
FCC ID: CCXTC100

Prepared for:

TRIMBLE NAVIGATION (LIMITED)

2105 Donley Drive
Austin, Texas 78758

By:

Professional Testing (EMI), Inc.
1601 FM 1460 Suite B
Round Rock, Texas 78664

Submitted to:

**Federal Communications Commission
Equipment Authorization Division,
Applications Processing Branch**

7435 Oakland Mills Road
Columbia, Maryland 21048

March 1999

**FCC Type Acceptance Test Report
for an Intentional Radiator**

TRIMBLE NAVIGATION (LIMITED)

TC100

**Airborne VHF Transceiver
(Transmitter Portion)**

Table of Contents

Title Page	1
Table of Contents.....	2
Certificate of Compliance	3
1.0 Equipment Under Test (EUT) Description.....	4
2.0 Modulation Characteristics	5
2.1 Voice Characteristics.....	5
2.1.1 Test Procedure	5
2.1.2 Test Criteria.....	6
2.1.3 Test Results	6
2.2 Modulation Limiting	6
2.2.1 Test Procedure	6
2.2.2 Test Criteria.....	6
2.2.3 Test Results	6
3.0 Power and Emission Measurements and Requirements	7
3.1 Test Procedure	7
3.2 Test Criteria	7
3.3 Test Results	7
4.0 Occupied Bandwidth Measurements	7
4.1 Test Procedure	7
4.2 Test Criteria	7
4.3 Test Results	8
5.0 Out of Band Emissions - Conducted.....	8
5.1 Test Procedure	8
5.2 Test Criteria	8
5.3 Test Results	9
6.0 Out of Band Emissions - Radiated	9
6.1 Test Procedure	9
6.2 Test Criteria	10
6.3 Test Results	10
7.0 FAA Notification Requirement.....	10
7.1 Evaluation Procedure.....	10
7.2 Evaluation Results	10
8.0 Modulation Requirements.....	11
8.1 Evaluation Procedure.....	11
8.2 Evaluation Results	11
9.0 Transmitter Control Requirements	11
9.1 Evaluation Procedure.....	11
9.2 Evaluation Results	11
10.0 Frequency Stability.....	12
10.1 Frequency Stability versus Temperature	12
10.1.1 Test Procedure	12
10.1.2 Test Criteria.....	12
10.1.3 Test Results	12
10.2 Frequency Stability versus DC Input Power.....	12
10.2.1 Test Procedure	13
10.2.2 Test Criteria.....	13
10.2.3 Test Results	13
11.0 Form 731 Information.....	13

11.1 Emission Designator..... 13

11.2 Output Power..... 14

11.3 Frequency Band of Operation..... 14

11.4 Frequency Stability..... 14

12.0 List of Test Equipment 15

Appendix A - Modulation Characteristics Test Data 16

Appendix B - Output Power Test Data 22

Appendix C - Occupied Bandwidth Test Data..... 24

Appendix D - Out of Band Emissions - Conducted Test Data..... 28

Appendix E - Out of Band Emissions - Radiated Test Data 32

Appendix F - Frequency Stability Test Data 39

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF PROFESSIONAL TESTING (EMI), INC.



Certificate of Compliance

Applicant: Trimble Navigation (Limited), Inc.

Applicant's Address: 2105 Donley Drive
Austin, Texas 7758

Model: TC100 Airborne VHF Transceiver

Serial Number: 14

Project Number: 99-411

Test Dates: May 19 through August 26, 1998

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measurement data and this report. I believe them to be true and accurate. The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** was tested and found to be in compliance with FCC Parts 15 and 87 for Intentional Radiators.

Jeffrey A. Lenk
President



1.0 Equipment Under Test (EUT) Description

The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** is a VHF Airborne Communications Transceiver. The **TC100** is a 7 watt, 2 way radio intended for use in general aviation aircraft. This radio tunes over the frequency range of 118.000 to 136.975 MHz. Tuning is performed over this range at fixed intervals of 25 kHz. The radio has memory and display functions to allow frequently used channels to be stored in memory and then quickly recalled. This equipment is not marketed with an antenna or associated wiring or adapters.

The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** is intended for operation under 47 CFR 87, Subparts D, E and F. Specific test requirements include the following:

47 CFR 2.987	Modulation Characteristics
47 CFR 87.131	Power and Emissions
47 CFR 2.989 & 47 CFR 87.135	Occupied Bandwidth
47 CFR 87.139	Out of Band Emissions - Conducted
47 CFR 87.139	Out of Band Emissions - Radiated
47 CFR 87.147	FAA Notification Requirement
47 CFR 87.141	Modulation Requirements
47 CFR 87.143	Transmitter Controls
47 CFR 2.995(a) & 47 CFR 87.133	Frequency Stability vs. Temperature
47 CFR 2.995(d) (1) & 47 CFR 87.133	Frequency Stability vs. DC Input Power

The system tested consisted of the following components:

EUT

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Trimble Navigation (Limited) TC100	14	CCXTC100	Airborne VHF Transceiver
Trimble Navigation (Limited) TC100	15	CCXTC100	Airborne VHF Transceiver

Support Equipment

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Power Design Model 4050	2648	N/A	DC Power Supply
Low VSWR Whip Antenna	N/A	N/A	VHF Band Whip Antenna
HP 33120	US36007563	N/A	Low Frequency Generator
Bird Model 8073-1	542	N/A	50 ohm Load

Cables

Multiconductor Signal and Power Cable, 6 feet long, 1 each
Double Shielded 50 ohm coaxial cable, 6 feet long, 1 each

The equipment within this report was tested to verify its compliance with FCC Rule Parts 2, 15 and 87, for Intentional Radiators. A separate verification report pursuant to Part 15, Subpart B has been prepared for the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** as a Receiver and as a Digital Device.

2.0 Modulation Characteristics

Measurements were made on the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** to verify compliance with the modulation characteristic requirements of §2.987. The specific tests for this device were the voice characteristics curve (§2.987(a)) and the modulation limiting test (§2.987(b)).

2.1 Voice Characteristics

Measurements of the audio profile of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** were performed in accordance with 47 CFR 2.987.

2.1.1 Test Procedure

Voice modulation characteristic measurements were made at Trimble Navigation (Limited)'s Austin, Texas facility as part of the FAA qualification procedure for this device. Secondary tests of the voice characteristics were performed by Professional Testing (EMI) Inc. to verify the figures obtained by Trimble.. All measurements were made in a controlled laboratory environment. Measurements were made with a HP 8901A Modulation Analyzer and a HP 33120 low frequency generator (used as the audio source).

2.1.2 Test Criteria

Section 2.987 of the Rules states the a curve or equivalent data showing the frequency response of the audio modulating circuit shall be provided over a range of 100 to 5000 Hz. For equipment for which an audio filter is required, a response curve of the filter, or of the complete audio system including the filter shall be submitted.

2.1.3 Test Results

Conducted measurements were performed on the output of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** utilizing a modulation analyzer. Two units were tested to determine the difference in response of the circuit based on tolerance of the components used (Unit 14 and Unit 15 demonstrate the two extremes for audio response which can be obtained based minimum and maximum tolerance component tolerances). The transmit frequency for these tests was 127.000 MHz. The output response of the EUTs versus frequency was obtained.

Data for this test is located in Appendix A of this report. Tabular data and plots of the response of the audio circuit for two systems are presented. By reporting this data as part of the Type Acceptance procedure, the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** satisfies the §2.987 voice modulation characteristics requirement.

2.2 Modulation Limiting

Measurements of the modulation limiting capability of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** were performed in accordance with 47 CFR 2.987.

2.2.1 Test Procedure

Modulation limiting measurements were made at Professional Testing (EMI) Inc. Round Rock, Texas facility. All measurements were made in a controlled laboratory environment. All measurements were made with a HP 8901A Modulation Analyzer and a HP 33120 low frequency generator (used as the audio source).

2.2.2 Test Criteria

Section 2.987 of the Rules states the a curve or equivalent data showing the modulation limiting of the EUT shall be provided to show the modulation limiting capability of the EUT over the range of modulating frequencies.

2.2.3 Test Results

Conducted measurements were performed on the output of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** utilizing a modulation analyzer. This device measured the modulation percentage of the output signal automatically. Full modulation limiting testing was performed with an audio frequency of 2.5 kHz. cursory testing of the limiting was also performed at test frequencies of 350 Hz and 1 kHz. The transmit frequency for these tests was 127.000 MHz. The output response of the EUT versus input level was obtained.

Data for this test is located in Appendix A of this report. The data obtained for this testing indicates that the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** possess modulation limiting capability over the EUT frequency range, satisfying the §2.987 modulation limiting requirement.

3.0 Power and Emission Measurements and Requirements

Measurements were made on the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** to verify compliance with the power and emission requirements of §87.131.

3.1 Test Procedure

Conducted output power measurements were made at Professional Testing (EMI) Inc. Round Rock, Texas facility. All measurements were made in a controlled laboratory environment.

3.2 Test Criteria

Section 87.131 of the Rules contains a table listing the allowed frequencies, emission types and power levels for aircraft related transmitter signals. The **TC100** falls under the category of Aircraft based UHF stations. Based on this table, the conducted power limit for this type of station is 55 watts.

3.3 Test Results

Measurements were performed utilizing a modulation analyzer. Conducted power measurements were made directly on the antenna port of the EUT in accordance with the power measurement requirements of §87.131. The maximum peak power detected during this test was 7.65 watts.

Data for output power testing is located in Appendix B of this report. **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** met the §87.131 output power requirements.

4.0 Occupied Bandwidth Measurements

Measurements were made on **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** to determine the occupied bandwidth in accordance with Part 2.989.

4.1 Test Procedure

All measurements were performed in a controlled laboratory environment. The occupied bandwidth of the **TC100** was measured using a Hewlett Packard 8591E Spectrum Analyzer. The EUT was modulated with a 2.5 kHz sine wave signal in accordance with 2.989(c)(1). Measurements of the occupied bandwidth were taken at three frequency settings across the band (lowest, middle and highest). Two of these were taken with

4.2 Test Criteria

Section 2.989 requires that the occupied bandwidth for Type Accepted units be measured and reported as part of the device filing.

4.3 Test Results

Measurements were performed utilizing a spectrum analyzer IF/video bandwidth of 300 Hz/300 Hz. The frequency span was set for 20 kHz and was centered on the peak of the output signal. Testing of the TC100 for occupied bandwidth was performed with the EUT tuned to each of the following frequencies:

Position versus Tuning Range	Tuning Frequency (MHz)
Lowest Channel	118.000
Middle Channel	127.000
Highest Channel	136.975

Data for occupied bandwidth testing is located in Appendix C of this report. **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** has a worst case occupied bandwidth of 6.00 kHz. This figure is in keeping with the emission designator (6K00A3E) required by the FAA for this product.

5.0 Out of Band Emissions - Conducted

Conducted emissions measurements were made to determine out of band radiated noise produced by the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** transmitter. All measurements were performed in a controlled laboratory environment.

5.1 Test Procedure

The EUT was tested in a controlled laboratory environment. Measurement of the conducted antenna emissions from the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** were performed with the device in transmit mode using a 2.5 kHz sine wave test signal in accordance with 2.989(c)(1). Testing of the TC100 for conducted spurious emissions was performed with the EUT tuned to each of the following frequencies:

Position versus Tuning Range	Tuning Frequency (MHz)
Lowest Channel	118.000
Middle Channel	127.000
Highest Channel	136.975

All recorded data was taken using a peak detector. The final measurements provided were determined by using the following formula:

$$\text{Corrected Level} = \text{Recorded Level} + \text{Cable Loss}$$

5.2 Test Criteria

Based on the out of band emission criteria of §87.139(a), transmitter related emissions for the **TC100** shall be reduced by the following amount with respect to the level of the fundamental:

Spacing From Fundamental	Attenuation Below Fundamental (dB)
50 to 100 % of the Authorized Bandwidth	25
100 to 250 % of the Authorized Bandwidth	35
250 % of the Authorized Bandwidth to 10 th Harmonic of the Fundamental	40 for Aircraft Stations 43 +10 Log(P) for Aeronautical Stations

The **TC100** is an aircraft station, defining the last attenuation requirement as 40 dBc.

5.3 Test Results

Conducted emission data sheets are contained in Appendix D of this report. The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** met the §87.139 conducted emission requirements.

6.0 Out of Band Emissions - Radiated

Radiated emissions measurements were made to determine out of band radiated noise produced by the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** transmitter. These measurements were made at the Professional Testing "Open Field" Site 3 located in Marble Falls, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. A measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

Since the EUT is not marketed with an antenna, a sample antenna was attached to the EUT to obtain a reference level then replaced with a shielded 50 ohm resistive load (same impedance as the antenna) for measurement of spurious case radiation.

A Hewlett Packard Spectrum Analyzer utilizing peak detection was used during the determination of worst-case orientation. All recorded data was taken using a peak detector. Testing of the TC100 for radiated spurious emissions was performed with the EUT tuned to each of the following frequencies:

Position versus Tuning Range	Tuning Frequency (MHz)
Lowest Channel	118.000
Middle Channel	127.000
Highest Channel	136.975

The final measurements provided were determined by using the following formula:

$$\text{Corrected Level} = \text{Recorded Level} - \text{Pre-Amp Gain} + \text{Antenna Factor} + \text{Cable Loss}$$

6.2 Test Criteria

Based on the out of band emission criteria of §87.139(a), transmitter related emissions for the **TC100** shall be reduced by the following amount with respect to the level of the fundamental:

Spacing From Fundamental	Attenuation Below Fundamental (dB)
50 to 100 % of the Authorized Bandwidth	25
100 to 250 % of the Authorized Bandwidth	35
250 % of the Authorized Bandwidth to 10 th Harmonic of the Fundamental	40 for Aircraft Stations 43 +10 Log(P) for Aeronautical Stations

The **TC100** is an aircraft station, defining the last attenuation requirement as 40 dBc.

6.3 Test Results

Radiated emission data sheets are contained in Appendix E of this report. The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** met the §87.139 spurious radiated emission requirements.

7.0 FAA Notification Requirement

Notification and coordination with the FAA was performed for the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** in order to meet the requirements of Section 87.147.

7.1 Evaluation Procedure

An official notice of pending FCC filing was forwarded to the Spectrum Engineering Division of the FAA on October 28, 1998. A copy of this letter is included as an exhibit with this application. This was followed by a series of phone conversations with Ms. Annette Allender of this office in December of 1998 and January 1999. Ms. Allender forwarded an inquiry sheet to Professional Testing which will be submitted to the FAA as part of the approval process. This sheet is an information sheet specific to VHF equipment which indicates to the operating parameters of the device and compliance with specific FAA items. Compilation of the reply to this inquiry is in progress at this time.

7.2 Evaluation Results

Notification of the filing of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** with the FCC was provided to the Spectrum Engineering Division of the FAA on October 28, 1998. This was followed by a series of phone conversations with Ms. Annette Allender of this office in December 1998 and January 1999. In addition, PTI is compiling a reply to a VHF equipment inquiry from the FAA as part of the notice procedure.

With the official filing date of the **TC100** being later February/early March of 1999, the 30 day notice requirement with the FAA is satisfied. The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** therefore meets FAA notice requirements of §87.147.

8.0 Modulation Requirements

An evaluation was performed to verify that the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** is compliant with the modulation requirements of Section 87.141.

8.1 Evaluation Procedure

Section 87.141 states the modulation parametrics that are allowed for specific types of earth and aircraft stations. In addition, this section also states that A3E based devices must have modulation limiting to prevent modulation in excess of 100% (Section 87.141(a)). The only exception to this rule is for emergency locator transmitters (ELTs).

8.2 Evaluation Results

All testing of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** except for frequency stability was performed with an audio signal injected into the EUT.

Since the EUT has modulation limiting to prevent modulation greater than 100%, the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** meets the modulation requirements of §87.141.

9.0 Transmitter Control Requirements

An evaluation was performed to verify that the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** is compliant with the transmitter control requirements of Section 87.143.

9.1 Evaluation Procedure

Section 87.143 states the device must meet the following requirements:

- (1) Limit access to controls for the device to only person(s) authorized to operate the equipment.
- (2) Device must have a control point at the location of the transmitting equipment.
- (3) Device must have an indicator which indicates that the device is transmitting.
- (4) If the device is computer controlled, it must shut down automatically after 3 minutes of continual transmission.

An analysis of the documentation, intended use, intended installation and the hardware itself was performed to determine compliance with this specification.

9.2 Evaluation Results

The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** has limited operator control features. The output power and modulation characteristics of the device cannot be modified by the operator. The operator can change the channel and squelch level of the EUT. The location of the **TC100** is immediately in front of the pilot, which limits the operation of the EUT to the person that is authorized to operate the aircraft. The **TC100** has a display which indicates that when the device is transmitting and has a control panel which can be used to turn the device off. The **TC100** does not

operate automatically (i.e. under computer control). Transmissions must be initiated by the aircraft operator and cease when the operator stops the transmission (either using a voice activated microphone or a keyed microphone).

Based on the design and installation location of the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver**, this device meets the transmitter control requirements of §87.143.

10.0 Frequency Stability

10.1 Frequency Stability versus Temperature

Measurements were made on the **TC100** to verify compliance with the frequency stability requirements of §2.995(a) and §87.133. Under this specification, the EUT is tested to verify satisfactory frequency stability versus changes in the ambient temperature.

10.1.1 Test Procedure

The tests were performed in a temperature and humidity test chamber. The EUT was powered constantly during this test and transmissions initiated at regular intervals. Constant transmitting of the EUT is not possible due to the power handling capability of the components inside the EUT. The TC100 is not intended for continuous transmission. The transmit frequency for this test was 127.000 MHz.

The temperature for the EUT was varied from -30 °C to +50 °C at 10 °C intervals. The EUT was allowed to soak at each temperature a minimum of 45 minutes prior to taking the frequency reading. The maximum frequency error was recorded at each data point.

10.1.2 Test Criteria

The table shown in Section 87.133 indicates that the maximum frequency error allowed for new aircraft stations in the 100 to 137 MHz band is 30 ppm. Based on a test frequency of 127.000 MHz, the maximum allowed frequency error is calculated as:

$$\begin{aligned} \text{Max frequency error} &= (127\text{MHz} / 1\text{E}6) * 30 \\ &= 3.82 \text{ kHz} \end{aligned}$$

10.1.3 Test Results

The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** meets the frequency stability requirements for frequency stability versus temperature variation based on the criteria listed above. Data for this test is located in Appendix F of this report.

10.2 Frequency Stability versus DC Input Power

Measurements were made on the **TC100** to verify compliance with the frequency stability requirements of §2.995(d)(1) and §87.133. Under these specifications, the EUT is tested to verify satisfactory

frequency stability versus changes in the amplitude of the primary power for operation from the DC input source.

10.2.1 Test Procedure

The tests were performed in a temperature and humidity test chamber. The EUT was powered constantly during this test and transmissions initiated at regular intervals. Constant transmitting of the EUT is not possible due to the power handling capability of the components inside the EUT. The TC100 is not intended for continuous transmission. The transmit frequency for this test was 127.000 MHz.

Power to the input terminals of the EUT were varied from 10 to 32 VDC. The nominal DC input power can be from 14 to 28 VDC. The maximum frequency error was recorded at 2 volt intervals as the input voltage was varied from 10 to 32 AVDC. The response of the EUT was monitored as the line voltage was changed.

10.2.2 Test Criteria

The table shown in Section 87.133 indicates that the maximum frequency error allowed for new aircraft stations in the 100 to 137 MHz band is 30 ppm. Based on a test frequency of 127.000 MHz, the maximum allowed frequency error is calculated as:

$$\begin{aligned} \text{Max frequency error} &= (127\text{MHz} / 1\text{E}6) * 30 \\ &= 3.82 \text{ kHz} \end{aligned}$$

10.2.3 Test Results

The **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** meets the frequency stability requirements for frequency stability versus DC input power variation based on the criteria listed above. Data for this test is located in Appendix F of this report.

11.0 Form 731 Information

The following information is provided for inclusion in the FCC Form 731 for **Trimble Navigation (Limited) TC100 Mode C ATCRBS Transponder**.

11.1 Emission Designator

The emission designator for the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** is determined from the following procedure:

Measured Bandwidth: 5.25kHz

This bandwidth was measured during the occupied bandwidth tests for the EUT.

Emission Designator:: A3E

The modulation characteristics based on this designator are

Symbol Position	Parameter	Description	Resulting Symbol
1	Type of Modulation	Double Sideband Amplitude Modulation	A
2	Nature of Symbol(s) Modulating the Carrier	Single Channel containing Analog information	3
3	Type of Information Being Transmitted	Telephony (voice)	E

The table located in Section 87.137 states that the emission designator for transmitters operating above 50 MHz using A3E emission types (fitting the operation of the **TC100**) shall be:

6K00A3E

In addition, this table also indicates that the authorized bandwidth for this device shall be 50 kHz.

11.2 Output Power

The rated output power of the **TC100** is 7.65 watts. This is based on test data for the power and emission requirements testing.

11.3 Frequency Band of Operation

The **TC100** operates over the frequency range of 118.000 to 136.975 MHz. The EUT tunes over this range in 25 kHz intervals.

11.4 Frequency Stability

The frequency stability requirement for Part 87 equipment is primarily determined based on the operational platform, frequency range, output power and intended use of the equipment. The table shown in Section 87.133 indicates that the maximum frequency error allowed for new aircraft stations in the 100 to 137 MHz band is 30 ppm. The the **Trimble Navigation (Limited) TC100 Airborne VHF Transceiver** fits into this category, setting the frequency stability requirement for this equipment as 30 ppm.

12.0 List of Test Equipment

A list of the test equipment utilized to perform the conducted and radiated emission measurements is given below. The date of calibration is given for each.

<u>Device</u>	<u>Description</u>	<u>Date Last Calibrated</u>	<u>Calibration Due</u>
HP 8566B	Spectrum Analyzer	09/22/97	09/22/98
HP 85650A	Quasi Peak Adapter	09/22/97	09/22/99
HP 8447D	Preamplifier	07/22/98	07/22/99
MITEQ AFS4-00101800-40-10P-N	Preamplifier	05/22/98	05/22/99
EMCO 3108	Bicon Antenna	07/22/98	07/22/99
EMCO 3146	Log Antenna	07/22/98	07/22/99
EMCO 3115	Double Ridged Horn Antenna	05/22/98	05/22/99
HP 8591E	Spectrum Analyzer	05/22/98	05/22/99
HP34401	Digital Multimeter	03/24/98	03/24/99
HP 8901A	Modulation Analyzer	01/29/98	01/29/99
Inmet Model 18N20W	30 dB Attenuator	Calibrated Prior to Test	Calibrated Prior to Test
NJE SVC 60-14	Adjustable DC Power Supply	Not Required	Not Required
Thermotron SM-32	Environmental Chamber	11/19/97	11/19/98

Appendix A

**Modulation
Characteristics Test Data**

Audio Response Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14 & 15
DATE: August 31, 1998

PROJECT #: 99-411

Test Frequency (Hz)	Normalized Audio Response Unit #14	Normalized Audio Response Unit #15
100	-14.0	-11.0
200	-8.0	-5.0
350	-4.0	-1.5
500	-1.8	-0.5
1000	0.0	0.0
2000	-1.5	-1.8
2500	-2.8	-3.0
5500	-9.5	-9.5

COMMENT #1: Target modulation index: 70%

COMMENT #2: Data normalized to maximum level (occured at 1 kHz).

COMMENT #3: Peak 1 kHz level the same for both samples

TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffrey Lenk

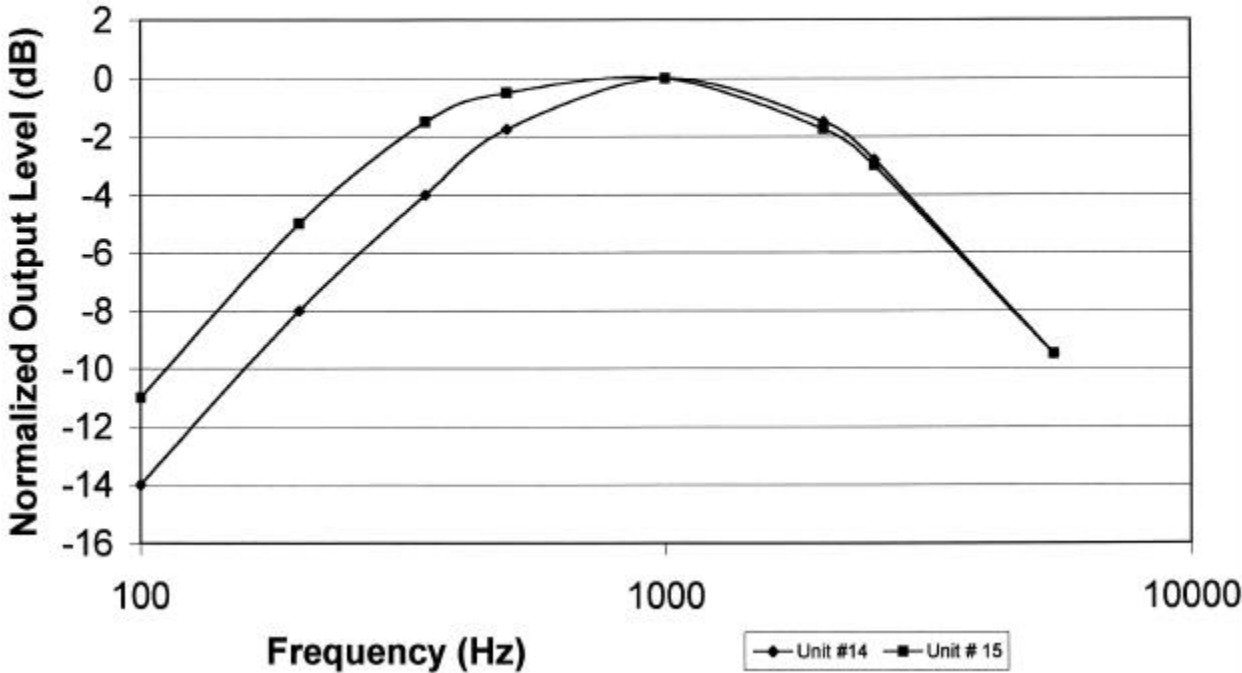
Audio Response Data Sheet

Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver

SERIAL #: 14 & 15
DATE: August 31, 1998

PROJECT #: 99-411

Audio Response



COMMENT #1: Data plotted from preceding table.

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffrey Lenk

Modulation Limiting Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14

PROJECT #: 99-411

DATE: August 31, 1998

Target Modulation (%)	Drive Level Required to Obtain Modulation Level (mV)
10	3.65
20	8.00
30	13.05
40	18.20
50	25.95
60	41.45
70	106.95
80	356.95
85	4639.00
88	6939.00
89	9639.00

COMMENT #1: Test Frequency = 2.5 kHz

COMMENT #2: Spot check of 350 Hz and 1 kHz showed modulation maximized to 89% at these test frequencies also.

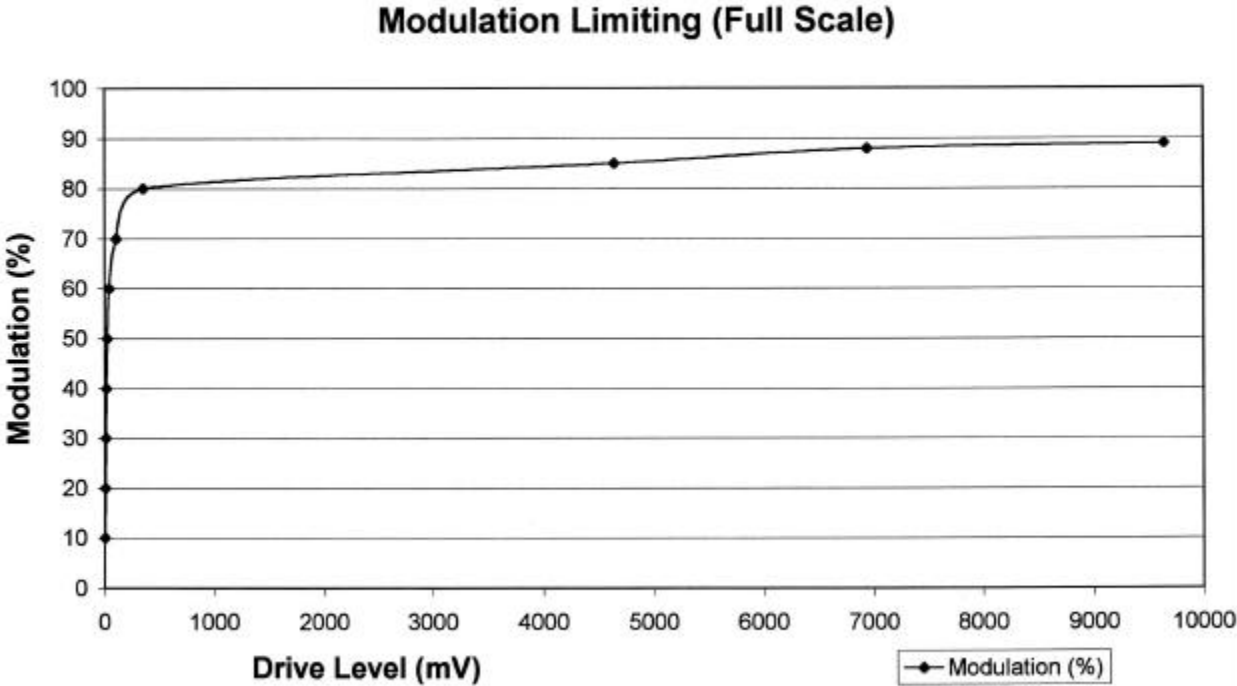
TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffrey Lenk

Modulation Limiting Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411



COMMENT #1: Data plotted from preceding table.

COMMENT #2: Modulation limiting set to 90% maximum modulation in accordance with TSO for the TC100.

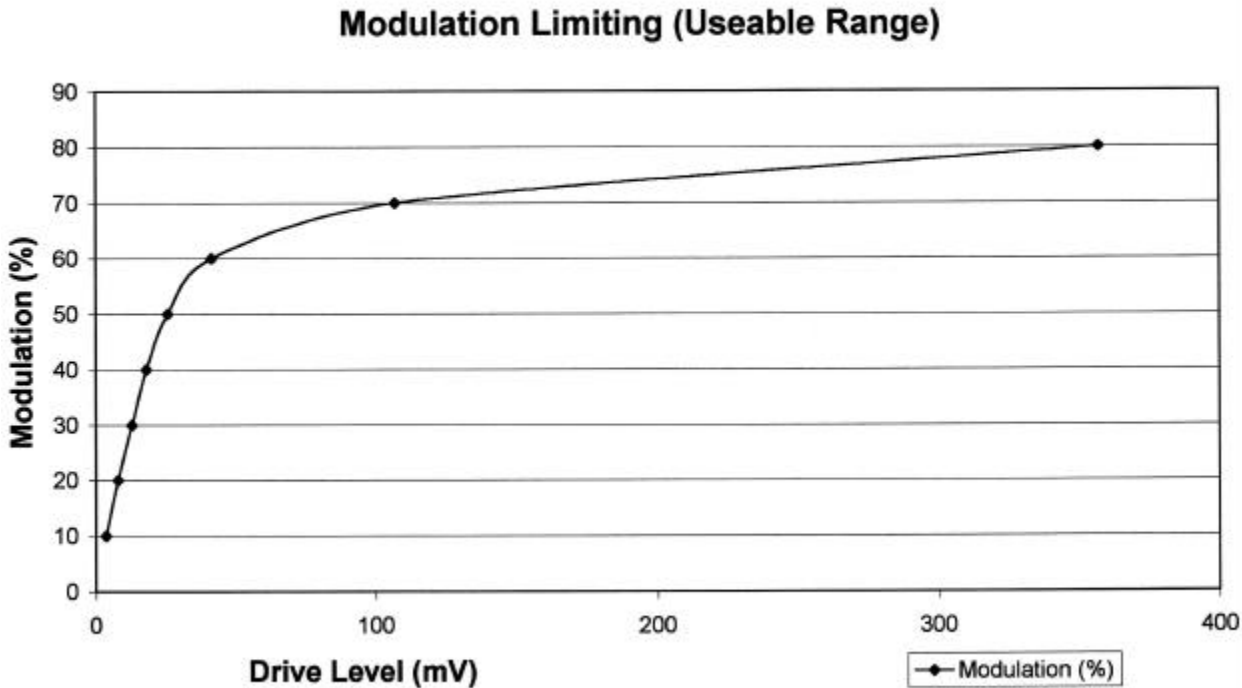
TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffrey Lenk

Modulation Limiting Data Sheet

Trimble Navigation (Limited) TC100 Airborne VHF Transceiver

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411



COMMENT #1: Data plotted from modulation limiting data table. Detailed area of preceding plot.

COMMENT #2: Modulation limiting set to 90% maximum modulation in accordance with TSO for the TC100.

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffrey Lenk

**Output Power
Test Data**

Appendix B

Output Power Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Frequency (MHz)	Recorded Level (watts)	Cable Loss (dB)	Corrected Level (dBm)	Corrected Level (Watts)
118.000	5.35	0.10	37.38	5.475
127.000	7.48	0.10	38.84	7.654
136.975	6.94	0.10	38.51	7.102

COMMENT #1: Conducted Measurement from Antenna Port.

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffrey Lenk

Appendix C

Occupied Bandwidth Test Data

Occupied Bandwidth Data Sheet

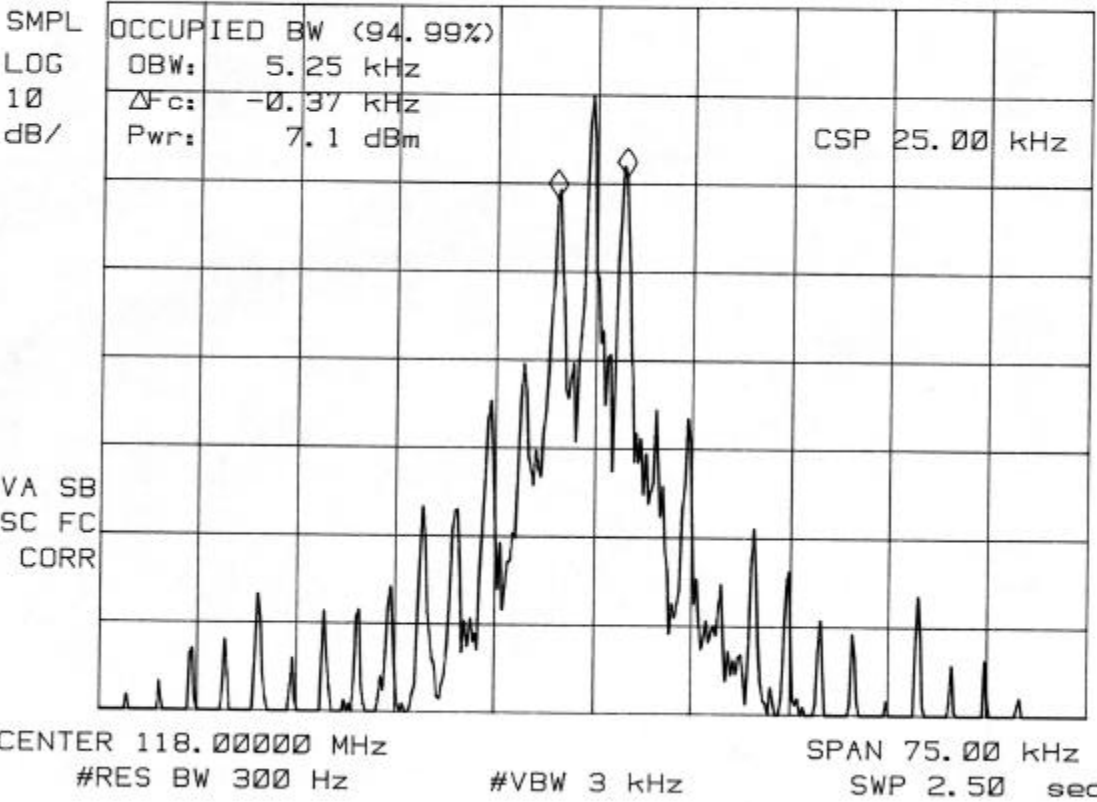
Trimble Navigation (Limited) TC100 Airborne VHF Transceiver

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

12:52:12 AUG 31, 1998
/P

REF 16.0 dBm AT 30 dB



COMMENT #1: Channel Setting = 118.000 MHz

COMMENT #2: Occupied BW = 5.25 kHz

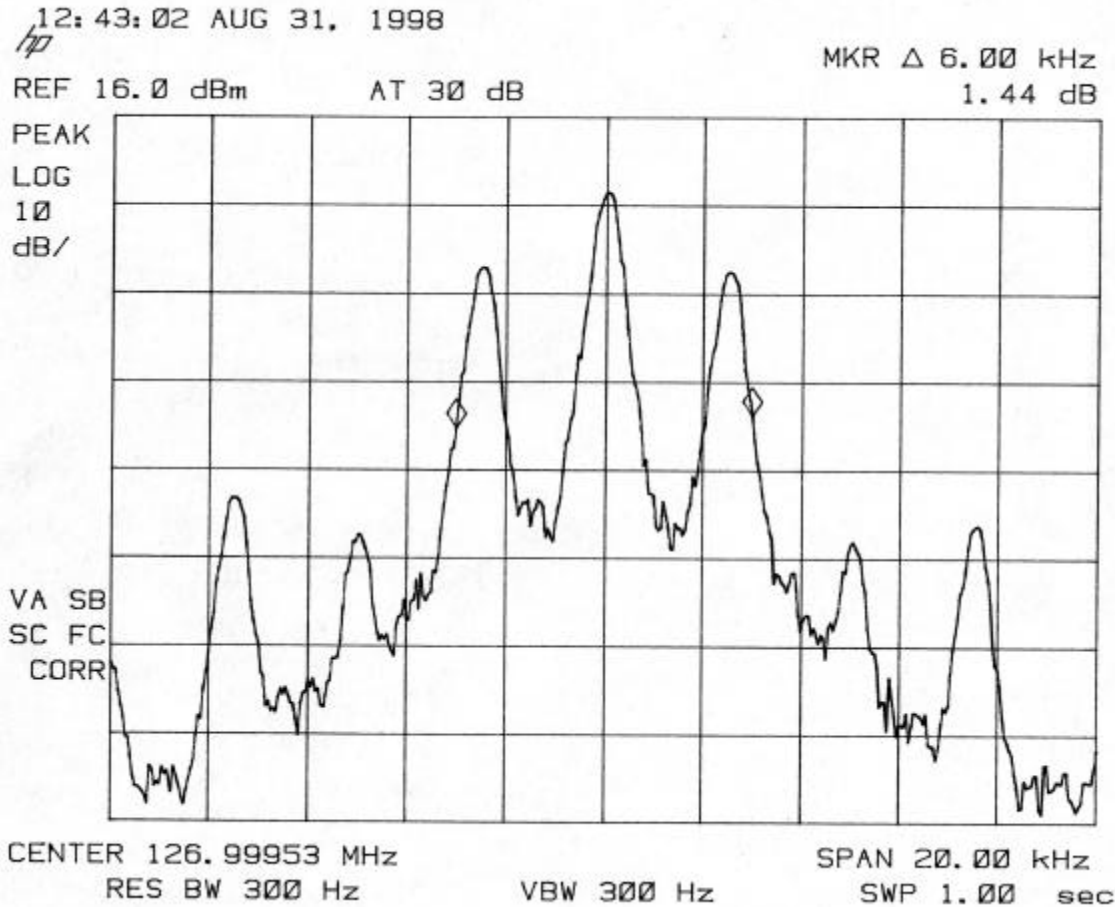
TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Occupied Bandwidth Data Sheet

Trimble Navigation (Limited) TC100 Airborne VHF Transceiver

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411



COMMENT #1: Channel Setting = 127.000 MHz

COMMENT #2: Occupied BW = 6.00 kHz

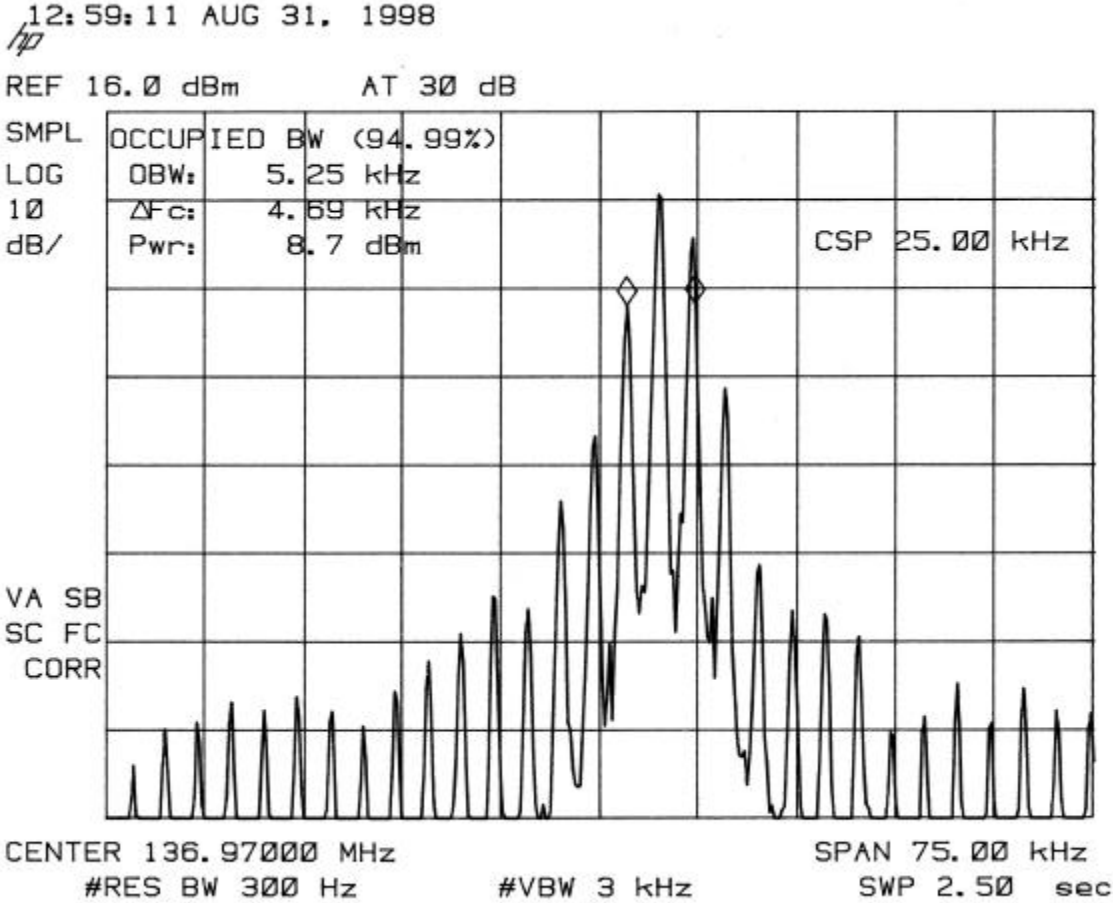
TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Occupied Bandwidth Data Sheet

Trimble Navigation (Limited) TC100 Airborne VHF Transceiver

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411



COMMENT #1: Channel Setting = 136.975 MHz

COMMENT #2: Occupied BW = 5.25 kHz

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Out Of Band Emissions Conducted Test Data

Appendix D

Conducted Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Freq. (MHz)	Recorded Level (dBm)	Cable Loss (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
118.000	37.1	0.2	37.3	Ref	Ref
118.003	9.6	0.2	9.8	12.3	-2.5
118.006	-1.2	0.2	-1.0	2.3	-3.3
118.015	-11.2	0.2	-11.0	-2.7	-8.3
236.000	-28.6	0.4	-28.2	-2.7	-25.5
354.000	-27.6	0.4	-27.2	-2.7	-24.5
472.000	-30.1	0.6	-29.5	-2.7	-26.8
590.000	-29.6	0.6	-29.0	-2.7	-26.3
708.000	-28.9	0.8	-28.1	-2.7	-25.4
826.000	-31.6	0.8	-30.8	-2.7	-28.1
944.000	-32.0	1.0	-31.0	-2.7	-28.3
1062.000	-29.6	1.0	-28.6	-2.7	-25.9
1180.000	-28.4	1.0	-27.4	-2.7	-24.7

COMMENT #1: Channel Setting = 118.000 MHz

COMMENT #2: Recorded Level corrected for attenuator.

TEST ENGINEER: _____ **APPROVED BY:** _____
 John O'Brien Jeffrey Lenk

Conducted Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Freq. (MHz)	Recorded Level (dBm)	Cable Loss (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
127.000	38.6	0.2	38.8	Ref	Ref
127.003	11.6	0.2	11.8	13.8	-2.0
127.006	0.3	0.2	0.5	3.8	-3.3
127.015	-12.3	0.2	-12.1	-1.2	-10.9
254.000	-26.7	0.4	-26.3	-1.2	-25.1
381.000	-28.9	0.4	-28.5	-1.2	-27.3
508.000	-29.6	0.6	-29.0	-1.2	-27.8
635.000	-30.8	0.6	-30.2	-1.2	-29.0
762.000	-28.6	0.8	-27.8	-1.2	-26.6
889.000	-29.7	0.8	-28.9	-1.2	-27.7
1016.000	-32.4	1.0	-31.4	-1.2	-30.2
1143.000	-33.6	1.0	-32.6	-1.2	-31.4
1270.000	-30.4	1.0	-29.4	-1.2	-28.2

COMMENT #1: Channel Setting = 136.975 MHz

COMMENT #2: Recorded Level corrected for attenuator.

TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffery Lenk

Conducted Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Freq. (MHz)	Recorded Level (dBm)	Cable Loss (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
136.975	38.3	0.2	38.5	Ref	Ref
136.978	11.3	0.2	11.5	13.5	-2.0
136.981	1.0	0.2	1.2	2.5	-1.3
136.990	-11.2	0.2	-11.0	-1.5	-9.5
273.950	-29.7	0.4	-29.3	-1.5	-27.8
410.925	-25.0	0.4	-24.6	-1.5	-23.1
547.900	-27.7	0.6	-27.1	-1.5	-25.6
684.875	-26.7	0.6	-26.1	-1.5	-24.6
821.850	-29.7	0.8	-28.9	-1.5	-27.4
958.825	-29.1	0.8	-28.3	-1.5	-26.8
1095.800	-34.7	1.0	-33.7	-1.5	-32.2
1232.775	-32.9	1.0	-31.9	-1.5	-30.4
1369.750	-27.7	1.0	-26.7	-1.5	-25.2

COMMENT #1: Channel Setting = 136.975 MHz

COMMENT #2: Recorded Level corrected for attenuator.

TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffery Lenk

Out Of Band Emissions Radiated Test Data

Appendix E

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Vertical

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
118.000	195.0	119.2	0.9	11.9	132.0	Ref	Ref
118.003	195.0	76.2	0.9	11.9	89.0	107.0	-18.0
118.006	195.0	61.8	0.9	11.9	74.6	97.0	-22.4
118.015	195.0	43.8	0.9	11.9	56.6	92.0	-35.4
236.000	195.0	13.4	1.4	14.9	29.7	92.0	-62.3
354.000	195.0	14.2	1.9	16.3	32.4	92.0	-59.6
472.000	195.0	48.4	2.2	18.3	68.9	92.0	-23.1
590.000	195.0	32.3	2.5	21.7	56.5	92.0	-35.5
708.000	195.0	28.9	2.7	22.0	53.6	92.0	-38.4
826.000	195.0	26.7	2.9	23.4	53.0	92.0	-39.0
944.000	195.0	31.4	2.0	23.3	56.7	92.0	-35.3
1062.000	195.0	32.4	2.4	23.4	58.2	92.0	-33.8
1180.000	195.0	34.6	2.6	23.5	60.7	92.0	-31.3

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 118.000 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffrey Lenk

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Horizontal

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
118.000	195.0	99.6	0.9	11.9	112.4	Ref	Ref
118.003	195.0	64.4	0.9	11.9	77.2	107.0	-29.8
118.006	195.0	52.4	0.9	11.9	65.2	97.0	-31.8
118.015	195.0	41.2	0.9	11.9	54.0	92.0	-38.0
236.000	195.0	14.2	1.4	14.9	30.5	92.0	-61.5
354.000	195.0	13.8	1.9	16.3	32.0	92.0	-60.0
472.000	195.0	48.4	2.2	18.3	68.9	92.0	-23.1
590.000	195.0	22.4	2.5	21.7	46.6	92.0	-45.4
708.000	195.0	24.6	2.7	22.0	49.3	92.0	-42.7
826.000	195.0	19.8	2.9	23.4	46.1	92.0	-45.9
944.000	195.0	32.4	2.0	23.3	57.7	92.0	-34.3
1062.000	195.0	30.8	2.4	23.4	56.6	92.0	-35.4
1180.000	195.0	33.6	2.6	23.5	59.7	92.0	-32.3

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 118.000 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffery Lenk

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Vertical

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
127.000	195.0	121.3	0.9	11.9	134.1	Ref	Ref
127.003	195.0	52.4	0.9	11.9	65.2	109.1	-43.9
127.006	195.0	42.1	0.9	11.9	54.9	99.1	-44.2
127.015	195.0	34.4	0.9	11.9	47.2	94.1	-46.9
254.000	195.0	12.4	1.4	14.9	28.7	94.1	-65.4
381.000	195.0	16.8	1.9	16.3	35.0	94.1	-59.1
508.000	195.0	38.9	2.2	18.3	59.4	94.1	-34.7
635.000	195.0	26.4	2.5	21.7	50.6	94.1	-43.5
762.000	195.0	22.4	2.7	22.0	47.1	94.1	-47.0
889.000	195.0	28.6	2.9	23.4	54.9	94.1	-39.2
1016.000	195.0	31.4	2.0	23.3	56.7	94.1	-37.4
1143.000	195.0	33.4	2.4	23.4	59.2	94.1	-34.9
1270.000	195.0	32.8	2.6	23.5	58.9	94.1	-35.2

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 127.000 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Horizontal

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
127.000	195.0	93.6	0.9	11.9	106.4	Ref	Ref
127.003	195.0	53.2	0.9	11.9	66.0	109.1	-43.1
127.006	195.0	39.8	0.9	11.9	52.6	99.1	-46.5
127.015	195.0	32.4	0.9	11.9	45.2	94.1	-48.9
254.000	195.0	13.4	1.4	14.9	29.7	94.1	-64.4
381.000	195.0	16.6	1.9	16.3	34.8	94.1	-59.3
508.000	195.0	42.2	2.2	18.3	62.7	94.1	-31.4
635.000	195.0	36.7	2.5	21.7	60.9	94.1	-33.2
762.000	195.0	26.8	2.7	22.0	51.5	94.1	-42.6
889.000	195.0	24.6	2.9	23.4	50.9	94.1	-43.2
1016.000	195.0	30.6	2.0	23.3	55.9	94.1	-38.2
1143.000	195.0	32.8	2.4	23.4	58.6	94.1	-35.5
1270.000	195.0	34.6	2.6	23.5	60.7	94.1	-33.4

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 127.000 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffery Lenk

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Vertical

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
136.975	195.0	120.7	0.9	11.9	133.5	Ref	Ref
136.978	195.0	78.8	0.9	11.9	91.6	108.5	-16.9
136.981	195.0	62.4	0.9	11.9	75.2	98.5	-23.3
136.990	195.0	44.5	0.9	11.9	57.3	93.5	-36.2
273.950	195.0	12.8	1.4	14.9	29.1	93.5	-64.4
410.925	195.0	11.0	1.9	16.3	29.2	93.5	-64.3
547.900	195.0	52.6	2.2	18.3	73.1	93.5	-20.4
684.875	195.0	28.4	2.5	21.7	52.6	93.5	-40.9
821.850	195.0	16.4	2.7	22.0	41.1	93.5	-52.4
958.825	195.0	16.0	2.9	23.4	42.3	93.5	-51.2
1095.800	195.0	30.5	2.0	23.3	55.8	93.5	-37.7
1232.775	195.0	27.8	2.4	23.4	53.6	93.5	-39.9
1369.750	195.0	32.7	2.6	23.5	58.8	93.5	-34.7

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 136.975 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffrey Lenk

Radiated Spurious Emissions Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: September 4, 1998

PROJECT #: 99-411
POLARIZATION: Horizontal

Freq. (MHz)	EUT Direction (Deg)	Recorded Level (dBuV)	Cable Loss (dB)	Antenna Factor (dBuV/m)	Corrected Level (dBuV/m)	Limit (dBm)	Margin (dB)
136.975	195.0	102.3	0.9	11.9	115.1	Ref	Ref
136.978	195.0	43.4	0.9	11.9	56.2	108.5	-52.3
136.981	195.0	38.6	0.9	11.9	51.4	98.5	-47.1
136.990	195.0	28.9	0.9	11.9	41.7	93.5	-51.8
273.950	195.0	8.8	1.4	14.9	25.1	93.5	-68.4
410.925	195.0	14.6	1.9	16.3	32.8	93.5	-60.7
547.900	195.0	32.4	2.2	18.3	52.9	93.5	-40.6
684.875	195.0	18.4	2.5	21.7	42.6	93.5	-50.9
821.850	195.0	24.2	2.7	22.0	48.9	93.5	-44.6
958.825	195.0	28.6	2.9	23.4	54.9	93.5	-38.6
1095.800	195.0	27.6	2.0	23.3	52.9	93.5	-40.6
1232.775	195.0	29.8	2.4	23.4	55.6	93.5	-37.9
1369.750	195.0	30.4	2.6	23.5	56.5	93.5	-37.0

COMMENT #1: EUT antenna in vertical polarization (worst case)

COMMENT #2: Channel Setting = 136.975 MHz

COMMENT #3: Worst case measurement antenna height = 1 meter

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffrey Lenk

Appendix F

Frequency Stability Test Data

Frequency Stability Versus Temperature Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Temperature (Degrees C)	Measured Frequency (MHz)	Frequency Deviation (kHz)	Deviation vs Limit (kHz)
50	126.999977	-0.02300	-3.79
40	126.999908	-0.09200	-3.72
30	127.000090	0.09000	-3.72
20	127.000299	0.29900	-3.51
10	127.000201	0.20100	-3.61
0	127.000379	0.37900	-3.43
-10	127.000358	0.35800	-3.45
-20	127.000225	0.22500	-3.58
-30	126.999938	-0.06200	-3.75

COMMENT #1: Test Frequency = 127.000 MHz

COMMENT #1: Reference Limit = 3.82 kHz

COMMENT #2: 45 minute soak at each temperature

TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffrey Lenk

Frequency Stability Versus DC Power Data Sheet

**Trimble Navigation (Limited)
TC100 Airborne VHF Transceiver**

SERIAL #: 14
DATE: August 31, 1998

PROJECT #: 99-411

Input Voltage (DC Volts)	Measured Frequency (MHz)	Frequency Deviation (kHz)	Deviation vs Limit (kHz)
32	126.999488	-0.51200	-3.30
30	126.999498	-0.50200	-3.31
28	126.999498	-0.50200	-3.31
26	126.999483	-0.51700	-3.29
24	126.999476	-0.52400	-3.29
22	126.999495	-0.50500	-3.30
20	126.999493	-0.50700	-3.30
18	126.999495	-0.50500	-3.30
16	126.999503	-0.49700	-3.31
14	126.999498	-0.50200	-3.31
12	126.999495	-0.50500	-3.30
10	N/A	N/A	Ceased Operation

COMMENT #1: Test Frequency = 127.000 MHz

COMMENT #1: Reference Limit = 3.82 kHz

COMMENT #2: 45 minute soak at each temperature

TEST ENGINEER: _____ **APPROVED BY:** _____
John O'Brien Jeffrey Lenk