



**Radio Systems Corporation
FCC Part 15, Certification Application
Model PRO-TX1**

August 15, 2002

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Radio Systems Corporation**

MODEL: **PRO-TX1**

FCC ID: **KE3PROTX1**

DATE: **August 15, 2002**

This report concerns (check one): Original grant X
Class II change

Equipment type: **Low Frequency, Low Power Transmitter**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes No X

If yes, defer until:
date

N.A. agrees to notify the Commission by NA
date

of the intended date of announcement of the product so that the grant can be issued on that date.

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SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

Product Description

The Equipment Under Test (EUT) is a Radio Systems Corporation Low Frequency, Low Power Pet Containment System Model PRO-TX1. The EUT is a dog fence transmitter. The EUT has the capability of 2 different independent zones (each designed for different size areas) and also utilizes a user selectable frequency (7.37 kHz & 10.65 kHz).

Related Submittal(s) Grant(s)

The EUT is subject to the following authorizations:

- a) Certification as a low power transmitter (10.65 kHz)

The information contained in this report is presented for the Certification authorization for the transmitter portion of the EUT.

SECTION 2

TESTS AND MEASUREMENTS

TESTS AND MEASUREMENTS

Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 30 MHz -1 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 100 Hz (9 kHz – 150 kHz), 9kHz (150 kHz - 30 MHz), and 120 kHz (30 MHz - 1 GHz) respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

Only one channel was selected for test since the unit operates on less than a 1 MHz band of channels. The 10.65 kHz was selected for test since the FCC does not approve transmitters below 9 kHz.

The EUT was set up with a 300' length of wire connected to it, to simulate a typical installation. The wire was not buried, as it would be in a typical installation (approximately 2 -3 inches). Measurements were taken at all three antenna polarities along one of the long edges (111') of the rectangle at a distance of 3 meters to characterize the emissions. The worse case emissions were then tested at 10 meters. Results between 100 kHz and 30 MHz were corrected to 30 meters by the following $40 \log (300/10) = 59.1$ dB. Those results below 100 kHz were corrected to 300 meters by the following $60 \log (300/10) = 88.6$ dB (which has been applied to other submittals and is allowed per previous discussions with Greg Czumak at the FCC).

Test Facility

Conducted and digital device testing was performed at US Tech's measurement facility as described to the FCC and acknowledged in their letter marked 31040/SIT/USTECH.

Additional radiated testing was performed at a vacant area that would allow measurements to be made 10 meters away from the EUT with the 300' length of wire connected to it.

Test Equipment

Table 2 describes test equipment used to evaluate this product.

Modifications

No modifications were made to bring the EUT into compliance with FCC Part 15, Class B Requirements:

FIGURE 1
TEST CONFIGURATION

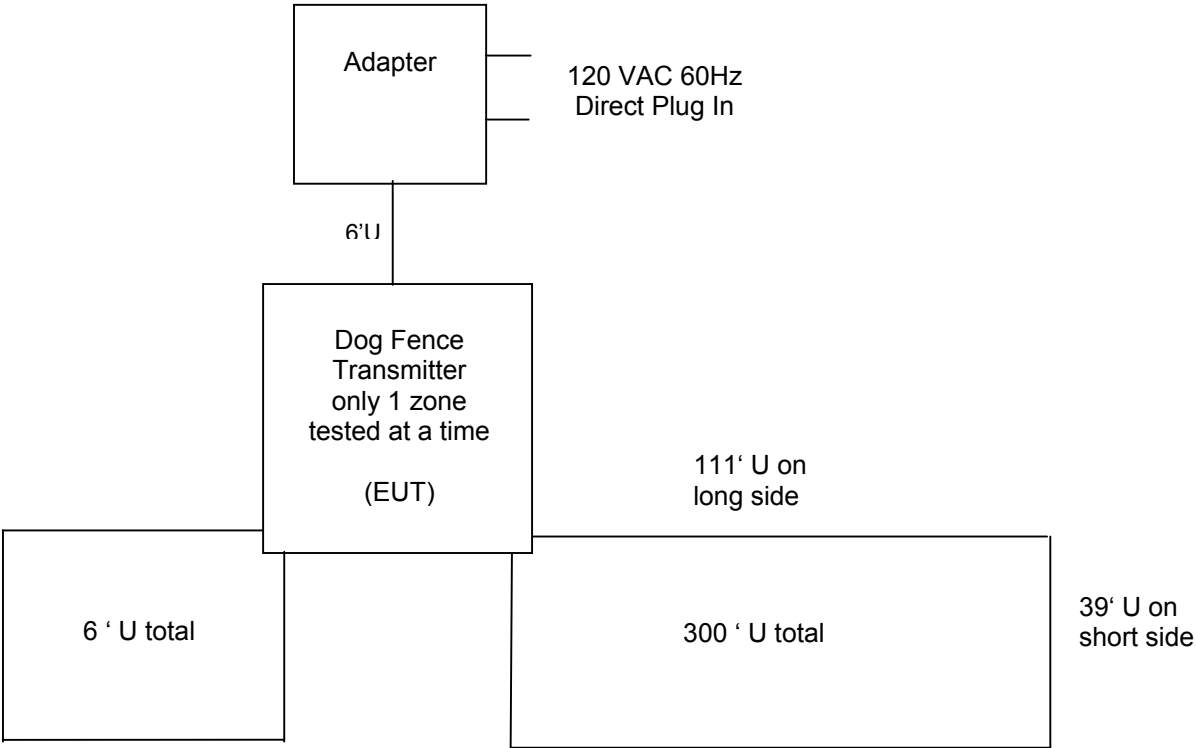


FIGURE 2a

Photograph(s) for Spurious and Fundamental Emissions



FIGURE 2b

Photograph(s) for Spurious and Fundamental Emissions



FIGURE 2c

Photograph(s) for Spurious and Fundamental Emissions

(Photograph Shows 1st portion of testing at 3 meters)



FIGURE 2d

Photograph(s) for Spurious and Fundamental Emissions



FIGURE 2e

Photograph(s) for Spurious and Fundamental Emissions



FIGURE 2f

Photograph(s) for Digital Device Emissions



FIGURE 2g

Photograph(s) for Digital Device Emissions



FIGURE 2h

Photograph(s) for Conducted Emissions



EUT and Peripherals

| PERIPHERAL MANUFACTURER | MODEL NUMBER | SERIAL NUMBER | FCC ID: | CABLES P/D |
|---|-----------------|------------------|------------------------|----------------|
| Dog Fence Transmitter Radio Systems Corporation (EUT) | PRO-TX1 | None | KE3PROTX1 (pending) | 300' U 6' U |
| Adapter Manufacturer Unknown | 300-021 | None | N/A | 6' U |

TABLE 2
TEST INSTRUMENTS

| TYPE | MANUFACTURER | MODEL | SN. |
|----------------------|-----------------|------------|------------|
| SPECTRUM ANALYZER | HEWLETT-PACKARD | 8593E | 3205A00124 |
| SPECTRUM ANALYZER | HEWLETT-PACKARD | 8558B | 2332A09900 |
| S A DISPLAY | HEWLETT-PACKARD | 853A | 2404A02387 |
| COMB GENERATOR | HEWLETT-PACKARD | 8406A | 1632A01519 |
| RF PREAMP | HEWLETT-PACKARD | 8447D | 1937A03355 |
| BICONICAL ANTENNA | EMCO | 3110 | 9307-1431 |
| LOOP ANTENNA | AH SYSTEMS | SAS200/562 | 142 |
| LOG PERIODIC ANTENNA | EMCO | 3146 | 9110-3600 |
| BILOG | CHASE | CBL6112A | 2238 |
| LISN | SOLAR ELE. | 8028 | N/A |

Field Strength of Fundamental Emission (47 CFR 15.209)

Measurements were made using a peak detector. Field strength of the peak fundamental emission is shown in Tables 3.

For purposes of this test, the EUT was set to a maximum duty cycle, maximum TX power, and 10.65 kHz transmit frequency.

Duty Cycle Correction During 100 msec:

Although the Transmitter has a Duty Cycle associated with the output of the transmitter, Duty Cycle correction was not applied.

FIGURE 3

**Duty Cycle Correction Not Applied
Therefore This Page is Intentionally Left Blank**

TABLE 3

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: August 13 & 14, 2002
 UST Project: 02-0246
 Customer: Radio Systems Corporation
 Model: PRO-TX1

Peak Measurements, Average Limits
Zone 1

| FREQ. (kHz) | TEST DATA (dBm) @ 10m | ANTENNA FACTOR + CABLE ATTENUATION | PEAK RESULTS (uV/m) @ 300m | AVERAGE FCC LIMITS (uV/m) @ 300m |
|----------------|-----------------------------|--|-------------------------------------|---|
| 10.65 | -65.78 | 75.7 | 26.1 | 225.4 |

Zone 2

| FREQ. (kHz) | TEST DATA (dBm) @ 10m | ANTENNA FACTOR + CABLE ATTENUATION | PEAK RESULTS (uV/m) @ 300m | AVERAGE FCC LIMITS (uV/m) @ 300m |
|----------------|-----------------------------|--|-------------------------------------|---|
| 10.65 | -80.96 | 75.7 | 4.53 | 225.4 |

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog $((-65.78 + 75.7 + 107 - 88.6)/20) = 26.1$

CONVERSION FROM dBm TO dBuV = 107 dB

CORRECTION FROM 10m TO 300m = -88.6 dB

Tested By: 

Name: Austin E. Thompson, Jr.

Field Strength Of Spurious Emissions (47 CFR 15.209)

Measurements were made using a peak detector. Field strength of Spurious Emissions are shown in Table 4. For all emission measurements made the limits given in 15.209 were applied.

For purposes of this test, the EUT was set to a maximum duty cycle, maximum TX power, and 10.65 kHz transmit frequency.

TABLE 4

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: August 13 & 14, 2002
 UST Project: 02-0246
 Customer: Radio Systems Corporation
 Model: PRO-TX1

Peak Readings (< 30 MHz), Average Limits
Zone 1

| FREQ. (kHz.) | TEST DATA (dBm) @ 10m | ANTENNA FACTOR + CABLE ATTENUATION | PEAK RESULTS (uV/m) @ 300m | AVERAGE FCC LIMITS (uV/m) @ 300m |
|-----------------|-----------------------------|--|-------------------------------------|---|
| 24.5 | -91.4 | 70.2 | 0.72 | 98.0 |
| 31.2 | -90.9 | 68.2 | 0.61 | 76.9 |

Zone 2

| FREQ. (kHz.) | TEST DATA (dBm) @ 10m | ANTENNA FACTOR + CABLE ATTENUATION | PEAK RESULTS (uV/m) @ 300m | AVERAGE FCC LIMITS (uV/m) @ 300m |
|-----------------|-----------------------------|--|-------------------------------------|---|
| 19.97 | -82.5 | 71.8 | 2.4 | 120.2 |
| 40.01 | -77.1 | 46.6 | 0.25 | 60.0 |

** = Ground Floor

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog $((-91.4 + 70.2 + 107 - 88.6)/20)$ = 0.72

CONVERSION FROM dBm TO dBuV = 107 dB

CORRECTION FROM 10m TO 300m = -88.6 dB

Tested By: 

Name: Austin E. Thompson Jr.

Radiated Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 1000 MHz. Measurements were made with the analyzer's bandwidth set to 120 kHz. These results are shown Table 5.

TABLE 5

FIELD STRENGTH OF SPURIOUS EMISSIONS (47 CFR 15.209)

CLASS B

Test Date: August 13, 2002
UST Project: 02-0246
Customer: Radio Systems Corporation
Model: PRO-TX1

Digital Device Emissions actually tested while in TX Mode

| Frequency (MHz) | Test Data (dBm) @3m | Ant. Factor + Cable Atten. - Amp Gain | Results (uV/m) | FCC Limits (uV/m) @3m | Margin Below FCC Limit (dB) |
|--|---------------------------|--|-------------------|-----------------------------|-----------------------------------|
| No emissions signals were seen from the EUT between the range of 30 MHz to 1 GHz | | | | | |

Tested by
Signature:



Name: David Blethen

Power Line Conducted Emissions (47 CFR 15.107a)

Conducted Emissions were evaluated from 450 kHz to 30 MHz. Measurements were made with the analyzer's bandwidth set to 9 kHz, emissions are shown in Table 6. The EUT was checked with a 300' fence length.

TABLE 6a CONDUCTED EMISSIONS DATA**CLASS B**

Test Date: August 13, 2002
UST Project: 02-0246
Customer: Radio Systems Corporation
Model: PRO-TX1

(PEAK/QP vs. QP LIMITS)

PHASE MEASUREMENT

| FREQ. (MHz) | TEST DATA (dBuV) PHASE | LISN LOSS (dB) PHASE | CABLE FACTOR (dB) | RESULTS (dBuV) PHASE | FCC LIMITS (dBuV) | MARGIN BELOW LIMIT (dB) PHASE |
|------------------------|---|-------------------------------------|----------------------------------|-------------------------------------|----------------------------------|--|
| 0.15 | 57.8 | 0.3 | 0.1 | 58.2 | 66.0 | 7.8 |
| 1.49 | 22.8 | 0.1 | 0.1 | 23.0 | 56.0 | 33.0 |
| 3.38 | 22.2 | 0.1 | 0.4 | 22.6 | 56.0 | 33.4 |
| 5.96 | 18.8 | 0.1 | 0.4 | 19.3 | 60.0 | 40.7 |
| 7.80 | 18.3 | 0.1 | 0.4 | 18.8 | 60.0 | 41.2 |
| 25.38 | 18.7 | 0.1 | 0.8 | 19.7 | 60.0 | 40.3 |

EN55022 Limits were used since they are considered more restrictive than the current FCC Limits and also to show compliance with the New Harmonized Limits that will soon be implemented by the FCC.

SAMPLE CALCULATIONS:

RESULTS dBuV = 57.8 + 0.3 + 0.1 = 58.2

Tested by
Signature: David B. Blethen **Name:** David Blethen

TABLE 6b CONDUCTED EMISSIONS DATA**CLASS B**

Test Date: August 13, 2002
UST Project: 02-0246
Customer: Radio Systems Corporation
Model: PRO-TX1

(PEAK/QP vs. QP LIMITS)

NEUTRAL DATA

| FREQUENCY (MHz) | TEST DATA (dBuV) NEUTRAL | LISN LOSS (dB) NEUTRAL | CABLE FACTOR (dB) | RESULTS (dBuV) NEUTRAL | EN55022 CLASS A LIMITS (dBuV) | MARGIN BELOW LIMIT (dB) NEUTRAL |
|----------------------------|---|---------------------------------------|----------------------------------|---------------------------------------|--|--|
| 0.15 | 58.2 | 0.3 | 0.1 | 58.6 | 66.0 | 7.4 |
| 1.49 | 18.9 | 0.1 | 0.1 | 19.1 | 56.0 | 36.9 |
| 10.79 | 15.2 | 0.1 | 0.5 | 15.8 | 60.0 | 44.3 |
| 17.10 | 15.8 | 0.1 | 0.6 | 16.5 | 60.0 | 43.5 |
| 21.40 | 15.0 | 0.1 | 0.8 | 15.9 | 60.0 | 44.1 |
| 23.88 | 16.0 | 0.1 | 0.8 | 16.9 | 60.0 | 43.1 |

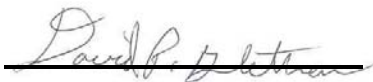
EN55022 Limits were used since they are considered more restrictive than the current FCC Limits and also to show compliance with the New Harmonized Limits that will soon be implemented by the FCC.

SAMPLE CALCULATIONS:

RESULTS dBuV = 58.2 + 0.3 + 0.1 = 58.6

Tested by

Signature:



Name: David Blethen

TABLE 6c CONDUCTED EMISSIONS DATA**CLASS B**

Test Date: August 13, 2002
UST Project: 02-0246
Customer: Radio Systems Corporation
Model: PRO-TX1

(AVERAGE vs. AVERAGE LIMITS)

PHASE MEASUREMENT

| FREQ. (MHz) | TEST DATA (dBuV) PHASE | LISN LOSS (dB) PHASE | CABLE FACTOR (dB) | RESULTS (dBuV) PHASE | FCC LIMITS (dBuV) | MARGIN BELOW LIMIT (dB) PHASE |
|------------------------|---|-------------------------------------|----------------------------------|-------------------------------------|----------------------------------|--|
| 0.15 | 12.6 | 0.3 | 0.1 | 13.0 | 56.0 | 43.0 |
| 1.49 | 11.0 | 0.1 | 0.1 | 11.3 | 46.0 | 34.7 |
| 3.38 | 8.1 | 0.1 | 0.4 | 8.6 | 46.0 | 37.4 |
| 5.96 | 6.2 | 0.1 | 0.4 | 6.7 | 50.0 | 43.3 |
| 7.80 | 5.8 | 0.1 | 0.4 | 6.3 | 50.0 | 43.3 |
| 25.38 | 11.3 | 0.1 | 0.8 | 12.3 | 50.0 | 37.7 |

EN55022 Limits were used since they are considered more restrictive than the current FCC Limits and also to show compliance with the New Harmonized Limits that will soon be implemented by the FCC.

SAMPLE CALCULATIONS:

RESULTS dBuV = 12.6 + 0.3 + 0.1 = 13.0

Tested by
Signature: David P. Blethen **Name:** David Blethen

TABLE 6d CONDUCTED EMISSIONS DATA**CLASS B**

Test Date: August 13, 2002
UST Project: 02-0246
Customer: Radio Systems Corporation
Model: PRO-TX1

(AVERAGE vs. AVERAGE LIMITS)

NEUTRAL DATA

| FREQUENCY (MHz) | TEST DATA (dBuV) NEUTRAL | LISN LOSS (dB) NEUTRAL | CABLE FACTOR (dB) | RESULTS (dBuV) NEUTRAL | EN55022 CLASS A LIMITS (dBuV) | MARGIN BELOW LIMIT (dB) NEUTRAL |
|----------------------------|---|---------------------------------------|----------------------------------|---------------------------------------|--|--|
| 0.15 | 7.0 | 0.3 | 0.1 | 7.4 | 56.0 | 48.6 |
| 1.49 | 4.7 | 0.1 | 0.1 | 5.0 | 46.0 | 41.0 |
| 10.79 | 4.1 | 0.1 | 0.5 | 4.7 | 50.0 | 45.3 |
| 17.10 | 4.5 | 0.1 | 0.6 | 5.2 | 50.0 | 44.8 |
| 21.40 | 4.3 | 0.1 | 0.8 | 5.2 | 50.0 | 44.9 |
| 23.88 | 4.1 | 0.1 | 0.8 | 5.0 | 50.0 | 45.0 |

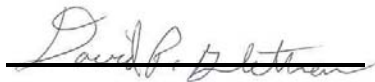
EN55022 Limits were used since they are considered more restrictive than the current FCC Limits and also to show compliance with the New Harmonized Limits that will soon be implemented by the FCC.

SAMPLE CALCULATIONS:

$$\text{RESULTS dBuV} = 7.0 + 0.3 + 0.1 = 7.4$$

Tested by

Signature:



Name: David Blethen