Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94085-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report (Permissive Change II) In Accordance With Industry Canada Radio Standards Specification 133 issue 2, FCC Part 24 Subpart E on the Thales Navigation Model: Z-Max GPS Receiver

FCC ID:	NZI110896
UPN:	4713A-110896
GRANTEE:	Thales Navigation 471 El Camino Real Santa Clara, CA 95050
TEST SITE:	Elliott Laboratories, Inc. 41039 Boyce Road Fremont, CA 94538
REPORT DATE:	September 16, 2004
FINAL TEST DATE:	September 11, 2004
AUTHORIZED SIGNATORY:	Juan Martinez Senior EMC Engineer

ACCREDITED

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FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, Section 2.1033(C) & to Industry Canada RSP-100.

2.1033(c)(1) Grantee:
Thales Navigation
471 El Camino Real
Santa Clara, CA 95050

2.1033(c)(2) & RSP-100 (4) FCC ID: NZI110896
UPN: 4713A-110896

2.1033(c)(3) & RSP-100 (7.2(a)) Instructions/Installation Manual

Please refer to Exhibit 7: User Manual, Theory of Operation, and Tune-up Procedure

2.1033(c)(4) & RSP-100 (7.2(b)(iii)) Type of emissions

FCC 24E & RSS-133**: 317KGXW**

2.1033(c)(5) & RSP-100 (7.2(a)) Frequency Range

FCC 24E & RSS-133**:** 1850.2 - 1909.8 MHz (1900)

2.1033(c)(6) & RSP-100 (7.2(a)) Range of Operation Power

FCC 24E & RSS-133**:** 19.6 dBm EIRP (0.091 Watts EIRP)

2.1033(c)(7) & RSP-100 (7.2(a)) Maximum FCC & IC Allowed Power Level

24.235(b) & RSS-133 (6.2): Mobile/portable stations are limited to 2 watts E.I.R.P. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

2.1033(c)(8) & RSP-100 (7.2(a)) Applied voltage and currents into the final transistor elements

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(9) & RSP-100 (7.2(a)) Tune-up Procedure

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(10) & RSP 100 (7.2(a)) Schematic Diagram of the Transmitter

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Frequency Stabilization

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Suppression of Spurious radiation

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Modulation

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Power

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(11) & RSP-100 (7.2(g)) Photographs or Drawing of the Equipment Identification Plate or Label

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(12) & RSP-100 (7.2(c)) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) & RSP-100 (7.2(a)) Equipment Employing Digital Modulation

This is a Class II permissive change (Information has been provided previously)

2.1033(c)(14) & RSP-100 (7.2(b)(ii)) Data taken per Section 2.1046 to 2.1057 and RSS-133 issue 2, Rev. 1.

Refer to Exhibit 2

DECLARATIONS OF COMPLIANCE

Equipment Name and Model:
Z-Max GPS Receiver

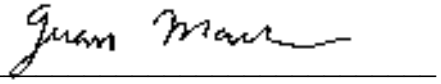
Manufacturer:
Thales Navigation
471 El Camino Real
Santa Clara, CA 95050

Tested to applicable standards:
RSS-133 Issue 2, Rev. 1 November 6, 1999 (2GHz Personal Communications Services)
FCC Part 24 Subpart E

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC4549 **4** Dated March 5, 2003

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of TIA/EIA-603 and the specific RSS standards applicable to this device); and that the equipment performed in accordance with the data submitted in this report.

Signature	
Name	Juan Martinez
Title	Senior EMC Engineer
Company	Elliott Laboratories Inc.
Address	41039 Boyce Road Fremont, CA 94538 USA
Date:	September 16, 2004

Maintenance of compliance with the above standards is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

SCOPE

FCC Part 24 Subpart E & IC RSS-133 testing was performed for the equipment mentioned in this report. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules & IC RSS-133. TIA-603 was also used as a test procedure guideline to perform some of the required tests.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC & RSS performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the FCC 24 Subpart E & IC RSS-133. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033 & RSP-100.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC & Industry Canada. FCC & Industry Canada issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

SUMMARY OF TEST RESULTS

Part 24E and RSS-133 Test Summary

Part 2 Measurements Required Section	FCC Part 24 Subpart E Section	RSS-133 Section	Test Performed	Measured Value	Test Procedure Used	Result
Modulation Tested	GSM	GSM	-	-	-	-
2.1047: Modulation characteristics	24.238 (b)	5.6	99% Bandwidth	317 kHz	D	Complies
2.1046: RF power output	24.232 (b)	6.2	Output Power Test	19.6 dBm (0.091 Watts EIRP)	A	Complies
2.1046: RF power output	24.232 (b)	6.2	Conducted Output Power Test (**Antenna Conducted**)	27.7 dBm (.589Watts)	B	Complies
2.1051: Spurious emissions at antenna Port	24.238 (a) & (b)	6.3	Emission Limits and/or Unwanted Emission 30MHz – 25GHz (**Radiated Method**)	All spurious emissions < -13dBm	N	Complies
2.1049: Occupied Bandwidth	24.238 (a) & (b)	6.3	Out of Block Emissions (**Radiated Method**)	All spurious emissions < -13dBm	I	Complies
2.1053 Field strength of spurious radiation	24.238 (a) & (b)	6.3	Radiated Spurious Emissions 30MHz – 25GHz	-25.4 dBm @ 1849.993 MHz (-12.4dB)	N	Complies
2.1055: Frequency stability	24.235	7(a)	Frequency Stability (Frequency Vs. Temperature)	<0.09 ppm	Reference from Report AC-EX06 Test Report	Note 1 (Report Page 26)
2.1055: Frequency stability	24.235	7(b)	Frequency Stability (Frequency Vs. Voltage)	<0.03 ppm	Reference from Report AC-EX06 Test Report	Note 1 (Report Page 26)
2.1093: Exposure to portable devices	24.52	8	Exposure of Humans to RF Fields	SAR Report provided	N/A	-
-	-	9 (ii)	Receiver Spurious Emissions (**Antenna Conducted**)	All spurious emission below 1 GHz < 2 nanowatts and above 1 GHz < 5 nanowatts	P	Complies

Note 1: No change was made to the frequency stability circuit so no test was performed. Data in table is reference to a previous test report that has been reviewed by the FCC and has been found compliant to the FCC rules.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Thales Navigation, Inc. model Z-Max GPS Receiver is a mobile surveying instrument. It contains a control module and various options of communications modules. In addition it has a battery module for power when in the portable mode, two external serial ports, one RS232 and one configurable in RS232 or RS422 and a dc input port. The main enclosure has a screw mount in the top that can accommodate the GPS, UHF, VOID (GPS pass through) receive antennas, or an adapter that provides coaxial ports for the GPS receive antenna and UHF receive antenna. If being used as a mobile device the Void or UHF receiver is used and the GPS antenna connects into the top of either, otherwise it connects directly into the screw mount.

The control module contains a BlueTooth FHSS transceiver and is intended to be used for short-distance communications with a control computer. It has an USB Port and a SD Interface.

The communications module may contain a GSM Transceiver and / or an UHF Receiver. The UHF receiver incorporated into this module is either one from a Pacific Crest series that cover the frequency range 410 - 470 MHz or a Thales receiver that covers the same frequency range. The GSM transceiver is a Motorola cellular transceiver module for data communications.

The device is designed to be used in two modes - portable mode and office mode. Portable mode is the mode used for field survey measurements. In this mode the device would be powered from its battery pack and the only peripheral connected would be either an external UHF transceiver or a field computer. Office mode is the mode used to download data from the device. In this mode the USB connection would be employed to transfer data from the instrument into a PC. As this is a professional product the Class A limits are appropriate for office mode.

The sample was received on September 11, 2004 and tested on September 11, 2004. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Thales Navigation	800963	Main Unit	
Thales Navigation	800964-08	Com Module (Pacific Crest UHF Rx and GSM TRx)	
Thales Navigation	800964-09	Com Module (Pacific Crest UHF Rx and GSM TRx)	
Thales Navigation	800964-10	Com Module (Pacific Crest UHF Rx and GSM TRx)	
Thales Navigation	800964-07	Com Module (Thales UHF Rx and GSM TRx)	

ENCLOSURE

The main enclosure, which houses the BlueTooth transceiver and the GPS receiver) is primarily constructed from a magnesium alloy. It measures approximately 30cm tall with a triangular base section measuring 10cm x 10cm x 10cm. The optional UHF antenna that connects into the top of the main unit is approximately 60cm long.

The com module, which houses the optional UHF receiver and optional GSM modem, is primarily constructed from a magnesium alloy. It measures approximately 18cm tall and 4cm deep and 8cm wide.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PPX	Laptop	62HMN	DoC
Globaltek	AD-740U-1240	Power Supply	N/A	N/A

No equipment was used as remote support equipment for emissions testing:

EUT INTERFACE PORTS

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial	Laptop	Multiwire	Shielded	1
DC input	AC/DC adaptor	3 wire	Unshielded	1.8

EUT OPERATION DURING TESTING

Continuously transmitting at full power on low, middle, and high channels.

ANTENNA REQUIREMENTS

The antenna port is a non standard, reverse polarity connector, which meets the requirements of 15.203.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 11, 2004 at the Elliott Laboratories Chamber #4 located at 41039 Boyce Road, Fremont, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing are performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment or Anechoic Chamber. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

INSTRUMENT CONTROL COMPUTER

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

PEAK POWER METER

A peak power meter and thermister mount may be used for output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

The requirements of ANSI C63.4 were used for configuration of the equipment turntable. It specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

General: For Transmitters with detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. The attenuators and/or filters are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

Procedure A – Power Measurement (Radiated Method): The following procedure was used for transmitters that do not use external antennas or with devices with test port were the output power can be measured directly, but Power must still be made with antenna attached.

1) Set the EUT to maximum power and to the lowest channel.
2) A spectrum analyzer was use to measure the power output. The search antenna was located 3 meter from the EUT.
3) The spectrum analyzer resolution and video bandwidth was set to 2 MHz to measure the power output. No amplifier was used since the fundamental will cause the amplifier to saturate.
4) The EUT was then rotated for a complete 360 degrees and the search antenna was raised and lowered to maximize the fundamental. Both vertical and horizontal polarization's were performed. All correction factors are applied to the fundamental.
5) Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a transmit antenna and signal generator. The substitution antenna can be reference to a half-wave dipole in dBi. The signal generator is then set to a fix output level of either –10 or –20dBm. This is then injected into the substitution antenna. The field strength produced by the substitution antenna is then measured. This measured value is then used to determine the conversion factor to convert the EUTs field strength levels to a dBm value.
6) Steps 1 to 5 are repeated for the middle and the highest channel.

Procedure B – Power Measurement (Conducted Method): The following procedure was used for transmitters that do use external antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) Either a power meter or a spectrum analyzer was used to measure the power output.
3) If a spectrum analyzer was used a resolution and video bandwidth 1MHz was used to measure the power output. Corrected for any external attenuation used for the protection of the input of analyzer. In addition, For CDMA or TDMA modulations set spectrum analyzer resolution to 1MHz and video to 30 kHz. Use video averaging with a 100-sample rate.
4) If a power meter was used, corrected for any external attenuation used for the protection of the input of the sensor head. Also set the power sensor correction by setting up the frequency range that will be measured.
5) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure D - Occupied Bandwidth (Conducted Method): Either for analog, digital, or data modulations, occupied bandwidth was performed. The EUT was set to transmit the appropriate modulation at maximum power. The bandwidth was measured using following methods:

1) The built-in 99% function of the spectrum analyzer was used.
2) If the built-in 99% is not available then the following method is used:

   26-dB was subtracted to the maximum peak of the emission. Then the display line function was used, in conjunction with the marker delta function, to measure the emissions bandwidth.

3) For the above two methods a resolution and video bandwidth of 10 or 30 kHz was used to measure the emission's bandwidth.

Procedure H - Other Types of Equipment: Either digital or data modulated signals were simulated, by software or external sources, to performed the required tests. The EUT was set to transmit the appropriate digital modulation.

Procedure I – Bandedge: Where Bandedge measurements are specified the following procedure was performed:

1) Set the transmitting signal as close as possible to the edge of the frequency band/block as specified in the standard. Power is set to maximum
2) Set the spectrum analyzer display line function to 84.4 dBuV/m.
3) Set the spectrum analyzer bandwidth to the minimum 1% of the emission bandwidth. The emission bandwidth is determined by using **procedure D**.
4) A spectrum analyzer was use to measure the radiated field strength. The search antenna was located 3 meter from the EUT.
5) The spectrum analyzer resolution and video bandwidth was set to 1MHz to measure the total bandwidth power of the signal. No amplifier was used since the fundamental will cause the amplifier to saturate.
6) The EUT was then rotated for a complete 360 degrees and the search antenna was raised and lowered to maximize the fundamental. Both vertical and horizontal polarization's were performed. All correction factors are applied to the fundamental.
7) Set the marker function to the FCC or IC specified frequency band/block, which gave a field strength result in dBuV/m.
8) Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a transmit antenna and signal generator. The substitution antenna can be reference to a half-wave dipole in dBi. The signal generator is then set to a fix output level of either –10 or –20dBm. This is then injected into the substitution antenna. The field strength produced by the substitution antenna is then measured. This measured value is then used to determine the conversion factor to convert the EUTs field strength levels to a dBm value.
9) Steps 1 to 8 were repeated for all modulations and output ports that will be used for transmission. Also, Bandedge is determined for blocks A (high edge), D, B, E, F, C (low edge).
10) Bandedge substitution level must not exceed the –13-dBm limit.

Procedure N - Field Strength Measurement: The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator (If antenna was permanently attach or internal to device, radiated emission was performed with antenna attached). The EUT was set at the middle of the frequency band and set at maximum output power.

For the first scan, a pre-liminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

For the final measurement, Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a transmit antenna and signal generator. The substitution antenna can be reference to a half-wave dipole in dBi. The signal generator is then set to a fix output level of either –10 or –20dBm. This is then injected into the substitution antenna. The field strength produced by the substitution antenna is then measured. This measured value is then used to determine the conversion factor to convert the EUTs field strength levels to a dBm value.

Procedure P – Receiver Antenna Conducted Emissions: Receiver spurious emission was measured at the antenna terminal, as a port was available.

1) Set the receiver was set to the midpoint of the operating band as specified in the standard.
2) Set the spectrum analyzer display line function to 2 nanowatts for measurements below 1 GHz and 5 nanowatts for measurements above 1 GHz.
3) Set the spectrum analyzer bandwidth to 1 MHz.
4) For the spectrum analyzer, the start frequency was set to 30 MHz and the stop frequency set to the 5^{th} harmonic of the receiver LO. All spurious or intermodulation emission must not exceed the specified limit.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

RADIATED EMISSIONS SPECIFICATION LIMITS

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver.

Below is a formula example used to calculate the attenuation requirement, relative to the transmitters power output, in dBuV/m. For this example an operating power range of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64 \text{ dB}}}{3 \text{ meters}}$$

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

FCC Rules request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

Note: Substitution Method is performed for spurious emissions with less than 20dB of margin relative to the calculated field strength limit.

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 1000 - 20,000 MHz, 11-Sep-04
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
Miteq	Preamplifier, 1-18GHz	AFS44	1346	08-Jan-05
EMCO	Horn Antenna D. Ridge 1-18 GHz (SA40 horn)	3115	1386	24-Mar-05
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 40 GHz, Fremont	8564E (84125C)	1393	26-Mar-05

Radiated Emissions, 30 - 1,000 MHz, 11-Sep-04
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
Com-Power	Pre Amplifier, 30-1000MHz	PA-103	1543	26-Nov-04
Rohde & Schwarz	EMI Test Receiver, 20Hz-7GHz	ESIB7	1630	05-Jan-05
Sunol Sciences	Biconilog, 30-3000MHz	JB3	1657	24-Feb-05

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T57109 13 Pages

Elliott

EMC Test Data

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Emissions Spec:	FCC 24E, RSS-133	Class:	Radio
Immunity Spec:		Environment:	

EMC Test Data

For The

Thales Navigation

Model

Z-Max GPS Reciever

Date of Last Test: 9/11/2004

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Emissions Spec:	FCC 24E, RSS-133	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

EUT INFORMATION

General Description

The EUT is a mobile surveying instrument. It contains a control module and various options of communications modules. In addition it has a battery module for power when in the portable mode, two external serial ports, one RS232 and one configurable in RS232 or RS422 and a dc input port. The main enclosure has a screw mount in the top that can accommodate the GPS, UHF, VOID (GPS pass through) receive antennas, or an adapter that provides coaxial ports for the GPS receive antenna and UHF receive antenna. If being used as a mobile device the Void or UHF receiver is used and the GPS antenna connects into the top of either, otherwise it connects directly into the screw mount.

The control module contains a BlueTooth FHSS transceiver and is intended to be used for short-distance communications with a control computer. It has an USB Port and a SD Interface.

The communications module may contain a GSM Transceiver and / or an UHF Receiver. The UHF receiver incorporated into this module is either one from a Pacific Crest series that cover the frequency range 410 - 470 MHz or a Thales receiver that covers the same frequency range. The communication module can also contain a Motorola cellular transceiver module for data communications.

The device is designed to be used in two modes - portable mode and office mode. Portable mode is the mode used for field survey measurements. In this mode the device would be powered from its battery pack and the only peripheral connected would be either an external UHF transceiver or a field computer. Office mode is the mode used to download data from the device. In this mode the USB connection would be employed to transfer data from the instrument into a PC. As this is a professional product the Class A limits are appropriate.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Thales Navigation	800963	Main Unit	N/A	NZI110896
Thales Navigation	800964-08	Com Module (Pacific Crest UHF Rx and PCS TRx)	N/A	NZI110896
Thales Navigation	800964-09	Com Module (Pacific Crest UHF Rx and PCS TRx)	N/A	NZI110896
Thales Navigation	800964-10	Com Module (Pacific Crest UHF Rx and PCS TRx)	N/A	NZI110896
Thales Navigation	800964-07	Com Module (Thales UHF Rx and PCS TRx)	N/A	NZI110896

Elliott

EMC Test Data

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Emissions Spec:	FCC 24E, RSS-133	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

Other EUT Details

The following UHF radios are the optional UHF receivers that may be incorporated into the communications module. Tests were performed on each receiver module.

Pacific Crest 800964-08 410-430MHz
Pacific Crest 800964-09 430-450MHz
Pacific Crest800964-10 450-470MHz
Thales Navigation 800964-07 410-470 MHz

The following BlueTooth radio was tested with Z-Max:
Samsung BTMZ5012x0

The following PCS module was tested with Z-Max:
Motorola IHDT6AC1

EUT Enclosure

The main enclosure, which houses the BlueTooth transceiver and the GPS receiver) is primarily constructed from a magnesium alloy. It measures approximately 30cm tall with a triangular base section measuring 10cm x 10cm x 10cm. The optional UHF antenna that connects into the top of the main unit is approximately 60cm long.

The com module, which houses the optional UHF receiver and optional GSM modem, is primarily constructed from a magnesium alloy. It measures approximately 18cm tall and 4cm deep and 8cm wide.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Emissions Spec:	FCC 24E, RSS-133	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PPX	Laptop	62HMN	DoC
Globaltek	AD-740U-1240	Power Supply	N/A	N/A

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial	Laptop	Multirwire	Shielded	1
DC input	AC/DC adaptor	3 wire	Unshielded	1.8

EUT Operation During Emissions

Continuously transmitting at full power on low, middle, and high channels.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Radiated Spurious Emissions, FCC 24E

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/11/2004
Test Engineer: Juan Martinez
Test Location: Fremont Chamber #4
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

The measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 20.3 °C
Rel. Humidity: 52 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1c	Power Output (Conducted)	FCC 24E	Pass	27.7dBm
1a-1c	Power Output (Radiated)	FCC 24E	Pass	19.6dBm EIRP
1a-1c	RE, 30 - 20,000 MHz - Spurious Emissions Transmit Mode	FCC 24E	Pass	-12.4dB @ 1849.993MHz

Modifications Made During Testing:

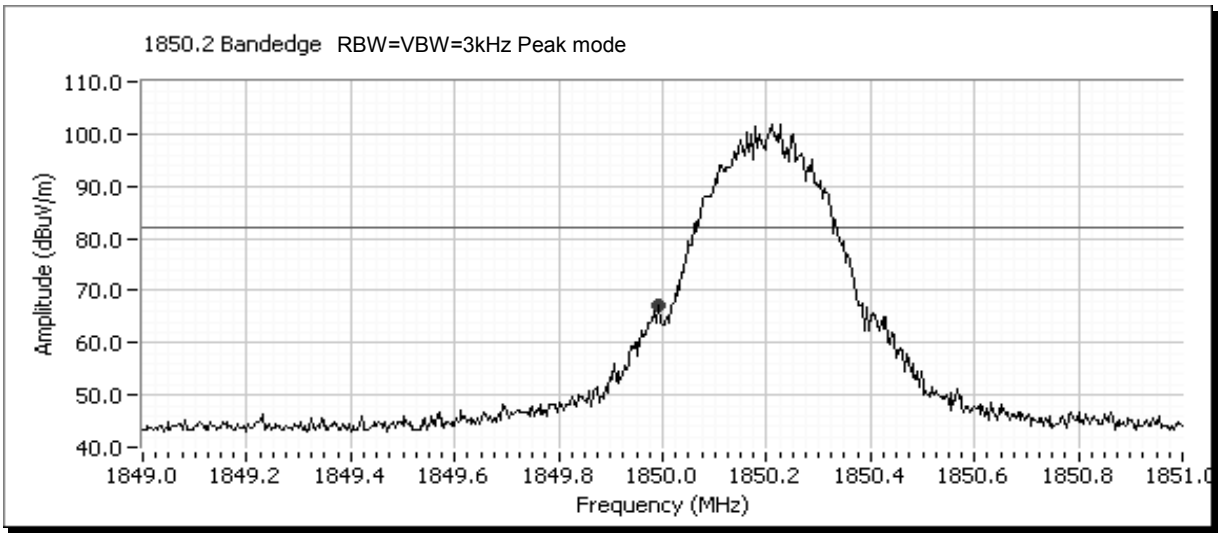
No modifications were made to the EUT during testing

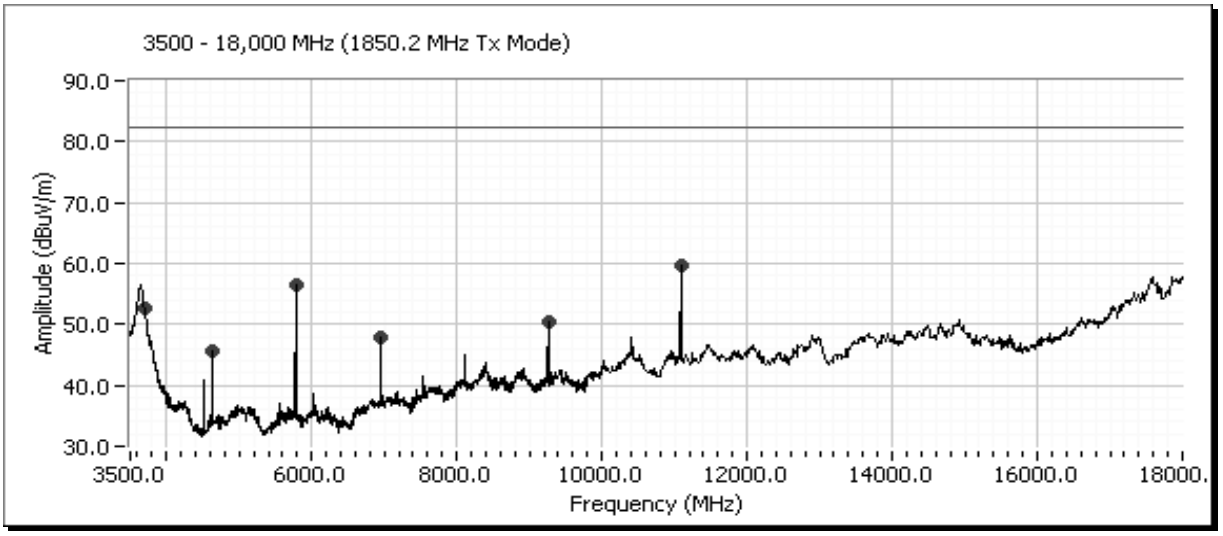
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Run #1a: Radiated Spurious Emissions, Transmit Mode, 1000 - 20,000 MHz. EUT @ 1850.2 MHz





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EMC Test Data

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Frequency	Level	Pol	FCC 24E [Note 1]		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1850.201	111.0	V	-	-	PK	201	1.2	Fundamental
1850.336	111.0	H	-	-	PK	258	1.0	Fundamental
1849.993	67.4	H	-	-	Peak	258	1.0	Bandedge
9260.061	52.6	H	82.2	-29.6	PK	3	1.0	RBW=VBW=1MHz
6944.969	50.7	H	82.2	-31.5	PK	118	1.0	RBW=VBW=1MHz
5787.531	55.8	H	82.2	-26.4	PK	126	1.8	RBW=VBW=1MHz
11101.66	59.2	V	82.2	-23.0	PK	196	1.2	RBW=VBW=1MHz
4630.045	48.6	H	82.2	-33.7	PK	210	1.0	RBW=VBW=1MHz
3699.090	56.7	V	82.2	-25.5	PK	255	1.6	RBW=VBW=1MHz

Note 1:	The limit in the table above is an approximate field strength limit. It has been calculated form the erp or eirp limit detailed in the EN standard using Friis' equation for free space propagation: E = 30PG/d . This limit is a conservative limit because it does not consider the presence of the ground plane. The actual signal level, in terms of erp or eirp, is determined from a substitution measurement for all signals with less than 20dB of margin relative to the calculated field strength limit.

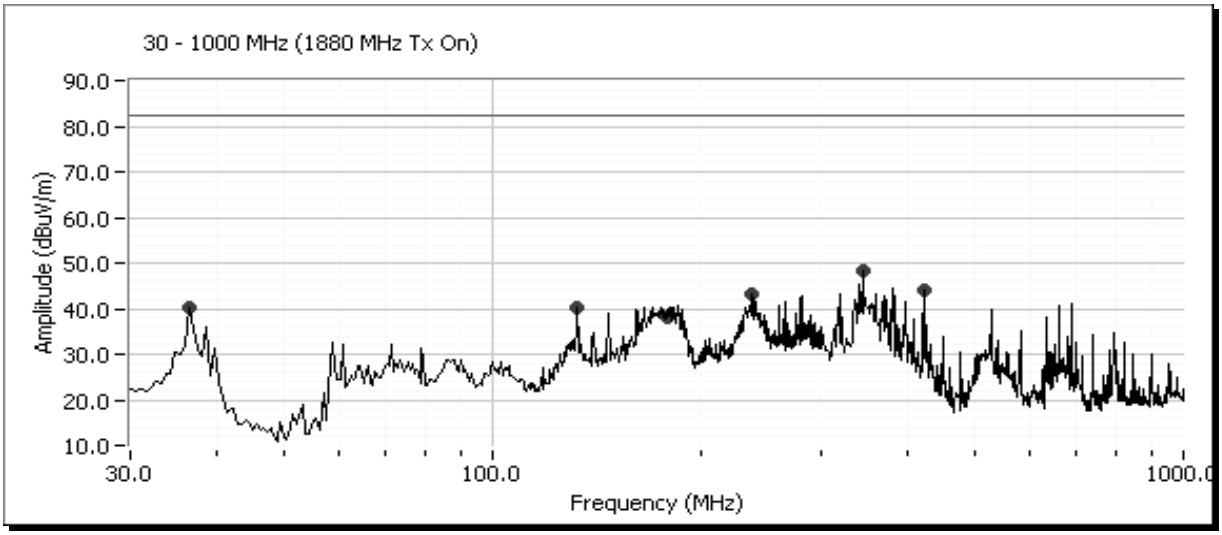
Transmit Mode: Final Field Strength and Substitution Measurements

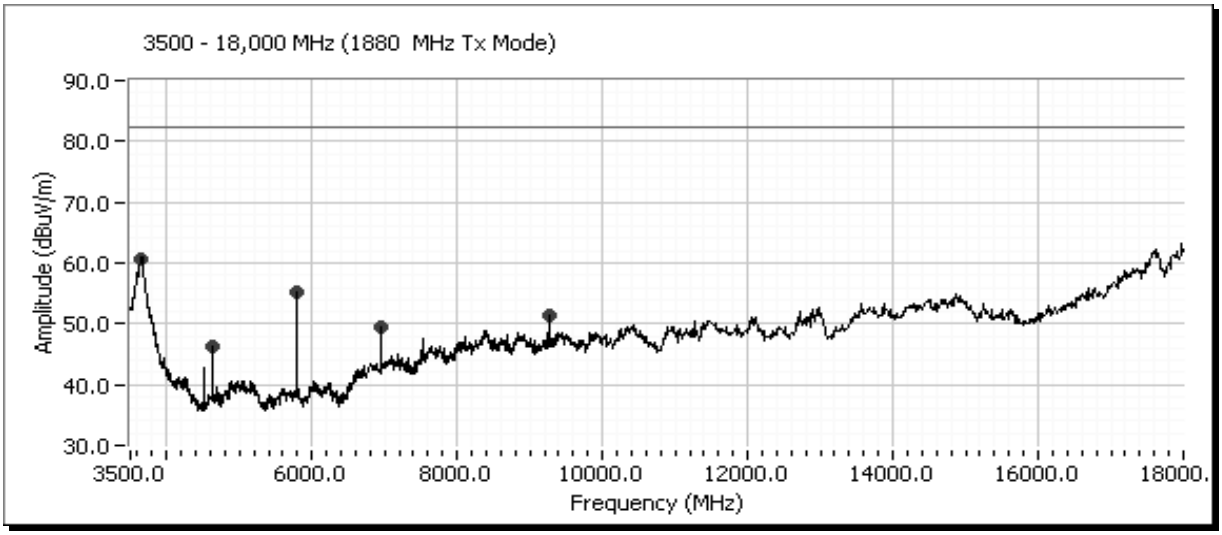
Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1850.201	-10.0	8.5	90.4	91.9	111.0	19.1	16.9			
1850.336	-10.0	8.5	91.3	92.8	111.0	18.2	16.0			
1849.993	-10.0	8.5	91.3	92.8	67.4	-25.4	-27.6	-13.0		-12.4

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna. A dipole has a gain of 2.2dBi.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Run #1b: Radiated Spurious Emissions, Transmit Mode, 30 - 20,000 MHz. EUT @ 1880 MHz





EMC Test Data

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Frequency	Level	Pol	FCC 24E Note 1		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1879.914	109.9	V	-	-	PK	209	1.2	Fundamental
1880.084	109.5	H	-	-	PK	273	1.0	Fundamental
36.493	40.4	V	82.2	-41.9	Peak	76	1.0	RBW=VBW=1MHz
132.806	40.2	H	82.2	-42.0	Peak	98	1.0	RBW=VBW=1MHz
179.339	38.0	H	82.2	-44.2	Peak	118	1.0	RBW=VBW=1MHz
237.776	43.1	H	82.2	-39.1	Peak	290	1.0	RBW=VBW=1MHz
343.487	48.3	H	82.2	-33.9	Peak	261	1.0	RBW=VBW=1MHz
423.447	44.1	H	82.2	-38.1	Peak	181	2.0	RBW=VBW=1MHz
3650.000	60.6	V	82.2	-21.6	Peak	139	1.8	RBW=VBW=1MHz
4630.000	46.1	H	82.2	-36.1	Peak	209	1.0	RBW=VBW=1MHz
5790.000	55.2	H	82.2	-27.1	Peak	24	1.4	RBW=VBW=1MHz
6943.334	49.6	H	82.2	-32.6	Peak	126	1.0	RBW=VBW=1MHz
9259.167	51.3	H	82.2	-30.9	Peak	10	1.0	RBW=VBW=1MHz

Note 1:	The limit in the table above is an approximate field strength limit. It has been calculated form the erp or eirp limit detailed in the EN standard using Friis' equation for free space propagation: E = 30PG/d . This limit is a conservative limit because it does not consider the presence of the ground plane. The actual signal level, in terms of erp or eirp, is determined from a substitution measurement for all signals with less than 20dB of margin relative to the calculated field strength limit.

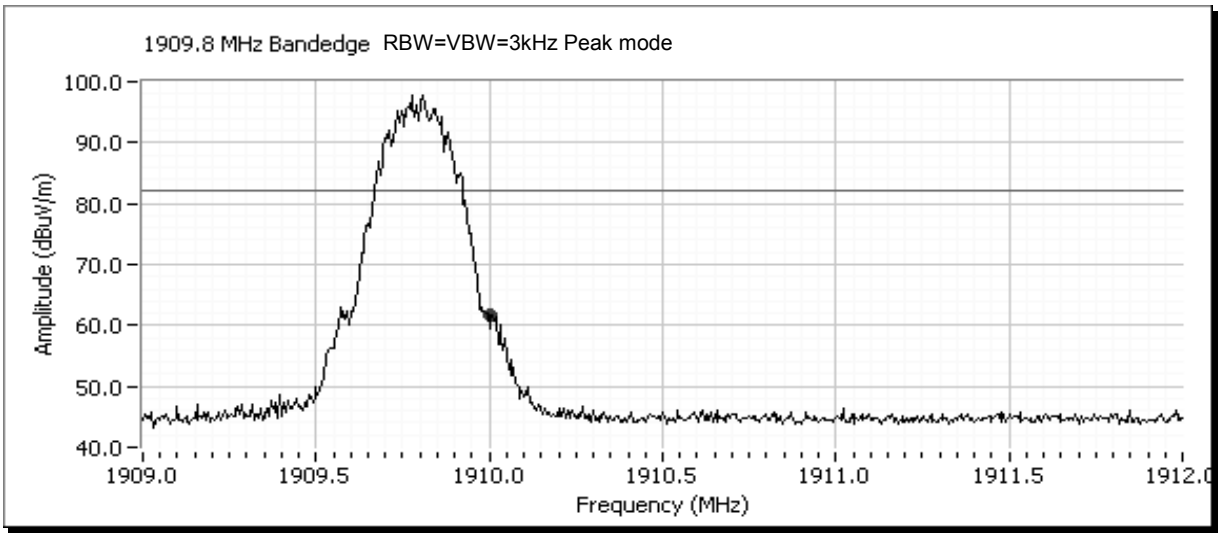
Transmit Mode: Final Field Strength and Substitution Measurements

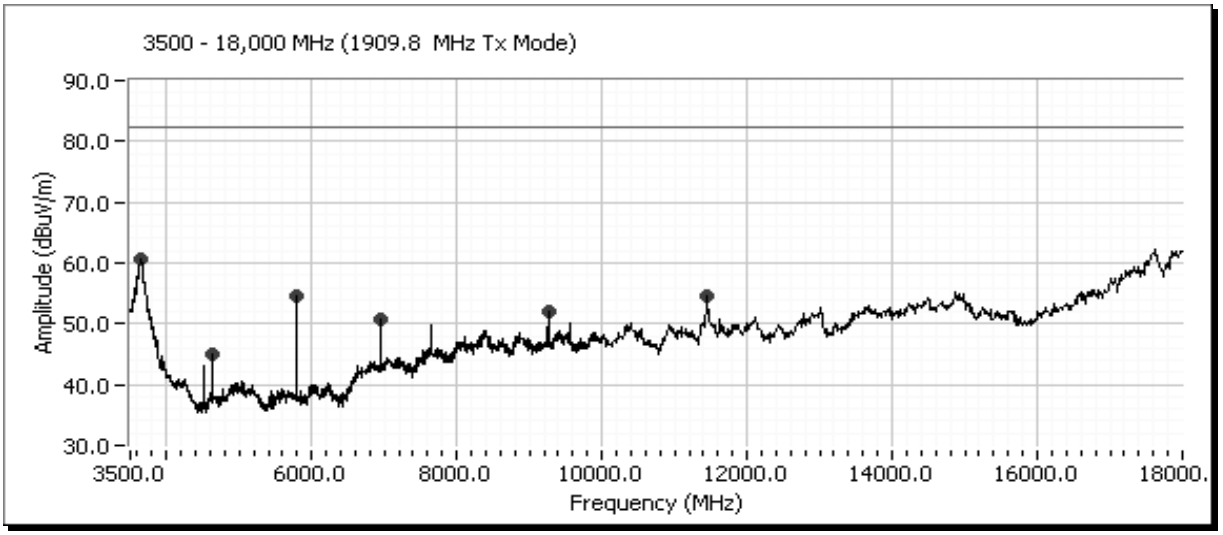
Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1879.914	-10.0	8.6	88.9	90.3	109.9	19.6	17.4			
1880.084	-10.0	8.6	90.0	91.4	109.5	18.1	15.9			

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna. A dipole has a gain of 2.2dBi.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Run #1c: Radiated Spurious Emissions, Transmit Mode, 1000 - 20,000 MHz. EUT @ 1909.8MHz





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EMC Test Data

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	N/A

Frequency	Level	Pol	FCC 24E [Note 1]		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3650.000	60.6	V	82.2	-21.6	Peak	63	2.0	RBW=VBW=1MHz
4630.000	45.1	H	82.2	-37.1	Peak	84	1.0	RBW=VBW=1MHz
5785.000	54.7	H	82.2	-27.5	Peak	121	1.8	RBW=VBW=1MHz
6943.334	50.6	H	82.2	-31.6	Peak	122	1.0	RBW=VBW=1MHz
9259.167	52.1	H	82.2	-30.1	Peak	83	1.0	RBW=VBW=1MHz
11453.33	54.7	V	82.2	-27.5	Peak	206	1.6	RBW=VBW=1MHz
1909.73	106.2	V	-	-	PK	213	1.1	Fundamental
1909.74	107.2	H	-	-	PK	272	1.0	Fundamental
1910.01	61.7	H	82.2	-20.5	Peak	273	1.0	Bandedge

Note 1:	The limit in the table above is an approximate field strength limit. It has been calculated form the erp or eirp limit detailed in the EN standard using Friis' equation for free space propagation: E = 30PG/d . This limit is a conservative limit because it does not consider the presence of the ground plane. The actual signal level, in terms of erp or eirp, is determined from a substitution measurement for all signals with less than 20dB of margin relative to the calculated field strength limit.

Transmit Mode: Final Field Strength and Substitution Measurements

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1909.73	-9.5	8.6	88.7	89.6	106.2	16.6	14.4			
1909.74	-9.5	8.6	89.0	89.9	107.2	17.2	15.0			
1910.01	-9.5	8.6	89.0	89.9	61.7	-28.2	-30.4	-13.0		-15.2

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna. A dipole has a gain of 2.2dBi.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Antenna Conducted Output Power (Power Meter)

Frequency	Power Output
MHz	(dBm)
1880.000	27.7

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	Radio

1900 MHz Receiver Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/11//2004
Test Engineer: jmartinez
Test Location: FT Chamber# 4
Config. Used: 1
Config Change: None
EUT Voltage: 120Vac, 60Hz

General Test Configuration

The Eut was connected directly to Spectrum Analyzer. A 20-dB attenuator was used between the EUT and Spectrum Analyzer. A external output connector was available to performed antenna receive conducted emissions. The device was set to received at midpoint of the operating range.

Ambient Conditions:

Temperature: 20.3 °C
Rel. Humidity: 52 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 30 - 25,000 MHz, Antenna Conducted Emissions	RSS-133 (9)	Pass	794.3 pW @ 13,4800 MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

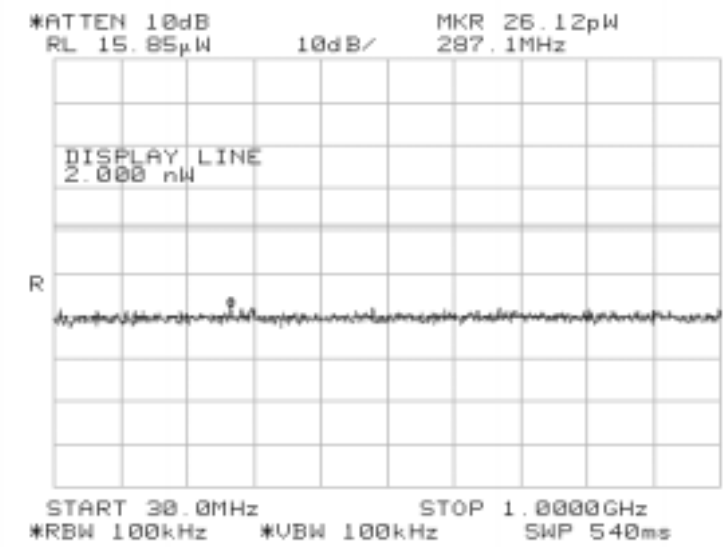
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Thales Navigation	Job Number:	J57066
Model:	Z-Max GPS Reciever	T-Log Number:	T57109
		Account Manager:	Rod
Contact:	Chales Branch		
Spec:	FCC 24E, RSS-133	Class:	Radio

Run #1: Antenna Conducted Emissions, 30-25,000 MHz

RSS-133 (9)(ii) Rx



RSS-133 (9)(ii) Rx

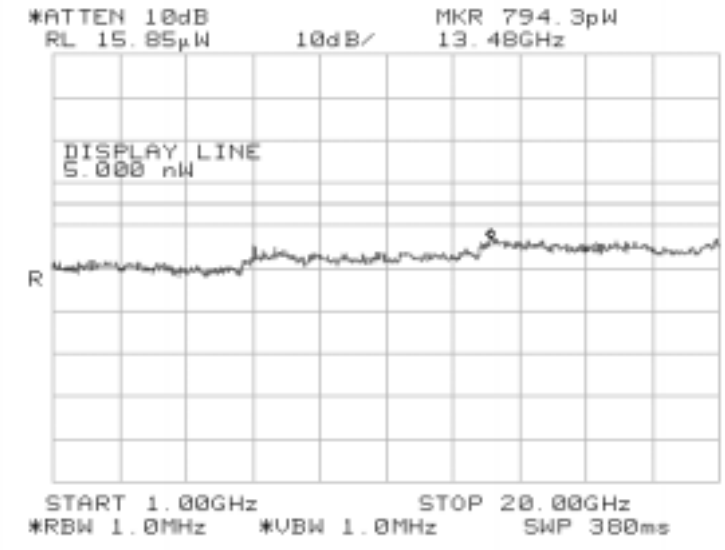


EXHIBIT 3: Test Configuration Photographs

2 Pages

EXHIBIT 4: Detailed Photographs of Thales Navigation Model Z-Max GPS ReceiverConstruction

1 Page

EXHIBIT 5: Operator's Manual for Thales Navigation Model Z-Max GPS Receiver

2 Pages

EXHIBIT 6: RF Exposure Information

2 Pages