

ELITE ELECTRONIC ENGINEERING INCORPORATED  
1516 CENTRE CIRCLE  
DOWNERS GROVE, ILLINOIS 60515-1082

ELITE PROJECT: 27443

DATES TESTED: February 1-12, 1999

TEST PERSONNEL: C. E. Herhold, H. Herhold, D. E. Crowder

TEST SPECIFICATION: FCC "Code of Federal Regulations" Title 47  
Part 2 and FCC Document DA 97-1451, Appendix B

ENGINEERING TEST REPORT NO. 21463  
ELECTROMAGNETIC INTERFERENCE TESTS ON  
AN INTELLIGENT TRANSCEIVER UNIT TRANSMITTER  
MODEL NO. DHF-2000

FOR: Terion, Inc.  
Melbourne, Florida

PURCHASE ORDER NO: 990076M

Report By:  
Neil J. Hurley

Approved By:  
Raymond J. Klouda  
Registered Professional  
Engineer of Illinois -

44894

ENGINEERING TEST REPORT NO. 21463

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

**DESCRIPTION OF TEST ITEM:** Intelligent Transceiver Unit Transmitter

**MODEL NO:** DHF-2000

**SERIAL NO:** DHF-000117  
DHF-000122

**MANUFACTURER:** Terion, Inc.

**APPLICABLE SPECIFICATIONS:** FCC "Code of Federal Regulations"  
Title 47, Part 2 and FCC Document  
DA 97-1451, Appendix B

**QUANTITY OF ITEMS TESTED:** Two (2)

**TEST PERFORMED BY:** ELITE ELECTRONIC ENGINEERING INCORPORATED  
1516 Centre Circle  
Downers Grove, Illinois 60515

**DATE RECEIVED:** February 2, 1999

**DATES TESTED:** February 2 through 12, 1999

**PERSONNEL (OPERATORS, OBSERVERS, AND CO-ORDINATORS):**

**CUSTOMER:** Alan Watts & Leon Venton, Terion, Inc.

**ELITE ELECTRONIC:** C. E. Herhold, H. Herhold

**ELITE JOB NO.:** 27433

**ABSTRACT:** The Intelligent Transceiver Unit (ITU) transmitter does meet the RF power output, the occupied bandwidth, the antenna conducted emissions and the frequency stability requirements of the FCC "Code of Federal Regulations", Title 47, Part 2 and FCC Document DA 97-1451, Appendix B. See test results and data pages for more details.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE  
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.

Page 3 of

## TABLE OF CONTENTS

PARAGRAPH NO.	DESCRIPTION OF CONTENTS	PAGE
1.0	INTRODUCTION	4
1.1	DESCRIPTION OF TEST ITEM	4
1.2	PURPOSE	4
1.3	DEVIATIONS, ADDITIONS AND EXCLUSIONS	4
1.4	APPLICABLE DOCUMENTS	5
1.5	SUBCONTRACTOR IDENTIFICATION	5
1.6	LABORATORY CONDITIONS	5
2.0	TEST ITEM SETUP AND OPERATION	5
2.1	POWER INPUT	5
2.2	GROUNDING	5
2.3	PERIPHERAL EQUIPMENT	5
2.4	INTERCONNECT CABLES	6
2.5	OPERATIONAL MODE	6
3.0	TEST EQUIPMENT	6
3.1	TEST EQUIPMENT LIST	6
3.2	CALIBRATION TRACEABILITY	6
4.0	REQUIREMENTS, PROCEDURES AND RESULTS	6
4.1	RF POWER OUTPUT	6
4.1.1	REQUIREMENTS	6
4.1.2	PROCEDURES	7
4.1.3	RESULTS	7
4.2	OCCUPIED BANDWIDTH MEASUREMENTS	7
4.2.1	REQUIREMENTS	7
4.2.2	PROCEDURES	7
4.2.3	RESULTS	8
4.3	ANTENNA CONDUCTED EMISSIONS	8
4.3.1	REQUIREMENTS	8
4.3.2	PROCEDURES	8
4.3.3	RESULTS	9
4.4	FREQUENCY STABILITY	9
4.4.1	REQUIREMENTS	9
4.4.2	PROCEDURES	9
4.4.3	RESULTS	9
5.0	CONCLUSION	10
6.0	CERTIFICATION	10
7.0	ENDORSEMENT DISCLAIMER	10
	TABLE I - EQUIPMENT LIST	11

TOTAL NUMBER OF PAGES IN THIS DOCUMENT,  
(INCLUDING DATA SHEETS): \_\_\_\_\_

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE  
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.

ENGINEERING TEST REPORT NO. 21463  
ELECTROMAGNETIC INTERFERENCE TESTS ON  
AN INTELLIGENT TRANSCEIVER UNIT TRANSMITTER  
MODEL NO. DHF-2000

**1.0 INTRODUCTION:**

**1.1 DESCRIPTION OF TEST ITEM:** This report presents the results of a series of radio interference measurements which were performed on an Intelligent Transceiver Unit Transmitter, Model No. DHF-2000, (hereinafter referred to as the test item). The tests were performed for Terion, Inc. of Melbourne, Florida.

The test item is a transceiver that has been designed for use by the trucking industry. The HF (High Frequency) Transmitter is designed to transmit on discrete frequencies from 3MHz to 25MHz. The test item interprets an incoming message that is contained in the RDS subcarrier of a local FM radio station. Once it receives and decodes the message, it transmits the message to Terion, Inc. via its HF Transmitter.

The test item has an external TNC type antenna port. In addition to the TNC port, the test item had three additional ports: a DC power input port, an I/O (input/output) computer/data terminal data port and a GPS (Global Positioning Satellite) port for the GPS antenna.

**1.2 PURPOSE:** The test series was performed to determine if the test item meets the type acceptance test requirements of the FCC "Code of Federal Regulations" Title 47, Part 2 and FCC Document DA 97-1451, Appendix B.

**1.3 DEVIATIONS, ADDITIONS AND EXCLUSIONS:** There were no deviations, additions to, or exclusions from the test specification during this test series.

**1.4 APPLICABLE DOCUMENTS:** The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 1997
- Federal Communications Commission "Equipment Type Acceptance Requirements", Document DA 97-1451, Appendix B

**1.5 SUBCONTRACTOR IDENTIFICATION:** This series of tests was performed by Elite Electronic Engineering Incorporated personnel assigned to Elite's test facility in Cocoa Beach, Florida. The Cocoa Beach laboratory is listed with the FCC under the name of its parent organization: CEMEC, Inc.

**1.6 LABORATORY CONDITIONS:** The temperature at the time of the test was 80°F and the relative humidity was 72%.

**2.0 TEST ITEM SETUP AND OPERATION:**

For all tests, the test item was placed on a 0.8 meter high non-conductive turntable.

**2.1 POWER INPUT:** The test item was connected to a Lambda DC power supply via its 15ft. long unshielded power leads. The Lambda power supply provided the test item with 12VDC power.

**2.2 GROUNDING:** The test item was not grounded at any point during the tests.

**2.3 PERIPHERAL EQUIPMENT:** The following peripheral equipment was submitted with the test item:

=====

=  
COMPUTER: Toshiba Satellite Pro 440 CDT/1.4 System Unit,  
M/N: PR1241U XCD, S/N 87185363-3

DATA TERMINAL: Omnidata, M/N: T700-101 Rev. A, S/N 00700117

ANTENNA MATCHING NETWORK: Terion antenna match/attenuator (AM/A)

**2.4 INTERCONNECT CABLES:** The following interconnect cables were submitted with the test item:

=====

=  
**ANTENNA CONNECTION CABLE:**  
A 7 foot long TNC to SO-239 type cable, used to connect the test item to the Shakespeare HF/FM Dual Band Magnetic Mount Antenna.

**GPS CABLE:**  
A 15 foot long TNC type cable. One end was internally wired to the GPS antenna module. Used to connect the GPS antenna to the test item.

**INPUT/OUTPUT DATA CABLE:**  
A 15 foot long DIN type cable. Used to connect the Laptop PC to the test item for programming and initializing the test item. Also used to provide data to the data terminal, which was left connected during the tests.

**2.5 OPERATIONAL MODE:** The test item was setup to transmit on an HF frequency of 14.500MHz. The test item was internally modulated at the maximum rate.

**3.0 TEST EQUIPMENT:**

**3.1 TEST EQUIPMENT LIST:** A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

**3.2 CALIBRATION TRACEABILITY:** The test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

**4.0 REQUIREMENTS, PROCEDURES AND RESULTS:**

**4.1 RF POWER OUTPUT:**

**4.1.1 REQUIREMENTS:** In accordance to FCC Document DA 97-1451, Appendix B, the maximum output power that will be authorized for Intelligent Transceiver Unit transmitters is 15 watts.

**4.1.2 PROCEDURES:** The power transmitted directly into the antenna was measured by connecting the output of the test item into a spectrum analyzer through the Terion antenna match/attenuator (AM/A). The measured loss through the AM/A at 14.5MHz was 46.3dB. The readings were made with peak detection. A 10kHz bandwidth was used, which exceeded the emissions bandwidth of the test signal.

**4.1.3 RESULTS:** Data page 12 shows the results of the output power measurements. As can be seen from this data page, the maximum output power at the fundamental (14.5MHz) was -8.7dBm or 5.75 watts, which is well below the 15 watt limit.

**4.2 OCCUPIED BANDWIDTH MEASUREMENTS:**

**4.2.1 REQUIREMENTS:** In accordance with FCC Document DA 97-1451, Appendix B, the authorized bandwidth of the Intelligent Transceiver Unit transmitter is 3.0 kHz. The power of emissions outside of the authorized bandwidth must be attenuated below the power of the unmodulated carrier wave in accordance with the following schedule:

- (1) On any frequency removed from the carrier frequency by 50% up to 150% of the authorized bandwidth, at least 25dB.
- (2) On any frequency removed from the carrier frequency by 150% up to 250% of the authorized bandwidth, at least 35dB.
- (3) On any frequency removed from the carrier frequency by 250% or more of the authorized bandwidth, at least 43dB.



**4.2.2 PROCEDURES:** The measurement equipment was connected to the test item's antenna port through the Terion antenna match network (AM/A). The unit was set to transmit continuously. The test item signal was modulated at the maximum level available. The measurement bandwidth was set to 30 Hz (1% of authorized bandwidth of 3kHz). The emissions near the fundamental frequency were plotted.

**4.2.3 RESULTS:** The plot of the emissions near the fundamental frequency are presented on data page 13. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

**4.3 ANTENNA CONDUCTED EMISSIONS:**

**4.3.1 REQUIREMENTS:** This test determines whether the test item produces excessive spurious emissions at the antenna terminals.

In accordance with FCC Document DA 97-1451, Appendix B, emissions on any frequency removed from the carrier frequency by 250% or more of the authorized bandwidth, shall be at least 43dB below the power of the unmodulated carrier wave. The peak power of the emissions shall be measured at the antenna terminal from 30MHz up to the 10th harmonic of the fundamental frequency.

**4.3.2 PROCEDURES:**

This test will measure spurious emissions at the antenna terminals.

(a) The test item was connected to the spectrum analyzer through the Terion antenna match/attenuator (AM/A).

(b) The frequency span was adjusted to cover 1 MHz up to 30 MHz. The emission levels over this frequency range were measured and

recorded.

(c) Next, the emissions over the frequency range from 30 MHz up to 200 MHz were measured and recorded. This range covers up through the 10th harmonic.

**4.3.3 RESULTS:** The plots of the antenna conducted output measurements are presented on data pages 14 and 15.

As can be seen from the data, the test item did not produce spurious emissions in excess of 43 dB below unmodulated carrier level with the nominal output power of 5.75 watts.

**4.4 FREQUENCY STABILITY:**

**4.4.1 REQUIREMENTS:** In accordance with FCC Document DA 97-1451, Appendix B, Paragraph 95.629(b), an Intelligent Transceiver Unit transmitter must be maintained within a frequency stability of  $\pm 10$  parts per million (ppm) over the temperature range of -20 to +70 degrees C.

**4.4.2 PROCEDURES:** Two separate procedures were performed for each of the two tests which are as follows:

(a) Frequency Stability vs. Temperature

(1) The test item was placed in a Thermotron temperature chamber. The test item was powered up.

(2) The measurement equipment was set to monitor the transmitted frequency.

(3) The ambient room temperature was recorded and a reference frequency was recorded.

(4) The temperature was varied from -30 to +70 degrees centigrade in 10 degree increments. The test item was

ENGINEERING TEST REPORT NO. 21463

allowed to soak from 30 to 45 minutes at each temperature.

(5) After this time period, the transmit frequency was recorded.

**4.4.3 RESULTS:** The results of the frequency stability tests can be found on data pages 116. As can be seen from the data, the frequency is within the  $\pm 10$  ppm ( $\pm 168$ Hz) tolerance.

**5.0 CONCLUSION:**

It was found that the Terion, Inc. Intelligent Transceiver Unit (ITU) transmitter, Model No. DHF-2000, does meet the RF Power, the occupied bandwidth, the antenna conducted emissions and the frequency stability requirements of the FCC "Code of Federal Regulations", Title 47, Part 2 and FCC Document DA 97-1451, Appendix B.

**6.0 CERTIFICATION:**

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specification.

The data presented in this test report pertains only to the test item at the test date as operated by Terion, Inc. personnel. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

**7.0 ENDORSEMENT DISCLAIMER:**

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

TABLE I - EQUIPMENT LIST

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: COMPUTERS								
CDA4	COMPUTER - FL	HEWLETT PACKARD	9836	2440A09718	---		N/A	
Equipment Type: CONTROLLERS								
CTE0	TEMPERATURE RECORDER	HONEYWELL	DR450T	891174541400	-87 TO +190 C	12/30/98	6	06/30/99
Equipment Type: METERS								
MFC0	MICROWAVE FREQ. COUNTER	HEWLETT PACKARD	5343A	2133A00591	10HZ-26GHZ	06/01/98	12	06/01/99
Equipment Type: PRINTERS/PLOTTERS								
HDK2	PLOTTER - FL	HEWLETT PACKARD	7550A	2631A53539	---		N/A	
Equipment Type: RECEIVERS								
RAE3	SPECTRUM ANALYZER - FL	HEWLETT PACKARD	8566A	2209A01339	100HZ-22GHZ	09/04/98	12	09/04/99

I/O: Initial Only      N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

## DATA SHEET

MANUFACTURER : Terion, Inc.  
 TEST ITEM : Intelligent transceiver Unit Transmitter  
 MODEL : DHF-2000  
 SERIAL NUMBER : DHF-000117  
 TEST PERFORMED : FCC Document DA 97-1451, Appendix B  
 Frequency Stability  
 DATE TESTED : February 15, 1999  
 TEST SPECIFICATION : Tolerance of 10 ppm (+168Hz)

Temperature Degrees Centigrade	Frequency MHz	Duration Minutes	Change Hz	Limit Hz
24	16.799991	---	Ref.	---
-30	16.800027	30	36	+168
-20	16.800026	30	35	+168
-10	16.800015	30	24	+168
0	16.800006	30	15	+168
10	16.799996	30	5	+168
20	16.799993	30	2	+168
30	16.799988	30	-3	+168
40	16.799986	30	-5	+168
50	16.799986	30	-5	+168
60	16.799986	30	-5	+168
70	16.799986	30	-5	+168

Checked By: \_\_\_\_\_

