



**RADIATION SCIENCES INC.**

**TEST REPORT NO. RSI-2062E**  
**ELECTROMAGNETIC INTERFERENCE (EMI)**  
**OF THE**  
**TACTICAL TECHNOLOGIES INC.**  
**MODEL # TX400**  
**FCC PART 15, SUBPART C §15.231**  
**25 MAY 2000**

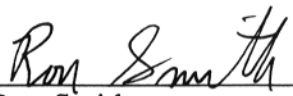
**PREPARED FOR:**

**Tactical Technologies**  
1701 Second Avenue  
Folsom, PA 19033

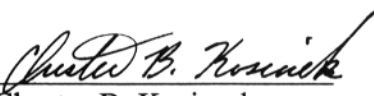
**SUBMITTED BY:**

**Radiation Sciences Inc.**  
3131 Detwiler Road  
Harleysville, PA 19438

**PREPARED BY:**

  
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Ron Smith  
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**REVIEWED BY:**

  
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Chester B. Kosiorek  
EMC Engineer  
**Radiation Sciences Inc.**



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**ADMINISTRATIVE DATA**

**TEST PERFORMED:**

Measurements of radiated RF and conducted emissions.

**PURPOSE OF TEST:**

To evaluate the ElectroMagnetic Interference (EMI) characteristics of the Equipment Under Test with respect to Subpart B and C of Part 15 of the Federal Communications Commission (FCC) Rules for intentional and unintentional radiators.

**EQUIPMENT UNDER TEST (EUT):**

Model Number: **TX400**

**CONTRACT:**

Purchase Order Number: 11338

**TEST PERIOD:**

4-9 May 2000

**TEST FACILITY:**

**Radiation Sciences Incorporated (RSI)**, EMI/EMC Test Laboratory, located at: 3131 Detwiler Road, Harleysville, Pennsylvania 19438.

**TEST PERSONNEL AND COORDINATORS:**

**Radiation Sciences Inc.**

Chet Kosiorek  
Ron Smith

**Tactical Technologies, Inc.**

Jeff Olsen



**SUMMARY OF TEST RESULTS**

The **Model TX400**, configured as described herein, **FULLY COMPLIES WITH THE REQUIREMENTS SET FORTH IN SUBPART B AND C OF PART 15 OF THE FEDERAL COMMUNICATIONS COMMISSION (FCC) RULES FOR INTENTIONAL AND UNINTENTIONAL RADIATORS.**



## **1.0 INTRODUCTION**

This document is a report of tests to determine the ElectroMagnetic Interference (EMI) characteristics of the **Model # TX400** presented by **Tactical Technologies** of Folsom, Pennsylvania.

The purpose of the testing was to evaluate the EMI characteristics of the test sample with respect to Subpart B and C of Part 15 of the FCC Rules for intentional and unintentional radiators.

Test setups and procedures are described in **RSI's Test Procedures 4963E** (see Appendix B) and test results are summarized herein on graphs.

All test procedures used meet the requirements of the American National Standards Institute Procedure C63.4: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz", dated 17 July 1992.



**2.0 DESCRIPTION OF THE TEST SAMPLE:**

The test sample is a saw controlled FM transmitter operating at 418MHz.

**3.0 TEST INSTRUMENTATION**

| <u>RSI<br/>INV<br/>#</u> | <u>DESCRIPTION</u> | <u>MANUFACTURER</u> | <u>MODEL #</u> | <u>SERIAL #</u> | <u>LAST<br/>CAL<br/>DATE</u> | <u>CAL<br/>DUE<br/>DATE</u> | <u>C<br/>Y<br/>C<br/>L<br/>E</u> | <u>T<br/>Y<br/>P<br/>E</u> |
|--------------------------|--------------------|---------------------|----------------|-----------------|------------------------------|-----------------------------|----------------------------------|----------------------------|
| 31                       | SPEC ANALYZER      | ADVANTEST           | R3271          | J003583         | 2/23/2000                    | 2/23/2001                   | 12                               | C                          |
| 32                       | SPEC. ANALY.       | H.P.                | 8568B          | 2841A04457      | 4/27/2000                    | 4/27/2001                   | 12                               | C                          |
| 33                       | SPEC. ANALY.       | H.P.                | 85662A         | 2848A17406      | 4/27/2000                    | 4/27/2001                   | 12                               | C                          |
| 77                       | ANTENNA            | TENSOR              | 4108           | 2011            | 5/25/1999                    | 5/25/2000                   | 12                               | UC                         |
| 83                       | ANTENNA            | EMCO                | 3146           | 1554            | 12/1/1999                    | 12/1/2000                   | 12                               | V                          |
| 91                       | ANTENNA            | EMCO                | 3115           | 2023            | 5/22/2000                    | 5/22/2001                   | 12                               | C                          |
| 391                      | RECEIVER           | R & S               | ESVP           | 861744/015      | 4/18/2000                    | 4/18/2001                   | 12                               | C                          |



#### **4.0 TEST RESULTS**

##### **4.1 Conducted Power Line Measurements, Paragraph §15.107**

No measures were performed on the **Model TX400** because it is a battery operated unit.



#### **4.2 Emission Bandwidth, FCC Part 15, §15.231c)**

The bandwidth requirement for intentional transmitters operating above 70MHz is that the bandwidth of the emission shall be no wider than 0.25% of the center frequency of the device measured at the 20dB points.

The center frequency of the **Model TX400** is 418MHz. Thus, the bandwidth cannot exceed 1.04MHz.

The measured bandwidth of the **TX400** is 133MHz as shown on the bandwidth data sheet, Figure 1.

Figure 2 is a photograph of the test setup and Figure 3 is a photograph showing the fundamental emission (Top) and the hi side 20dB down point (bottom).

Company: Tactical Technologies Inc.  
Model # TX400

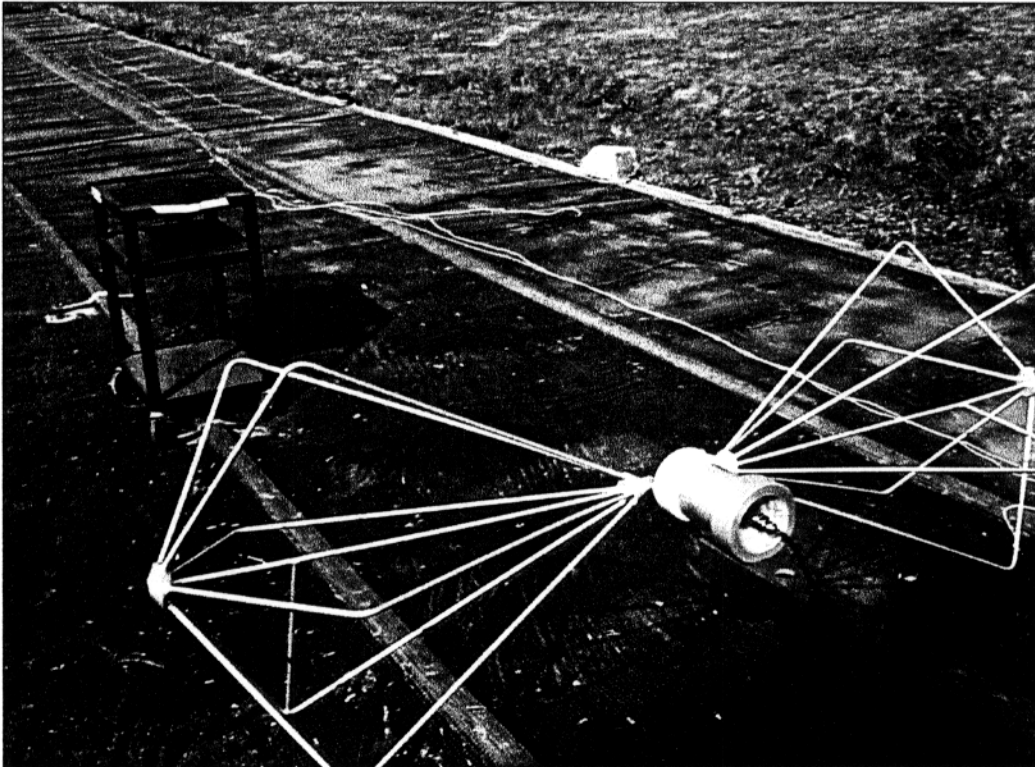
Test Personnel: Chester Kosiorek  
Date: 5/9/00

### Bandwidth of Fundamental Frequency

|                  | Frequency<br>(MHz) | Measurement<br>(dBuV/m) |
|------------------|--------------------|-------------------------|
| Center Frequency | 418.047            | 112                     |
| 20dB Down        | 418.082            | 92                      |
| 20dB Down        | 417.949            | 92                      |

Bandwidth is 133 KHz

**FIGURE 1**



Name: DCP01449.JPG  
Dimensions: 1152 x 864 pixels

**RADIATED TEST SETUP PHOTOGRAPH**

**FIGURE 2**

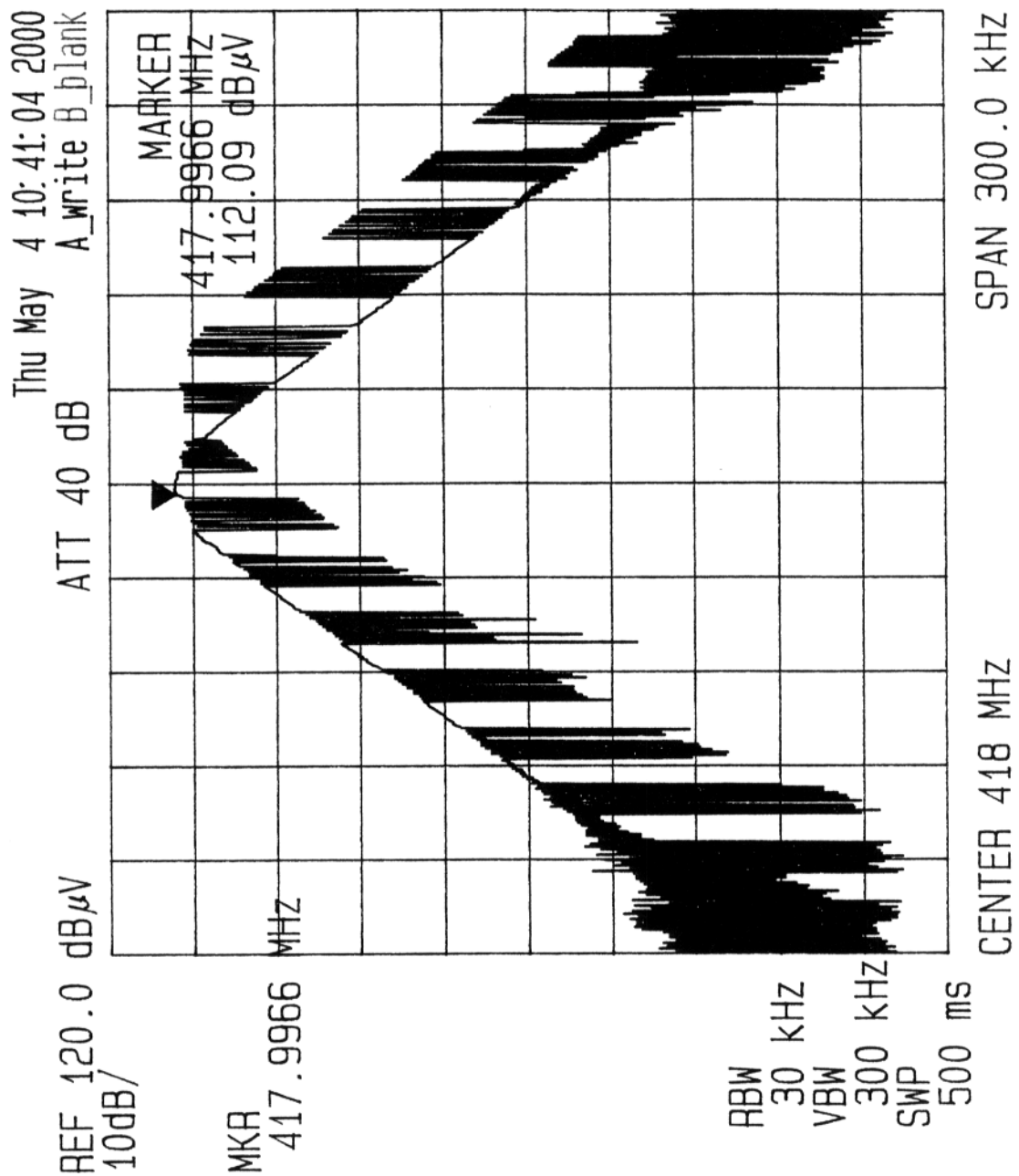


FIGURE 3



**4.3 Radiated Emission Measurements, Paragraphs 15.33, 15.35, 15.109, 15.205, 15.209 and 15.231**

Radiated emission measurements were recorded for the test sample at a distance of 3 meters unless otherwise stated. The results of field strength measurements are illustrated on Figure 4 for Intentional radiators and Figure 5 for Unintentional radiators. Radiated emissions were measured with the antenna in both the horizontal and vertical polarizations. The antenna was raised 1 to 4 meters in height and the equipment under test (EUT) was rotated 360° to maximize the mission.

During radiated emissions testing the EUT was scanned from 30MHz to 4.18GHz (10 times the fundamental).

An average factor of 20dB was applied to the level of the fundamental emission when compared to the FCC limit.

**ALL LEVELS COMPLY WITH APPLICABLE LIMITS.**



**RADIATION SCIENCES INC.**

Company: Tactical Technologies Inc.  
Model # TX400

Test Personnel: Chester Kosiorek  
Date: 5/9/00

### Radiated Emission for Intentional Radiators

| Frequency<br>(MHz) | Polarity | Antenna<br>Height<br>(Meters) | Antenna<br>Azimuth<br>(Degrees) | Indicated<br>Level<br>(dBuV) | Antenna<br>Factor<br>(dB) | Distance<br>Factor<br>1m to 3m<br>(dB) | Cable<br>Loss<br>(dB) | Averaging<br>Factor<br>(dB) | Field<br>Strength<br>@ 3m<br>(dBuV/m) | Limits<br>@ 3m<br>(dBuV/m) | Field<br>Strength<br>@ 3m<br>(uV/m) | Limits<br>@ 3m<br>(uV/m) | Margin<br>(dB) |
|--------------------|----------|-------------------------------|---------------------------------|------------------------------|---------------------------|----------------------------------------|-----------------------|-----------------------------|---------------------------------------|----------------------------|-------------------------------------|--------------------------|----------------|
| 418.0              | Vert     | 1.30                          | 0                               | 49.0                         | 18.0                      | 0.0                                    | 1.6                   | -20.0                       | 48.6                                  | 72.3                       | 269                                 | 4133.3                   | -23.7          |
| 836                | Vert     | 1.20                          | 0                               | 18.0                         | 23.0                      | 0.0                                    | 4.0                   | -20.0                       | 25.0                                  | 54.0                       | 18                                  | 500                      | -29.0          |
| 1254               | Vert     | 1.30                          | 0                               | 19.0                         | 23.0                      | -10.0                                  | 4.0                   | -20.0                       | 16.0                                  | 54.0                       | 6                                   | 500                      | -38.0          |
| 1672               | Vert     | 1.00                          | 0                               | 17.0                         | 24.0                      | -10.0                                  | 4.0                   | -20.0                       | 15.0                                  | 54.0                       | 6                                   | 500                      | -39.0          |
| 2090               | Vert     | 1.00                          | 0                               | 28.5                         | 27.0                      | -10.0                                  | 4.0                   | -20.0                       | 29.5                                  | 54.0                       | 30                                  | 500                      | -24.5          |
| 2508               | Vert     | 1.00                          | 0                               | 18.0                         | 28.0                      | -10.0                                  | 4.0                   | -20.0                       | 20.0                                  | 54.0                       | 10                                  | 500                      | -34.0          |
| 2926               | Vert     | 1.00                          | 0                               | 16.0                         | 29.0                      | -10.0                                  | 4.0                   | -20.0                       | 19.0                                  | 54.0                       | 9                                   | 500                      | -35.0          |
| 3344               | Vert     | 1.00                          | 0                               | 12.0                         | 31.0                      | -10.0                                  | 4.0                   | -20.0                       | 17.0                                  | 54.0                       | 7                                   | 500                      | -37.0          |
| 3762               | Vert     | 1.00                          | 0                               | 12.0                         | 32.0                      | -10.0                                  | 4.0                   | -20.0                       | 18.0                                  | 54.0                       | 8                                   | 500                      | -36.0          |
| 4180               | Vert     | 1.00                          | 0                               | 12.0                         | 33.0                      | -10.0                                  | 4.0                   | -20.0                       | 19.0                                  | 54.0                       | 9                                   | 500                      | -35.0          |
| 418.0              | Horiz    | 1.70                          | 0                               | 38.5                         | 19.0                      | 0.0                                    | 1.6                   | -20.0                       | 39.1                                  | 72.3                       | 90                                  | 4133.3                   | -33.2          |
| 836                | Horiz    | 1.00                          | 0                               | 14.0                         | 23.0                      | 0.0                                    | 4.0                   | -20.0                       | 21.0                                  | 54.0                       | 11                                  | 500                      | -33.0          |
| 1254               | Horiz    | 1.00                          | 0                               | 17.0                         | 23.0                      | -10.0                                  | 4.0                   | -20.0                       | 14.0                                  | 54.0                       | 5                                   | 500                      | -40.0          |
| 1672               | Horiz    | 1.00                          | 0                               | 13.0                         | 24.0                      | -10.0                                  | 4.0                   | -20.0                       | 11.0                                  | 54.0                       | 4                                   | 500                      | -43.0          |
| 2090               | Horiz    | 1.00                          | 0                               | 27.0                         | 27.0                      | -10.0                                  | 4.0                   | -20.0                       | 28.0                                  | 54.0                       | 25                                  | 500                      | -26.0          |
| 2508               | Horiz    | 1.00                          | 0                               | 18.0                         | 28.0                      | -10.0                                  | 4.0                   | -20.0                       | 20.0                                  | 54.0                       | 10                                  | 500                      | -34.0          |
| 2926               | Horiz    | 1.00                          | 0                               | 17.0                         | 29.0                      | -10.0                                  | 4.0                   | -20.0                       | 20.0                                  | 54.0                       | 10                                  | 500                      | -34.0          |
| 3344               | Horiz    | 1.00                          | 0                               | 13.0                         | 31.0                      | -10.0                                  | 4.0                   | -20.0                       | 18.0                                  | 54.0                       | 8                                   | 500                      | -36.0          |
| 3762               | Horiz    | 1.00                          | 0                               | 12.0                         | 32.0                      | -10.0                                  | 4.0                   | -20.0                       | 18.0                                  | 54.0                       | 8                                   | 500                      | -36.0          |
| 4180               | Horiz    | 1.00                          | 0                               | 12.0                         | 33.0                      | -10.0                                  | 4.0                   | -20.0                       | 19.0                                  | 54.0                       | 9                                   | 500                      | -35.0          |

**FIGURE 4**

Company: Tactical Technologies  
Model # TX400

Test Personnel: Chester B Kosiorek  
Date: 5/9/00  
Frequency Range Tested: 30 MHz - 1000MHz

### Radiated Emission for Unintentional Radiators

| Frequency<br>(MHz) | Polarity | Antenna<br>Height<br>(Meters) | Antenna<br>Azimuth<br>(Degrees) | Indicated<br>Level<br>(dBuV) | Antenna<br>Factor<br>(dB) | Cable<br>Loss<br>(dB) | Field<br>Strength<br>@ 3m<br>(dBuV/m) | Limits<br>@ 3m<br>(dBuV/m) | Field<br>Strength<br>@ 3m<br>(uV/m) | Limits<br>@ 3m<br>(uV/m) | Margin<br>(dB) | Remarks |
|--------------------|----------|-------------------------------|---------------------------------|------------------------------|---------------------------|-----------------------|---------------------------------------|----------------------------|-------------------------------------|--------------------------|----------------|---------|
| 30                 | Vert     | 1.00                          | 0                               | 10.0                         | 11.0                      | 0.8                   | 21.8                                  | 40.0                       | 12                                  | 100                      | -18.2          |         |
| 55                 | Vert     | 1.00                          | 0                               | 11.0                         | 11.0                      | 1.3                   | 23.3                                  | 43.5                       | 15                                  | 150                      | -20.2          |         |
| 120                | Vert     | 1.00                          | 0                               | 8.0                          | 12.0                      | 2.4                   | 22.4                                  | 46.0                       | 13                                  | 200                      | -23.6          |         |
| 200                | Vert     | 1.00                          | 0                               | 9.0                          | 15.0                      | 3.4                   | 27.4                                  | 46.0                       | 23                                  | 200                      | -18.6          |         |
| 300                | Vert     | 1.00                          | 0                               | 9.0                          | 15.5                      | 4.0                   | 28.5                                  | 46.0                       | 27                                  | 200                      | -17.5          |         |
| 1000               | Vert     | 1.00                          | 0                               | 12.5                         | 25.0                      | 4.0                   | 41.5                                  | 54.0                       | 119                                 | 500                      | -12.5          |         |
|                    |          |                               |                                 |                              |                           |                       |                                       |                            |                                     |                          |                |         |
| 30                 | Horiz    | 1.00                          | 0                               | 10.0                         | 11.0                      | 0.8                   | 21.8                                  | 40.0                       | 12                                  | 100                      | -18.2          |         |
| 55                 | Horiz    | 1.00                          | 0                               | 9.0                          | 11.0                      | 1.3                   | 21.3                                  | 43.5                       | 12                                  | 150                      | -22.2          |         |
| 120                | Horiz    | 1.00                          | 0                               | 11.0                         | 12.0                      | 2.4                   | 25.4                                  | 46.0                       | 19                                  | 200                      | -20.6          |         |
| 200                | Horiz    | 1.00                          | 0                               | 8.0                          | 15.0                      | 3.4                   | 26.4                                  | 46.0                       | 21                                  | 200                      | -19.6          |         |
| 300                | Horiz    | 1.00                          | 0                               | 8.0                          | 15.0                      | 4.0                   | 27.0                                  | 46.0                       | 22                                  | 200                      | -19.0          |         |
| 1000               | Horiz    | 1.00                          | 0                               | 12.5                         | 25.0                      | 4.0                   | 41.5                                  | 54.0                       | 119                                 | 500                      | -12.5          |         |

**FIGURE 5**



## **5.0 CONCLUSIONS**

The evaluation of the **Model # TX400** configured as described herein, indicated that the unit complies with the requirements set forth in Subpart B and C of Part 15 of the **FCC Rules** for unintentional and intentional radiators.

1. The **EUT** meets the radiated emission limits for unintentional radiators set forth in §15.109. The closest measurement was 12.5dB under the limit.
2. The **EUT** meets the radiated emission limits for intentional radiators set forth in §15.205, §15.209 and §15.231. The closest measurement was 22.4 under the limit..
3. The **EUT** meets the bandwidth requirements set forth in §15.231(c).

Certification by the Federal Communications Commission (**FCC**) is required. This report, **RSI's Test Procedure 4963E** and **FCC Form 731** must be submitted to the **FCC** for approval.