



EMC Test Services  
1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

TEST SPECIFICATION:

**FCC "Rules and Regulations", Part 15, Subpart C**  
Sections 15.231 (a-d), 15.207 & 15.205

**Intentional Radiators**

Periodic operation in the band 40.6 – 40.77 MHz & above 70 MHz

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION

Formal Name: Run Safe Tire Pressure Warning System

Kind of Equipment: Transmitter

Test Configuration: NA

Transmitter FCC ID: PC8-TX-201

Model Number: TX-201

Serial Number: NA

Dates of Test: September 21 & November 13, 2000

Test Conducted For: Sensor Technology International

5336 West 79th Street

Indianapolis, Indiana 46268

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11/28/00

## SIGNATURE PAGE

Report Written By:

Arnom C. Rowe

A handwritten signature in black ink that reads "Arnom C. Rowe". The signature is written in a cursive style with a large initial 'A'.

Test Engineer  
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Jack Prawica  
Lab Manager

Report Approved by:

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Brian J. Mattson  
General Manager

Company Official:

Sensor Technology International



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request.**



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1.	Cover Page	i
2.	Signature Page	ii
3.	NVLAP Certificate of Accreditation	iii
6.	Table of Contents	iv
8.	Summary of Test Report	1.0
8.	Introduction	2.0
8.	Object	3.0
8.	Test Set-up	4.0
9.	Test Equipment (Bandwidths and Detector Function)	5.0
9.	Conducted Emission Measurements	6.0
10.	Conducted Emission Data taken during testing	6.0
11.	Conducted Emission Graphs taken during testing	6.0
12.	Field Strength of Spurious Emission Measurements	7.0
14.	Radiated <u>Data</u> taken for Fundamental & Spurious Emissions Measurements	7.0
19.	Radiated <u>Graphs</u> taken for Fundamental & Spurious Emissions Measurements	7.0
28.	Pulsed Operation (Duty Cycle Correction Factor)	8.0
29.	Pulse Operation Graphs taken during testing	8.0
30.	Bandwidths	9.0
31.	Graphs taken of Fundamental Frequency & Bandwidths	9.0
33.	Restricted Bands	10.0



EMC Test Services  
1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

34.	Photo Information and Test Set-Up	11.0
35.	Photos Taken During Testing	12.0
37.	Change Information	13.0
39.	Results of Tests	14.0
39.	Conclusion	15.0
40.	Equipment List	TABLE 1



## 1.0 SUMMARY OF TEST REPORT

It was found that the Run Safe Tire Pressure Warning System S/N NA meets the radio interference emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Sections 15.231 (a-d), 15.207 and 15.205 for Intentional Radiators operating in the bands 40.66 to 40.77 MHz and above 70 MHz with periodic operation.

### NOTE:

**The conducted emissions test was not required because the EUT is powered from a DC power source. It does not have a line cord to plug into the A.C. power line.**

## 2.0 INTRODUCTION

On September 21 & November 13, 2000, a series of radio frequency interference measurements were performed on Transmitter, S/N NA. The tests were performed according to the procedures of FCC as stated in MP-1 "FCC Methods of Measurement for determining Compliance of Radio Control and Security Alarm Devices and Associated Receivers". Tests were performed by personnel of D.L.S. Electronic Systems, Inc. who are responsible to Donald L. Sweeney, Senior EMC Engineer.

## 3.0 OBJECT

The purpose of this series of tests was to determine if the test sample could meet the radio frequency emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Sections 15.231 (a-d), 15.207 and 15.205 for Intentional Radiators operating in the bands 40.66 to 40.77 MHz and above 70 MHz Frequency Band with periodic operation.

## 4.0 TEST SET-UP

All radiated emission tests were performed at D.L.S. Electronic Systems, Inc. The radiated tests were made with the test item placed on a non-conductive turntable located in the Test Room with the receive antenna placed three meters from the device under test. The equipment under test was set up according to ANSI C63.4-1992, Section 8, (Figures 9c and 9d).



## 5.0 TEST EQUIPMENT (Bandwidths and Detector Function)

All preliminary data below 1000 MHz was automatically plotted using the Peak or CISPR Detector Functions. This information was then used to determine the frequencies of maximum emissions. Manual measurements were performed on these frequencies using a peak detector function of the Receiver with the bandwidths specified by the FCC. Above 1000 MHz final data was taken using the Peak Detector.

Below 1000 MHz final data was taken using the fixed tuned receiver. Plots were made using the Peak Detector, with manual measurements made on the frequencies of interest, using the Peak, CISPR, and Average Detector Functions of the receiver. When average measurements were made using the fixed tuned receiver, the average was taken of a linear IF signal as specified by FCC and ANSI C63.4-1992.

The fundamental frequency was measured using the Average Detector and the CISPR Detector was used for measuring the Harmonics as stated in Section 15.209. From 10 kHz to 30 MHz a bandwidth of 9 kHz was used. From 30 MHz to 1000 MHz a bandwidth of 120 kHz was used and above 1000 MHz, a bandwidth of 1 MHz was used to ensure proper measurement of the narrowband signal.

A list of the equipment used can be found in Table 1. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

## 6.0 CONDUCTED EMISSION MEASUREMENTS

### NOTE:

**The conducted emissions test was not required because the EUT is powered from a DC power source. It does not have a line cord to plug into the A.C. power line.**



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1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

## **CONDUCTED DATA TAKEN DURING TESTING**

### **PART 15.207**

#### **NOTE:**

**The conducted emissions test was not required because the EUT is powered from a DC power source. It does not have a line cord to plug into the A.C. power line.**



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Report No. 8640  
11/28/00

## **CONDUCTED GRAPHS TAKEN DURING TESTING**

### **PART 15.207**

#### **NOTE:**

**The conducted emissions test was not required because the EUT is powered from a DC power source. It does not have a line cord to plug into the A.C. power line.**

## 7.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS

The allowed radiated emissions for transmitters of this type can not exceed the following field strength limits at a distance of three meters as shown in Section 15.231b. The limits are show in the following table.

Fundamental Frequency in MHz	Field Strength of Fundamental (uV/m at 3m)	Field Strength of Harmonics (uV/m at 3m)
40.66 to 40.70	2250 (67.04 dBuV)	225 (47.04 dBuV)
70 to 130	1250 (61.94 dBuV)	125 (41.94 dBuV)
130 to 174	1250 (61.94 dBuV) to 3750 (71.48 dBuV)	125 (41.94 dBuV) to 375 (51.48 dBuV)
174 to 260	3750 (71.48 dBuV)	375 (51.48 dBuV)
260 to 470	3750 (71.48 dBuV) to 12500 (81.84 dBuV)	375 (51.48 dBuV) to 1250 (61.94 dBuV)
470 and above	12500 (81.84 dBuV)	1250 (61.94 dBuV)

### NOTE:

**As stated in 15.35b the 20 dB peak-to-average limit is applicable to all devices measured using an average detector.**

For pulsed operation, the switches were set to generate its maximum “on” time, and measurements were made with the peak detector. As stated in Docket 86-422, the duty cycle of the pulse is determined from the total “on” time for the worst case condition during 100 msec. Using the percentage of the total “on” time over a 100 msec period, the total absolute average value was determined.

## 7.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS (CON'T)

Preliminary radiation measurements were performed at a 3 meter test distance with the limits adjusted linearly when required. The frequency range from 9 kHz to over 960 MHz, depending upon the fundamental frequency as stated in Part 15.33a, was automatically scanned and plotted at various angles.

Measurements for the Run Safe Tire Pressure Warning System were made up to 5800, in accordance with Section 15.33a for Intentional Radiators with a fundamental frequency of 433.92. For intentional radiators, the frequency range to be investigated is determined by the lowest radio frequency generated by the device without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or 1000 MHz, whichever is lower.

At those frequencies where significant signals were detected, measurements were made at an open field test site, located at Genoa City, Wisconsin, FCC file number 31040/SIT, to determine the actual radiation levels.

All signals in the frequency range of 30 MHz to 200 MHz were measured with a Biconical Antenna or Tuned Dipoles as the pickup device. From 200 MHz to 1000 MHz, a Log Periodic or Tuned Dipoles were used, and above 1000 MHz a Double Ridge Horn Antenna was used. During the test, below 1000 MHz the equipment was rotated and the antenna was raised and lowered from 1 meter to 4 meters to find the maximum level. In order to find maximum emissions, the cables were moved through all the positions the equipment would be expected to experience in the field. Tests were made in both the horizontal and vertical planes of polarization with the Loop (rotated 360° around its vertical axis), Biconical and Log Periodic. The table was rotated to find the maximum emissions. Above 1000 MHz the antenna was set one meter off the ground plane and three meters from the test item. The table was rotated to find the maximum emissions.

When the equipment is out of limit at 3 meters, and the signals from the equipment at 30 meters cannot be recorded due to the background, a representative sample of these frequencies were remeasured at various distances such as 4, 5, 6, 8, 15 meters and the greatest distance that can be measured to demonstrate graphically that the emissions are dropping off and will be under the limit at the specified distance.



EMC Test Services  
1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

# **RADIATED DATA TAKEN FOR FUNDAMENTAL**

## **EMISSION MEASUREMENTS**

### **PART 15.225**



SUMMARY DATA SHEET OF **RADIATED EMISSIONS <1000 MHz**

TEST DATE:----- November 13, 2000  
MANUFACTURER:----- Sensor Technology International  
MODEL NO:----- TX-201  
S/N:----- NA  
CONFIGURATION:----- **NA**  
RATED POWER:----- 0.065

TEST SPECIFICATION: FCC "RULES AND REGULATION", PART 15  
SUBPART C / SECTION 15.231

TEST EQUIPMENT: Receiver --- EMC-25 -- SN 772

Antennas --- BIA-25 --- SN 2453  
LPA-25 --- SN 1114

TYPE OF TEST: **VERTICAL** MEASURED **AT 3 METERS**

THE FOLLOWING ARE SIGNIFICANT RADIATED LEVELS FOUND:

FREQ IN MHz.	METER READING dBuV	METER CORR dB	ANTENNA FACTOR dBuV	TOTAL dBuV	LIMIT dB	MARGIN dB
433.00	43.50	4.50	21.64	69.64	80.80	11.16
866.00	28.50	3.00	27.61	59.11	60.80	1.69



SUMMARY DATA SHEET OF **RADIATED EMISSIONS <1000 MHz**

TEST DATE:----- November 13, 2000  
MANUFACTURER:----- Sensor Technology International  
MODEL NO:----- TX-201  
S/N:----- NA  
CONFIGURATION:----- **NA**  
RATED POWER:----- 0.065  
  
TEST SPECIFICATION: FCC "RULES AND REGULATION", PART 15  
SUBPART C / SECTION 15.231

TEST EQUIPMENT: Receiver --- EMC-25 -- SN 772

Antennas --- BIA-25 --- SN 2453  
LPA-25 --- SN 1114

TYPE OF TEST: **HORIZONTAL** MEASURED **AT 3 METERS**

THE FOLLOWING ARE SIGNIFICANT RADIATED LEVELS FOUND:

FREQ IN MHz.	METER READING dBuV	METER CORR dB	ANTENNA FACTOR dBuV	TOTAL dBuV	LIMIT dB	MARGIN dB
433.00	48.00	4.50	21.64	74.14	80.80	6.66
866.00	29.00	3.00	27.61	59.61	60.80	1.19





## SUMMARY DATA SHEET OF **RADIATED EMISSIONS >1000 MHz**

TEST DATE:----- November 13, 2000  
MANUFACTURER:----- Sensor Technology International  
MODEL NO:----- TX-201  
S/N:----- NA  
CONFIGURATION:----- **NA**  
RATED POWER:----- 0.0650

TEST SPECIFICATION: FCC "RULES AND REGULATION", PART 15  
SUBPART C / SECTION 15.231

### \*\*\*\***LOW POWER AUXILIARY STATIONS**\*\*\*\*

TEST EQUIPMENT: Spectrum Analyzer ----- HP 8566B  
Quasi Peak Adapter ----- HP 85650A

TYPE OF TEST: RADIATED EMISSIONS USING **VERTICAL** POLARIZATION

### THE FOLLOWING ARE SIGNIFICANT RADIATED LEVELS FOUND:

FREQ IN MHz.	METER READING dBuV	ANTENNA PLUS CABLE	PRE-AMP GAIN dB	TOTAL dBuV	ANTENNA DISTANCE IN METERS	LIMIT dBuV	MARGIN dB
1299.00	65.30	27.20	-42.40	50.10	3	60.82	10.72
1736.00	63.20	29.00	-42.40	49.80	3	60.82	11.02
2589.00	70.80	29.20	-42.50	57.50	1	70.30	12.80
3022.00	62.30	31.80	-42.80	51.30	1	70.30	19.00



## SUMMARY DATA SHEET OF **RADIATED EMISSIONS >1000 MHz**

TEST DATE:----- November 13, 2000  
MANUFACTURER:----- Sensor Technology International  
MODEL NO:----- TX-201  
S/N:----- NA  
CONFIGURATION:----- **NA**  
RATED POWER:----- 0.0650

TEST SPECIFICATION: FCC "RULES AND REGULATION", PART 15  
SUBPART C / SECTION 15.231

### \*\*\*\***LOW POWER AUXILIARY STATIONS**\*\*\*\*

TEST EQUIPMENT: Spectrum Analyzer ----- HP 8566B  
Quasi Peak Adapter ----- HP 85650A

TYPE OF TEST: RADIATED EMISSIONS USING **HORIZONTAL** POLARIZATION

### THE FOLLOWING ARE SIGNIFICANT RADIATED LEVELS FOUND:

FREQ IN MHz.	METER READING dBuV	ANTENNA PLUS CABLE	PRE-AMP GAIN dB	TOTAL dBuV	ANTENNA DISTANCE IN METERS	LIMIT dBuV	MARGIN dB
1299.00	66.20	27.20	-42.40	51.00	3	60.82	9.82
1736.00	55.90	29.00	-42.40	42.50	3	60.82	18.32
2589.00	68.70	29.20	-42.50	55.40	1	70.30	14.90
3455.00	61.80	33.00	-42.50	52.30	1	70.30	18.00
4763.00	60.00	34.50	-41.20	53.30	1	70.30	17.00



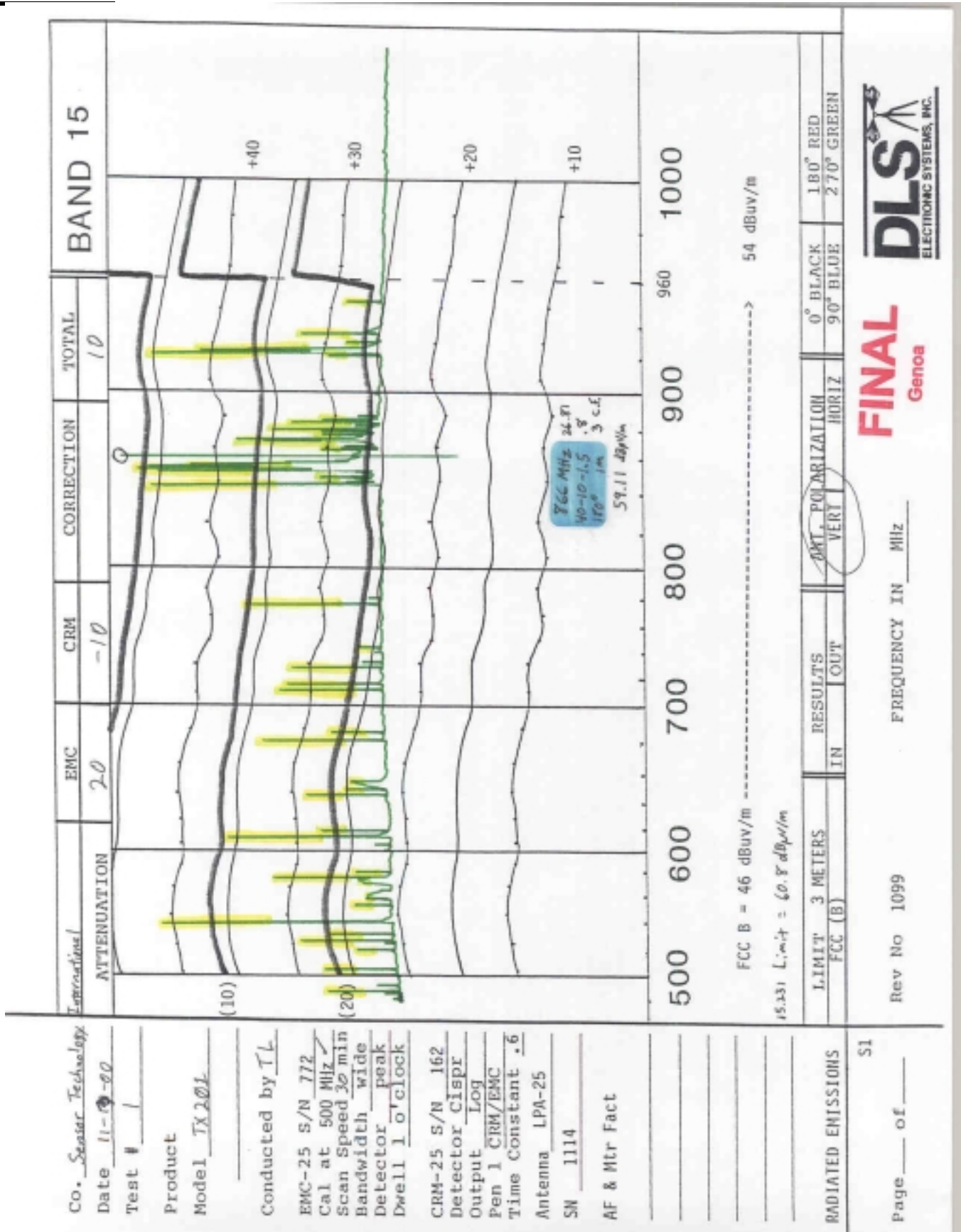
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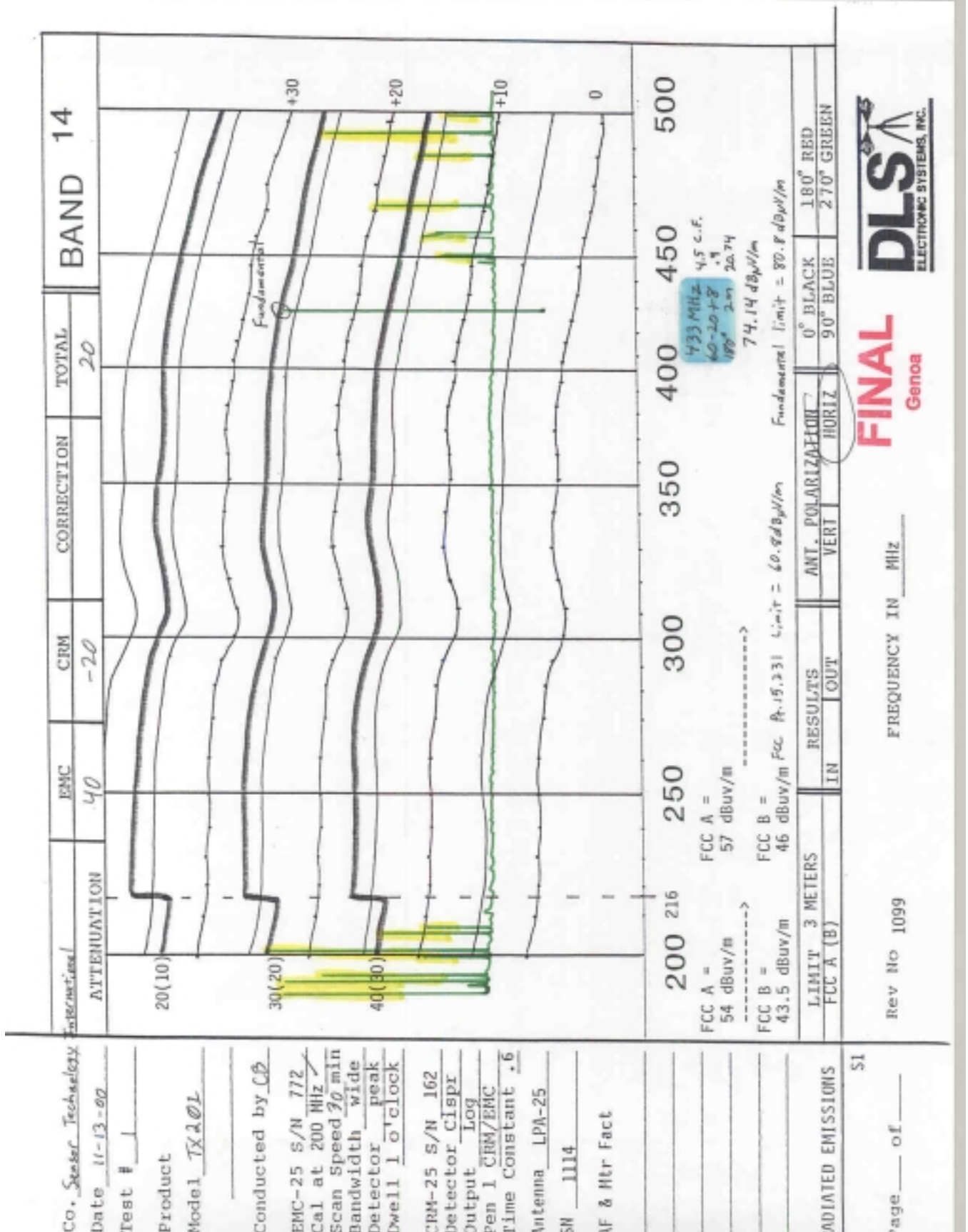
Report No. 8640  
11/28/00

# **RADIATED GRAPHS TAKEN FOR FUNDAMENTAL EMISSION MEASUREMENTS**

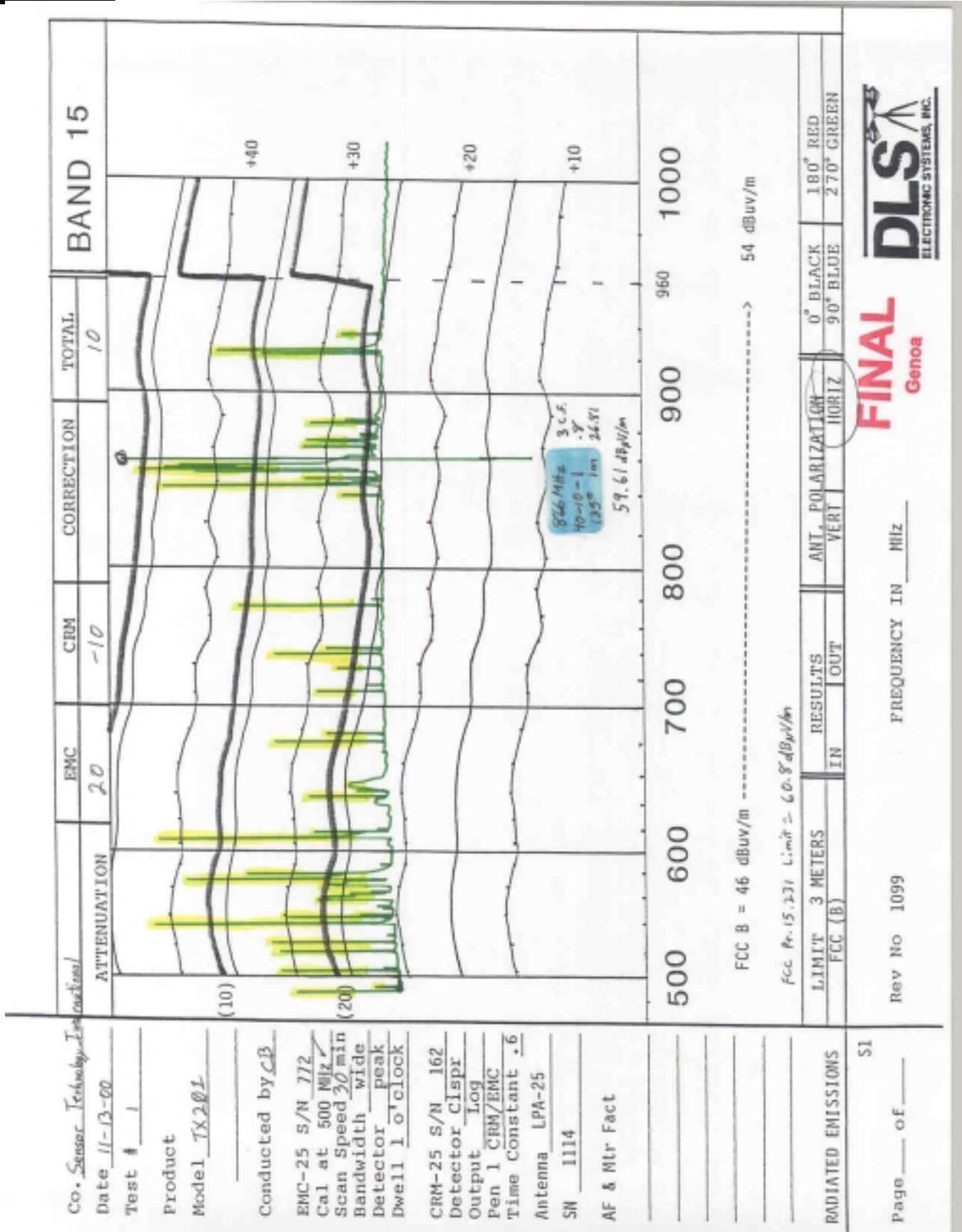
**PART 15.225**

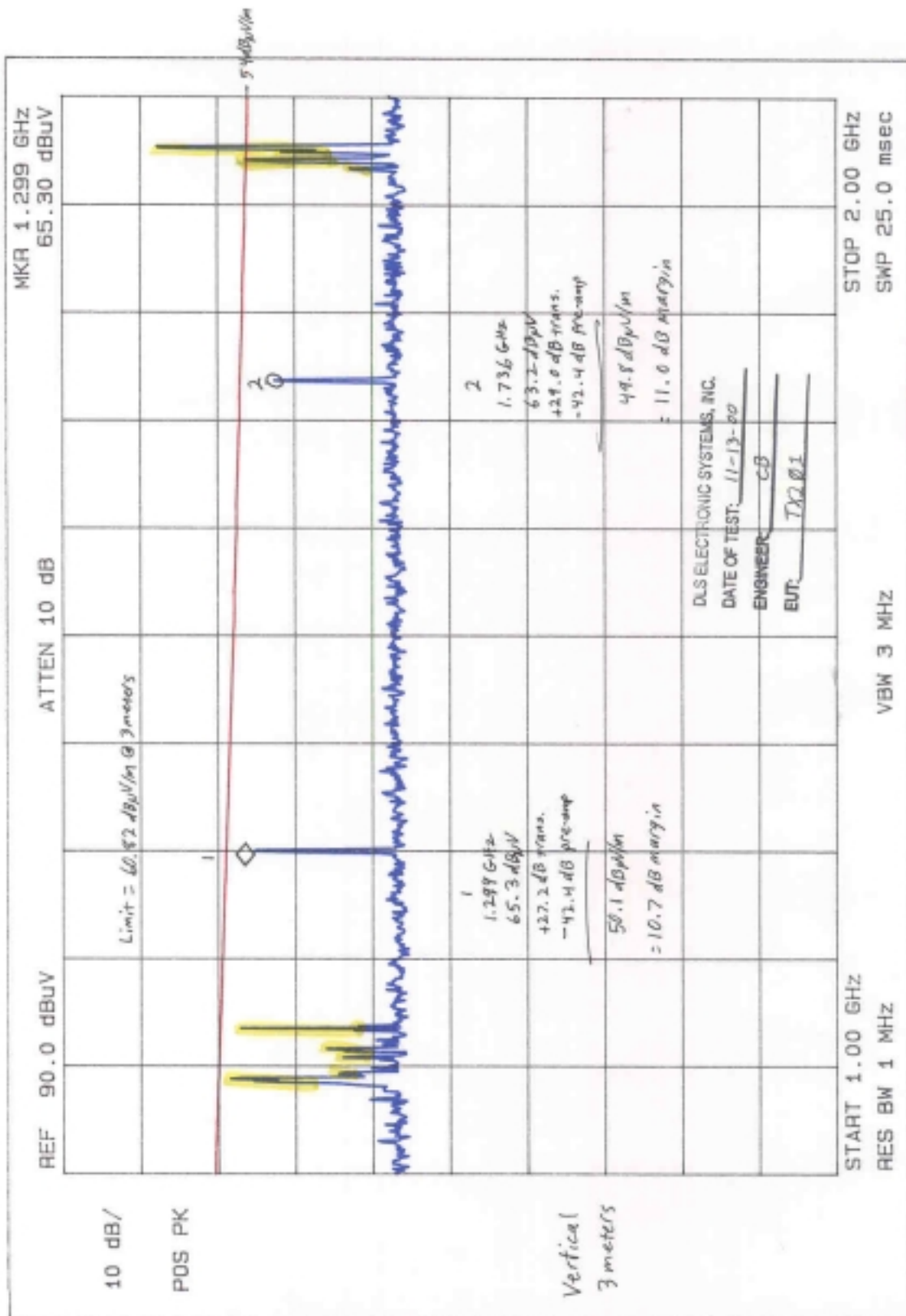






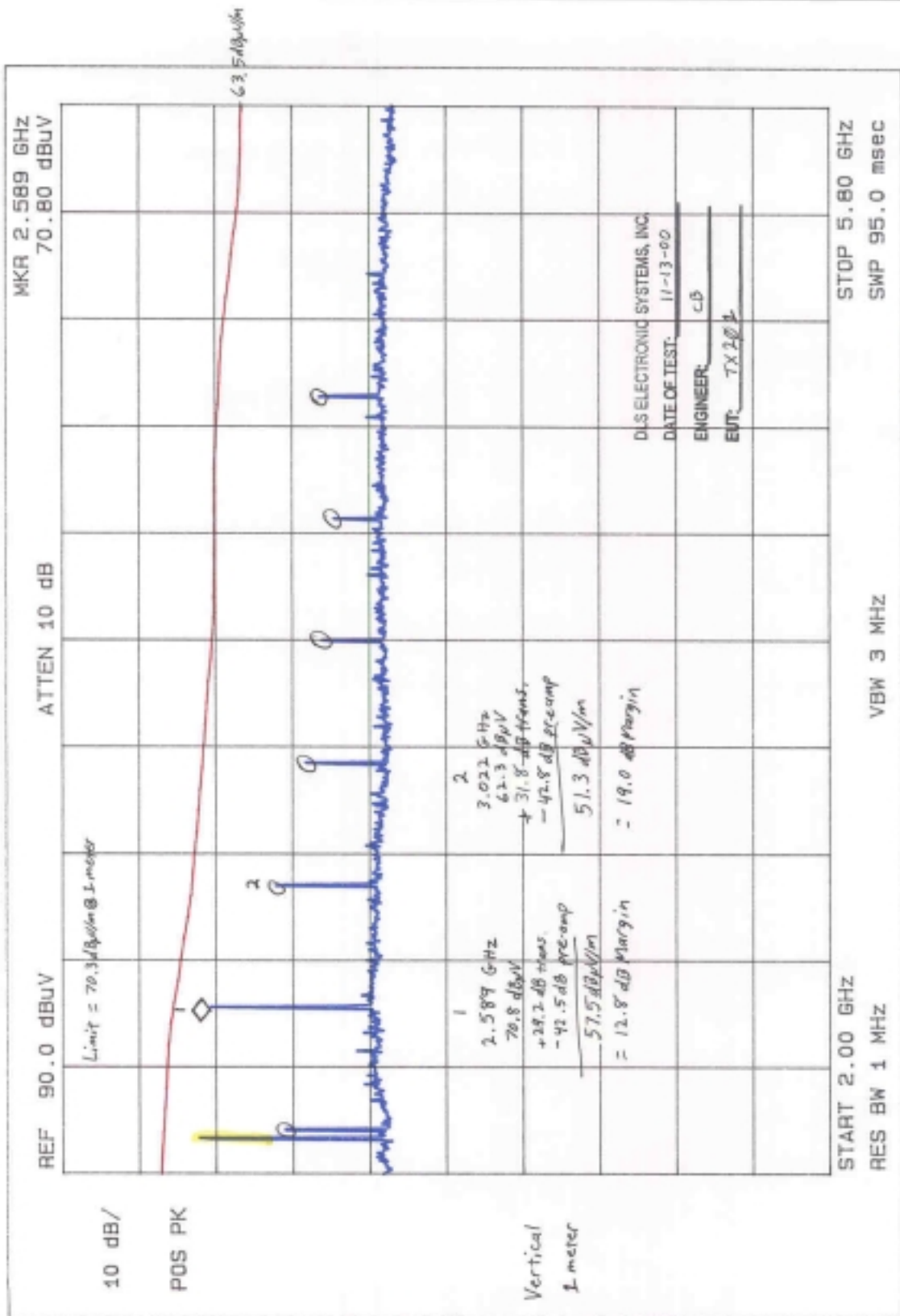




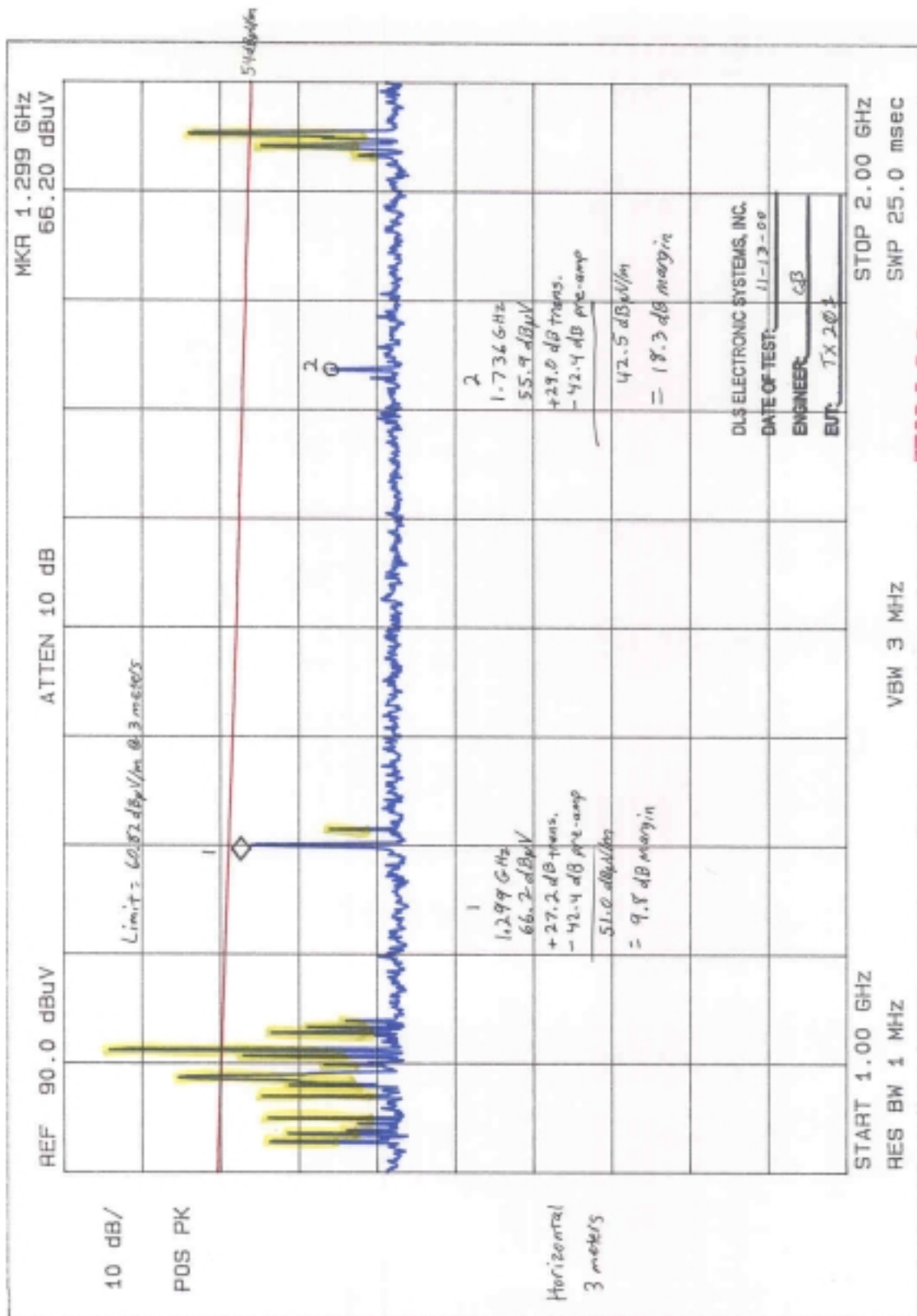


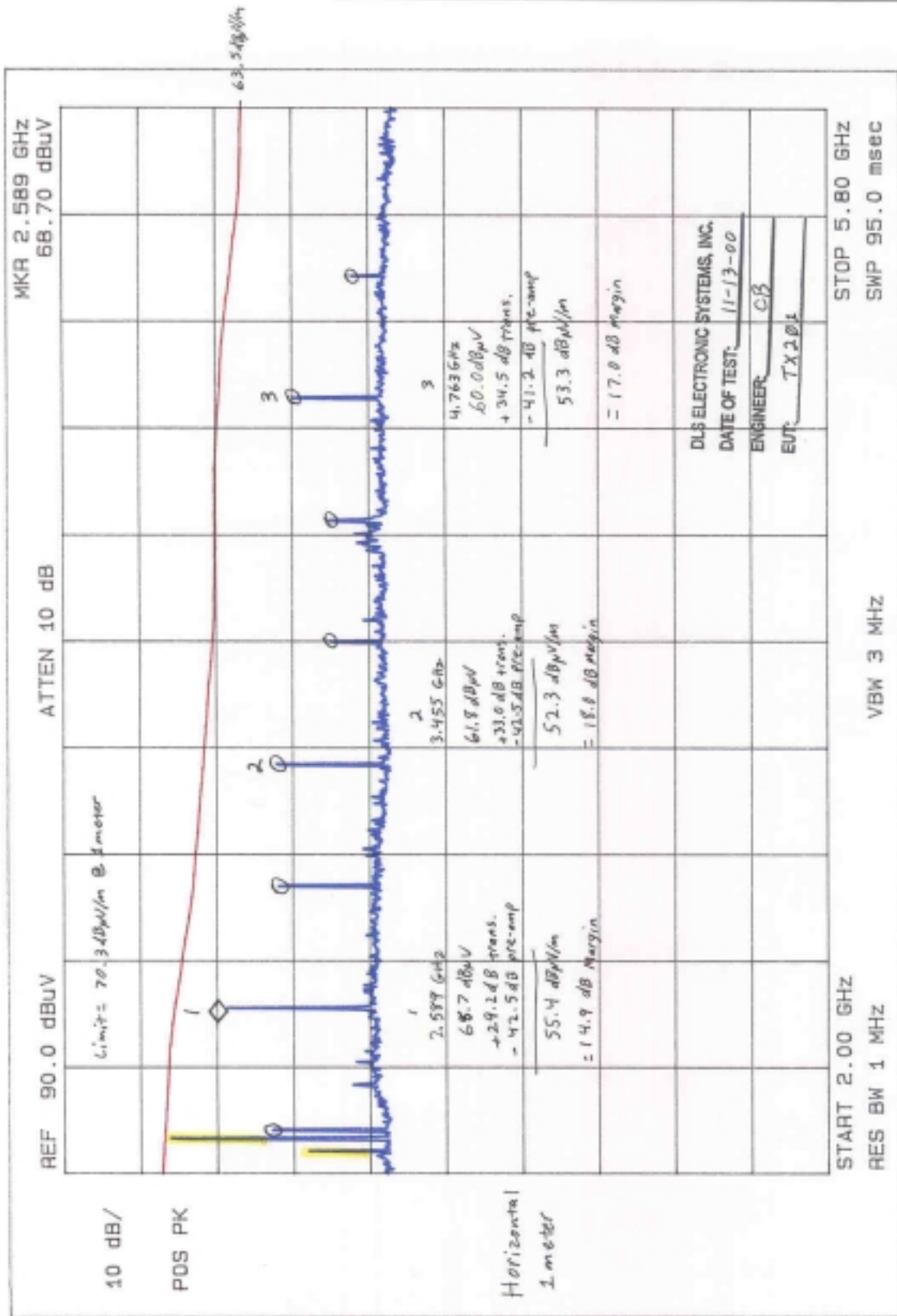
**FINAL**  
Genoa





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## 8.0 DUTY CYCLE CORRECTION FACTOR

### **NOTE:**

**The Duty Cycle Correction Factor does not need to be determined because the measurements made using the Quasi Peak detector are under the 15.231b limit.**



# **PULSED OPERATION CHARTS TAKEN DURING TESTING**

## **PART 15.231**

### **GRAPHS TAKEN OF THE PULSE TRAIN SHOWING THE FOLLOWING:**

1. NUMBER OF BITS PER DATA WORD
2. NUMBER OF PULSES PER 100 MSEC
3. OFF TIME BETWEEN DATA WORDS
4. DATA WORD ON TIME

#### **NOTE:**

**The Duty Cycle Correction Factor does not need to be determined because the measurements made using the Peak detector are under the 15.231b limit.**

## 9.0 BANDWIDTHS

The bandwidth of the transmitter shall be confined to the following specifications as specified in Section 15.231c & d:

40.66 to 40.7 MHz	$\pm .01\%$ within the band edges
70.00 to 900 MHz	.25% of the center frequency
Above 900 MHz	.50% of the center frequency

The bandwidth is determined at the points 20 dB down from the modulated carrier.

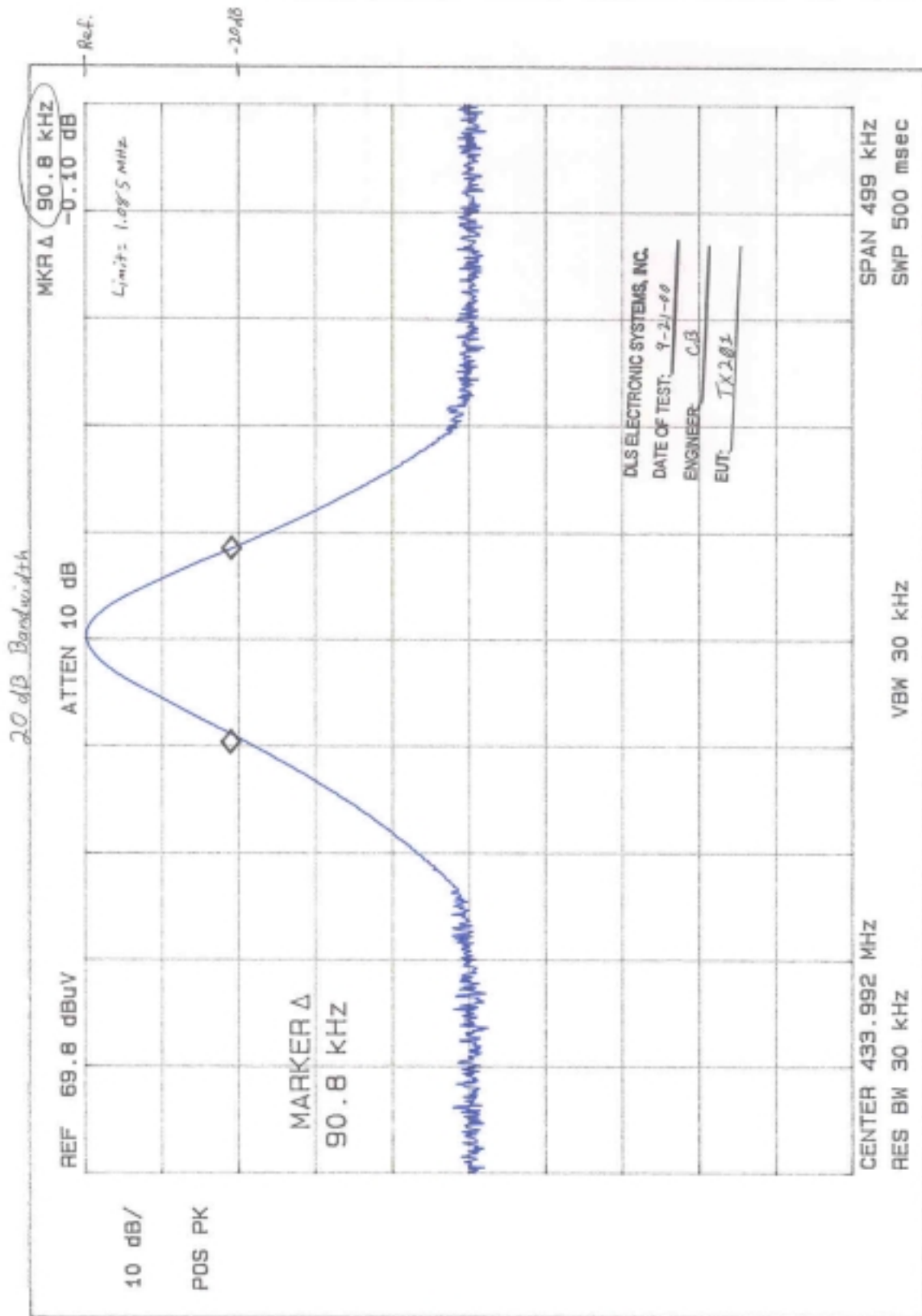
As shown by the graph on the following page, the bandwidth for the Run Safe Tire Pressure Warning System was measured at 90.8 kHz, which meets the above specification. With a fundamental frequency of 433.92 MHz, the margin is 994 kHz when multiplying the fundamental by .25% and subtracting it from the measured bandwidth.



EMC Test Services  
1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

## **GRAPHS TAKEN OF THE FUNDAMENTAL FREQUENCY AND BANDWIDTH**



**FINAL**  
Genoa



## 10.0 RESTRICTED BANDS

As stated in Section 15.205a, the fundamental emission from the Run Safe Tire Pressure Warning System shall not fall within any of the bands listed below:

Frequency in MHz	Frequency in MHz	Frequency in MHz	Frequency in GHz
.0900 to .1100	162.0125 to 167.17	2310.0 to 2390	9.30 to 9.50
.4900 to .5100	167.7200 to 173.20	2483.5 to 2500	10.60 to 12.70
2.1735 to 2.1905	240.000 to 285.00	2655.0 to 2900	13.25 to 13.40
8.362 to 8.3660	322.200 to 335.40	3260.0 to 3267	14.47 to 14.50
13.36 to 13.410	399.900 to 410.00	3332.0 to 3339	15.35 to 16.20
25.50 to 25.670	608.000 to 614.00	3345.8 to 3358	17.70 to 21.40
37.50 to 38.250	960.000 to 1240.00	3600.0 to 4400	22.01 to 23.13
73.00 to 75.500	1300.000 to 1427.00	4500.0 to 5250	23.60 to 24.00
108.00 to 121.94	1435.000 to 1626.50	5350.0 to 5450	31.20 to 31.80
123.00 to 138.00	1660.000 to 1710.00	7250.0 to 7750	36.43 to 36.50
149.90 to 150.00	1718.800 to 1722.20	8025.0 to 8500	ABOVE 38.60
156.70 to 156.90	2200.000 to 2300.00	9000.0 to 9200	

### NOTE:

**The noise floor within the Restricted Bands for the EMC Receiver and HP Spectrum Analyzer typically lies 20 dB below the limit.**



## 11.0 PHOTO INFORMATION AND TEST SET-UP

The test set-up can be seen on the accompanying photo page.

Item 0 Run Safe Tire Pressure Warning System  
FCC ID#: PC8-TX-201 SN: NA

Item 1

Item 2

Item 3

Item 4

Item 5

Item 6

Item 7

Item 8

Item 9

Item 10



EMC Test Services  
1250 Peterson Drive, Wheeling, Illinois 60090, USA

Report No. 8640  
11/28/00

## 12.0 CONDUCTED PHOTOS TAKEN DURING TESTING.

**The equipment under test is battery operated and will not at any time be plug into the Public Utility lines, therefore the conducted test was not performed.**

## 12.0 RADIATED PHOTOS TAKEN DURING TESTING





### 13.0 CHANGE INFORMATION

The following changes were implemented during the testing and must be incorporated into the production units to ensure compliance.

Change 1.      There were no changes made at D.L.S. Electronic Systems, Inc.

Change 2.

Change 3.

Change 4.

Change 5.



### 13.0 CHANGE INFORMATION (CON'T)

Change 6.

Change 7.

Change 8.

Change 9.

Change 10.

The responsibility of implementing the changes listed in this report is accepted or I certify that no changes were made

by \_\_\_\_\_  
Signature Title

for \_\_\_\_\_  
Company Name Date



#### 14.0 RESULTS OF TESTS

The emission test results can be seen on pages at the end of this report. Data sheets indicating the open field radiated measurements can also be found with this report. Those points on the radiated charts shown with a yellow mark are background frequencies that were verified during the test.

#### 15.0 CONCLUSION

It was found that the Transmitter, Model Number TX-201, S/N NA meets the radio interference emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Sections 15.231 (a-b), 15.207 and 15.205 for Intentional Radiators operating in the bands 40.66 to 40.77 MHz and above 70 MHz. This test report relates only to the items tested.

#### NOTE:

**The conducted emissions test was not required because the EUT is powered from an DC power source. It does not have a line cord to plug into the A.C. power line.**

This report contains the following number of pages.

Text:	29 pages
Data Summary:	4 pages
Charts:	9 pages

TABLE 1 - EQUIPMENT LIST

Test Equipment	Manufacturer/Description	Model Number	Serial Number	Frequency Range	Cal Due Date
*Spectrum Analyzer	Hewlett/Packard	8566B	2240A 02041	25 Hz –22 GHz	4/01
Quasi-Peak Adapter	Hewlett/Packard	85650A	2043A 00121	10 kHz – 1 GHz	4/01
***Spectrum Analyzer	Hewlett/Packard	8591A	3009A 00700	9 kHz- 1.8 GHz	6/01
Receiver	Electrometrics	EMC-25 Mark-III	772	.01-1000 MHz	10/01
Meter Module	Electrometrics	CRM-25	162	.01-1000 MHz	10/01
Receiver	Electrometrics	EMC-25 Mark-III	804	.01-1000 MHz	10/01
Meter Module	Electrometrics	CRM-25	138	.01-1000 MHz	10/01
Receiver	Electrometrics	EMC-25 Mark-III	645	.01-1000 MHz	10/01
Meter Module	Electrometrics	CRM-25	116	.01-1000 MHz	10/01
Receiver	Electrometrics	EMC-30 Mark-III	44168	.01-1000 MHz	10/01
Antenna	Electrometrics	BIA-25	2453	20 - 200 MHz	10/01
Antenna	Electrometrics	LPA-25	1114	200 - 1000 MHz	10/01
Antenna	Electrometrics	BIA-25	2614	20 - 200 MHz	10/01
Antenna	Electrometrics	LPA-25	1205	200 - 1000 MHz	10/01
Antenna	Electrometrics	BIA-25	4785	20 - 200 MHz	10/01
Antenna	Electrometrics	LPA-25	4895	200 - 1000 MHz	10/01

\*Firmware Version 29.9.86 Software Version 85864C Rev A

\*\*Firmware Version 14.1.85 Software Version 85864C Rev A

\*\*\*Firmware Version 5.1.3 Software Version 82301-12029 Rev C

I/O Initial Calibration Only