	V	135	1.0	55.2	-6.7	48.5	9.5	89.3	604.2	-16.6	
2205.05	V	158	1.0	54.2	-5.7	48.5	9.5	88.9	500.0	-15.0	
2520.06	V	158	1.0	51.0	-5.2	45.8	9.5	65.6	604.2	-19.3	
2835.07	V	0	1.0	42.0	-4.7	37.3	9.5	24.6	500.0	-26.2	amb
3150.08	V	0	1.0	43.0	-4.3	38.7	9.5	29.0	604.2	-26.4	amb
1260.03	H	0	315.0	55.0	-10.6	44.4	9.5	55.8	604.2	-20.7	
1575.04	H	0	180.0	56.0	-8.5	47.5	9.5	80.1	500.0	-15.9	

1890.05	H	0	225.0	56.5	-6.7	49.8	9.5	103.7	604.2	-15.3	
2205.05	H	0	225.0	56.0	-5.7	50.3	9.5	109.4	500.0	-13.2	
2520.06	H	0	225.0	53.2	-5.2	48.0	9.5	84.5	604.2	-17.1	
2835.07	H	0	1.0	42.0	-4.7	37.3	9.5	24.6	500.0	-26.2	amb
3150.08	H	0	1.0	42.5	-4.3	38.2	9.5	27.4	604.2	-26.9	amb

Table 7: Radiated Emission Test Data

CLIENT: REFLEX PROJECT
MODEL NO: 088Tx Transmitter
TYPE/PART: FCC Part 15.231 Periodic
DATE: August 22, 2001
BY: Santo Lavorata
JOB #: 6599
Tx Frequency: 315.03 (MHz)
Orientation: Z-Axis

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (Peak) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	E-Field uV/m	Limit uV/m	Margin dB
315.01	V	270	1.2	46.7	16.5	63.2	9.5	485.2	6041.7	-21.9
630.02	V	45	1.5	9.0	24.1	33.1	9.5	15.2	604.2	-32.0
945.02	V	315	1.5	8.5	28.8	37.3	9.5	24.6	604.2	-27.8
315.03	H	315	1.5	60.3	16.5	76.8	9.5	2322.4	6041.7	-8.3
630.06	H	135	1.3	7.3	24.1	31.4	9.5	12.5	604.2	-33.7
945.02	H	225	2.0	6.3	28.8	35.1	9.5	19.1	604.2	-30.0

Peak Measurements Above 1 GHz (Z-Axis)

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (PEAK) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	Average E-Field uV/m	Limit uV/m	Margin dB	
1260.03	V	225	1.0	48	-10.6	37.4	9.5	24.9	604.2	-27.7	
1575.04	V	45	1.0	53	-8.5	44.5	9.5	56.7	500.0	-18.9	
1890.05	V	315	1.0	53	-6.7	46.3	9.5	69.3	604.2	-18.8	
2205.05	V	180	1.0	57	-5.7	51.3	9.5	122.8	500.0	-12.2	
2520.06	V	135	1.0	51	-5.2	45.8	9.5	65.6	604.2	-19.3	
2835.07	V	0	1.0	42	-4.7	37.3	9.5	24.6	500.0	-26.2	amb
3150.08	V	0	1.0	42	-4.3	37.7	9.5	25.9	604.2	-27.4	amb
1260.03	H	315	1.0	55	-10.6	44.4	9.5	55.8	604.2	-20.7	
1575.04	H	90	1.0	54	-8.5	45.5	9.5	63.6	500.0	-17.9	
1890.05	H	135	1.0	57	-6.7	50.3	9.5	109.8	604.2	-14.8	
2205.05	H	180	1.0	59	-5.7	52.8	9.5	145.9	500.0	-10.7	

2520.06	H	90	1.0	50	-5.2	44.8	9.5	58.4	604.2	-20.3	
2835.07	H	0	1.0	42	-4.7	36.8	9.5	23.2	500.0	-26.7	amb
3150.08	H	0	1.0	42	-4.3	37.7	9.5	25.9	604.2	-27.4	amb

Table 8: Radiated Emission Test Data

CLIENT: REFLEX PROJECT
MODEL NO: 088Tx Transmitter
TYPE/PART: FCC Part 15.231 Periodic
DATE: August 22, 2001
BY: Santo Lavorata
JOB #: 6599
Tx Frequency: 315.03 (MHz)
Orientation: Y-Axis

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (Peak) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	E-Field uV/m	Limit uV/m	Margin dB
315.01	V	90	2.0	40.40	16.5	56.9	9.5	234.9	6041.7	-28.2
630.02	V	225	3.0	6.10	24.1	30.2	9.5	10.9	604.2	-34.9
945.02	V	158	1.4	7.90	28.8	36.7	9.5	23.0	604.2	-28.4
315.03	H	180	1.0	55.60	16.5	72.1	9.5	1351.8	6041.7	-13.0
630.06	H	45	2.0	8.10	24.1	32.2	9.5	13.7	604.2	-32.9
945.02	H	45	1.6	8.20	28.8	37.0	9.5	23.8	604.2	-28.1

Peak Measurements Above 1 GHz (Y-Axis)

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (PEAK) dBuV	AFc dB/m	E-Field dBuV/m	Duty Cycle Correction Factor	Average E-Field uV/m	Limit uV/m	Margin dB	
1260.03	V	202	1.0	58	-10.6	47.4	9.5	78.9	604.2	-17.7	
1575.04	V	202	1.0	58	-8.5	49.5	9.5	100.8	500.0	-13.9	
1890.05	V	225	1.0	59	-6.7	51.9	9.5	132.0	604.2	-13.2	
2205.05	V	225	1.0	57	-5.7	51.6	9.5	127.1	500.0	-11.9	
2520.06	V	202	1.0	52	-5.2	46.8	9.5	73.6	604.2	-18.3	
2835.07	V	0	1.0	44	-4.7	39.3	9.5	31.0	500.0	-24.2	amb
3150.08	V	0	1.0	43	-4.3	38.2	9.5	27.4	604.2	-26.9	amb
1260.03	H	90	1.0	52	-10.6	41.4	9.5	39.5	604.2	-23.7	
1575.04	H	45	1.0	51	-8.5	42.5	9.5	45.0	500.0	-20.9	
1890.05	H	180	1.0	55	-6.7	48.3	9.5	87.2	604.2	-16.8	
2205.05	H	180	1.0	52	-5.7	46.3	9.5	69.0	500.0	-17.2	

2520.06	H	180	1.0	53	-5.2	47.8	9.5	82.5	604.2	-17.3	
2835.07	H	0	1.0	43	-4.7	38.3	9.5	27.6	500.0	-25.2	amb
3150.08	H	0	1.0	42	-4.3	37.7	9.5	25.9	604.2	-27.4	amb

4.7 Frequency Stability: (FCC Part §2.1055)

Not Applicable.

4.8 Transient Frequency Response (Part 90.214)

Not Applicable.

5 Transmitter Environmental Assessment, Maximum Permissible Exposure (MPE)

5.1 SCOPE

Not applicable.