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

FCC ID NUMBER:	NZI110896
UPN:	4713A-110896
GRANTEE:	Thales Navigation, Inc. 471 El Camino Real Santa Clara, CA 95050
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
TEST SITE:	Elliott Laboratories, Inc. 41039 Boyce Road Fremont, CA 94538
REPORT DATE:	September 16, 2003
FINAL TEST DATE:	June 24, June 25, and June 27, 2003
AUTHORIZED SIGNATORY:	Sr. EMC Engineer

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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, Inc.
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**:** 1850.4 - 1909.8 MHz (1900)

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

FCC 24E & RSS-133**:** 5.2dBm EIRP (0.003 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

Refer to Exhibit 6. The schematic diagram

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

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

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

Refer to Exhibit 6. The schematic diagram

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

Refer to Exhibit 6. The schematic diagram

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

Refer to Exhibit 6. The schematic diagram

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

For more information please refer to Exhibit 7: Theory of Operation

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

Refer to Exhibit 6. The schematic diagram

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

Refer to Exhibit 4

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

For more information please refer to Exhibit 7: Theory of Operation

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

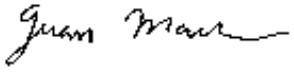
Manufacturer:
Thales Navigation, Inc.
471 El Camino Real
Santa Clara, CA 95050

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: IC2845 **SV4** Dated July 30, 2001
Departmental Acknowledgement Number: IC2549_**5** 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	Sr. EMC Engineer
Company	Elliott Laboratories Inc.
Address	684 W. Maude Ave Sunnyvale, CA 94086 USA
Date:	September 16, 2003

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	5.2 dBm (0.003 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	-31.2 dBm @ 7531.1 MHz (-7.0 dB)	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 3, 2003 and tested on September 3, 2003. 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

Manufacturer / Model / Description	Serial Number	FCC ID
IBM / Thinkpad 2647-46U / Laptop	78-KBKA9	DoC

EUT INTERFACE PORTS

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
RS232 Port B	Laptop serial	multiwire	shielded	1.5
USB	Not Connected			
Pwr in	AC	2 wire	unshielded	1.8
RS433 / RS 232 Port A	Not Connected			

Note: Port A was not connected as the manufacturer stated that either Port A or Port B would be used and they would not both be used at the same time.

For the transmitter-related and receiver-related radiated emissions tests the USB port was not connected. Preliminary testing demonstrated that the connection of these ports only affected the digital device-related emissions and had no affect on the emissions due to the receivers or the transmitters.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 4, 2003 at the Elliott Laboratories Chamber # 5 located Fremont, 41039 Boyce Road, Fremont CA 94538. Final test measurements were taken on September 3, 2003 at the Elliott Laboratories Open Area Test Site # 4 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to Section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the 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 is then performed. Substitution method is performed by replacing the EUT with a horn antenna and signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level is adjusted until a similar level, which was measured, in step 4, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected 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 is then performed. Substitution method is performed by replacing the EUT with a horn antenna and signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level is adjusted until a similar level, which was measured, in step 4, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected 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. 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 horn antenna and signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level was adjusted until a similar level, which was measured on the first scan, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected 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

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

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

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

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 emission not being 20-dB below the calculated field strength.

EXHIBIT 1: Test Equipment Calibration Data

Radiated Emissions, 1000 - 19000 MHz, 04-Sep-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	12	3/14/2003	3/14/2004
Hewlett Packard	Spectrum Analyzer 9KHz - 26.5GHz, non programable	8563E	284	12	3/3/2003	3/3/2004
Miteq	Preamplifier, 1-18GHz	AFS44	1540	12	6/16/2003	6/16/2004

EXHIBIT 2: Test Measurement Data

The following data includes conducted and radiated emission measurements of the Thales Navigation, Inc., Model No: Z-Max GPS Receiver.

T52433_Radio	27 Pages
AC-EX06 test report	3 Pages

Elliott

EMC Test Data

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Emissions Spec:	Part 24E & RSS-133	Class:	Radio
Immunity Spec:		Environment:	

EMC Test Data

For The

Thales Navigation

Model

Z_Max GPS Receiver Project

Date of Last Test: 9/4/2003

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Emissions Spec:	Part 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

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Emissions Spec:	Part 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:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Emissions Spec:	Part 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
IBM	Thinkpad	Laptop	78-KBKA9	DoC

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
RS232 Port A	Laptop serial	multiwire	shielded	1.5
USB	Not connected			
Pwr in	AC outlet	2 wire	Unshielded	1.8
RS433 Port B	Not connected			

For the transmitter-related and receiver-related radiated emissions tests the USB port was not connected. Preliminary testing demonstrated that the connection of these ports only affected the digital device-related emissions and had no affect on the emissions due to the receivers or the transmitters.

EUT Operation During Emissions

The transmitter was set to operate at the top,bottom or center of its operating range during testing.

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Radiated Power & Bandedge Measurement (1900 MHz)

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: 9/3/2003
Test Engineer: jmartinez
Test Location: SVOATS #4

Config. Used: 1
Config Change: None
EUT Voltage: 120V / 60Hz

General Test Configuration

The EUT was located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3m from the EUT for the Bandedge.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT. Subsititution was performed for the power output and bandedges. Antenna factor and cable loss were entered into the analyzer. All measurements are calibrated readings.

Ambient Conditions:

Temperature: 20 °C
Rel. Humidity: 45 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Power Output (Substitution)	24.232(b) & RSS-133	Pass	5.2 dBm
1	Power Output (Conducted)	24.232(b) & RSS-133	Pass	27.7 dBm
2	Bandedges	24.238(a) & RSS-133	Pass	All emission < -13 dBm
3	99% Bandwidth	24.238(a) & RSS-133	Pass	317 kHz

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:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Run# 1: Power Output
All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1850.305	97.3	V	-	-	PK	317	1.2	Low Channel
1850.175	100.8	H	-	-	PK	344	1.2	Low Channel
1879.733	102.9	H	-	-	Pk	218	1.0	Middle Channel
1879.783	100.9	V	-	-	Pk	241	1.0	Middle Channel
1909.783	100.7	V	-	-	Pk	234	1.1	High Channel
1909.842	101.5	H	-	-	Pk	261	1.0	High Channel

(Substitution Method)

Substitution [Note 1]							
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	
1850.2	100.8	H	-4.2	7.8	3.7	1.5	Note 1
1879.7	102.9	H	-2.6	7.8	5.2	3.0	Note 1
1909.8	101.5	H	-2.8	7.8	5.0	2.8	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)

Antenna Conducted Output Power (Power Meter)

Frequency	Power Output
MHz	(dBm)
1880.000	27.7

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Run# 2: Bandedge Measurements

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1850.305	97.3	V	-	-	PK	317	1.2	Low Channel
1850.175	100.8	H	-	-	PK	344	1.2	Low Channel

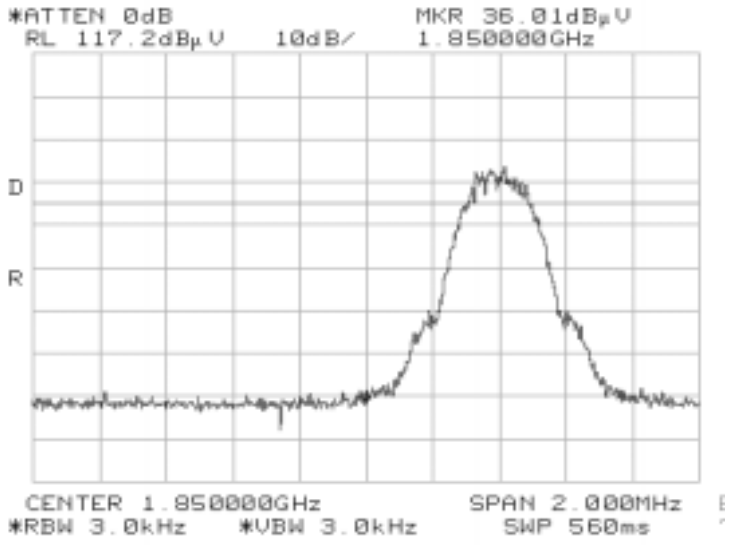
Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1850.0	36.0	H	-65.2	7.8	-57.4	-59.6	-13.0	-44.4	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)

Low channel Block A



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1864.758	101.1	H	-	-	PK	221	1.0	Refe leve 31.4
1864.683	98.8	V	-	-	PK	235	1.1	

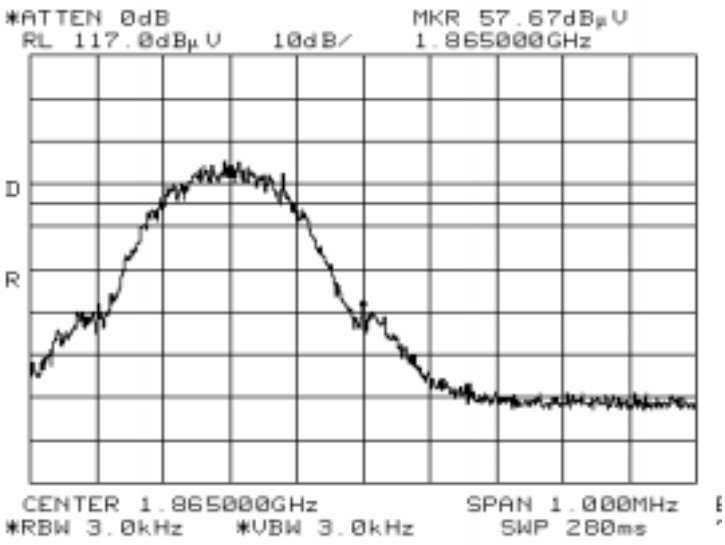
Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
18650.0	57.7	H	-52.6	7.8	-44.8	-47.0	-13.0	-31.8	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)

Block A High channel



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block D Low channel

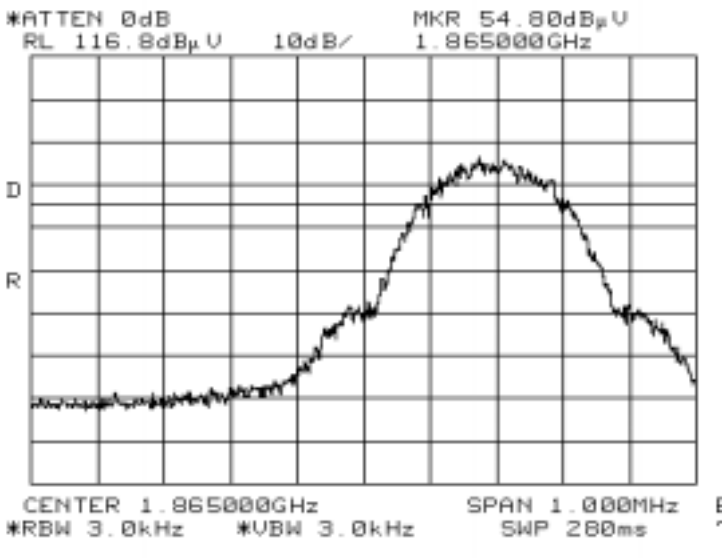
All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1865.225	101.2	H	-	-	PK	224	1.0	31.2
1865.100	97.7	V	-	-	PK	235	1.1	

Harmonics Emissions (Substitution Method)

			Substitution Note 1						
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1865.0	54.8	H	-49.1	7.8	-41.3	-43.5	-13.0	-28.3	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block D High channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

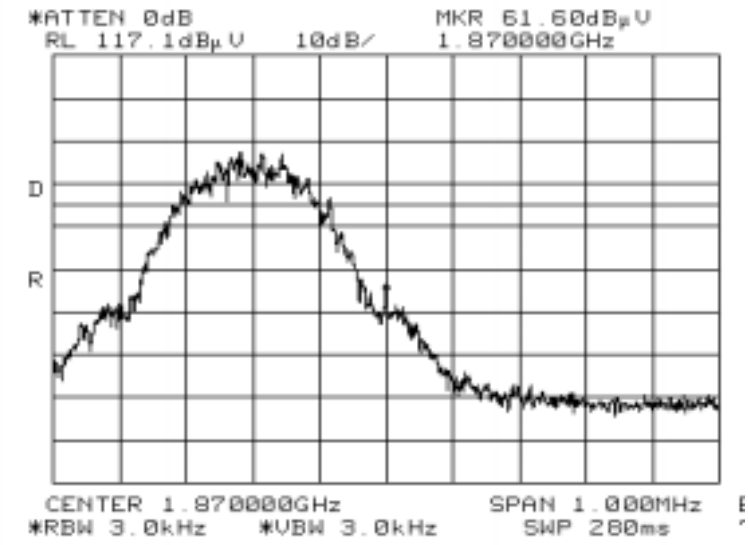
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1870.000	103.3	H	-	-	PK	274	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1870.0	61.6	H	-42.1	7.8	-34.3	-36.5	-13.0	-21.3	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block B Low channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

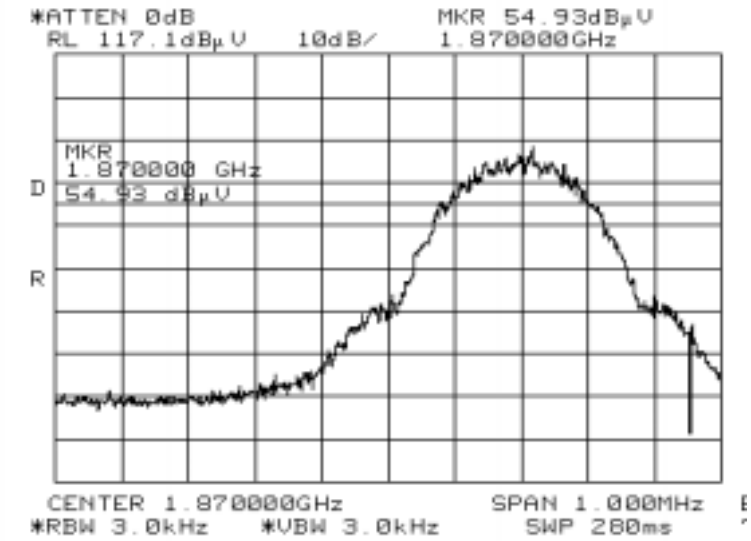
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1870.200	102.8		-	-	PK	224	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1870.0	54.9	H	-49.4	7.8	-41.6	-43.8	-13.0	-28.6	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block B High channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

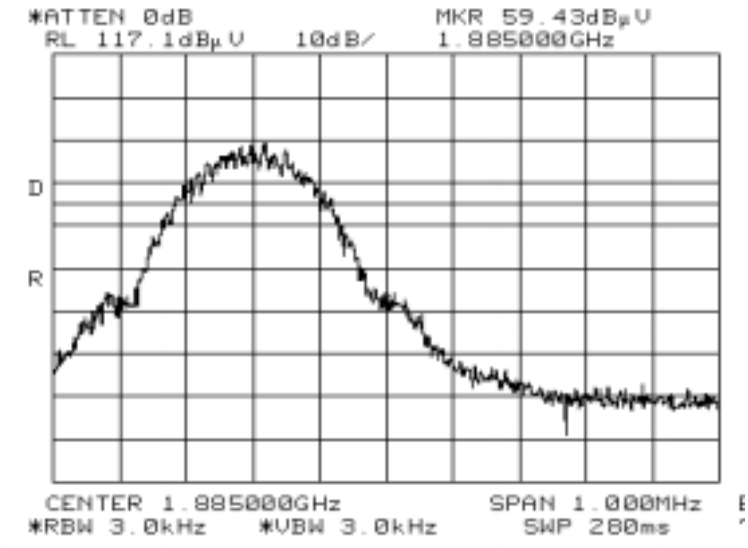
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1884.700	104.6	h	-	-	PK	220	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1885.0	59.4	H	-43.6	7.8	-35.8	-38.0	-13.0	-22.8	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block E Low channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

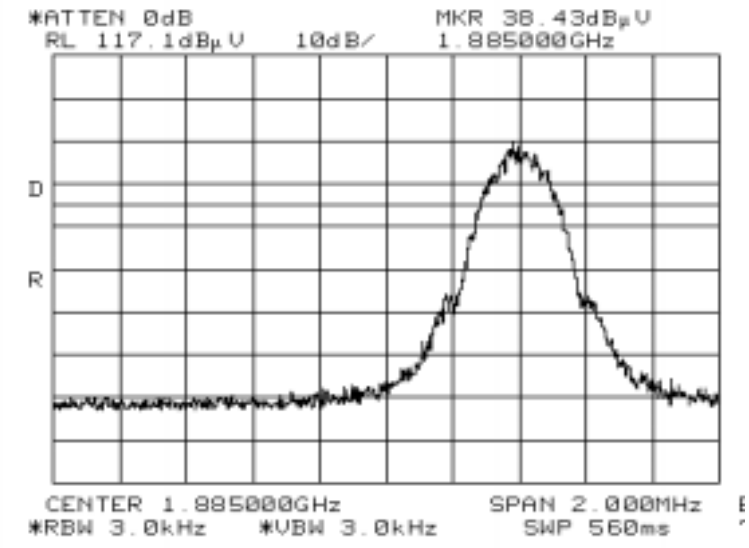
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1885.400	105.1	h	-	-	PK	222	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1885.0	38.4	H	-65.6	7.8	-57.8	-60.0	-13.0	-44.8	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block E High channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

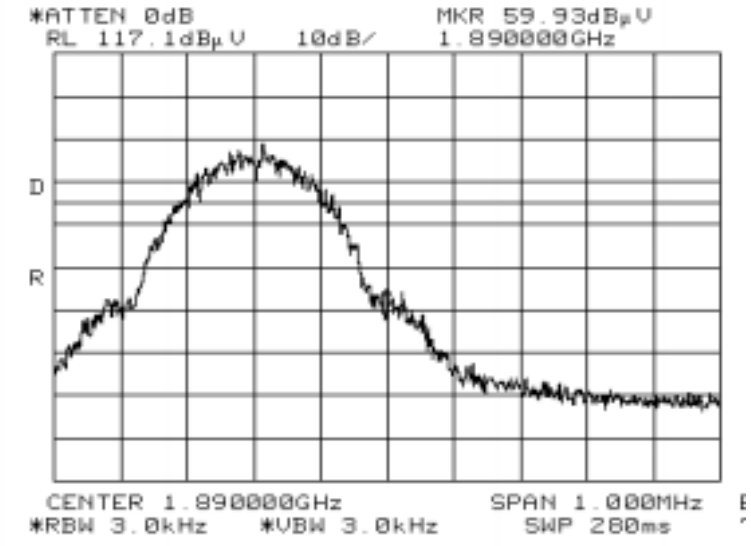
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1889.200	104.6	h	-	-	PK	234	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1890.0	59.9	H	-43.8	7.8	-36.0	-38.2	-13.0	-23.0	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block F Low channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

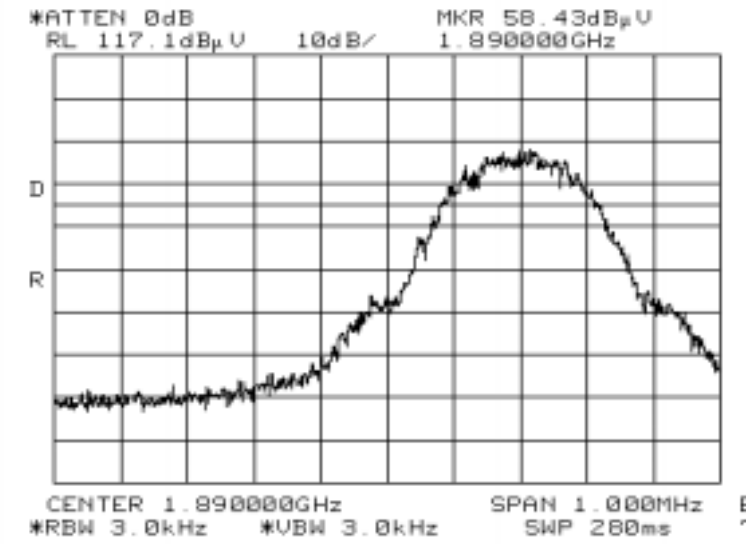
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1890.200	104.3	h	-	-	PK	224	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1890.0	58.4	H	-46.7	7.8	-38.9	-41.1	-13.0	-25.9	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block FHigh channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

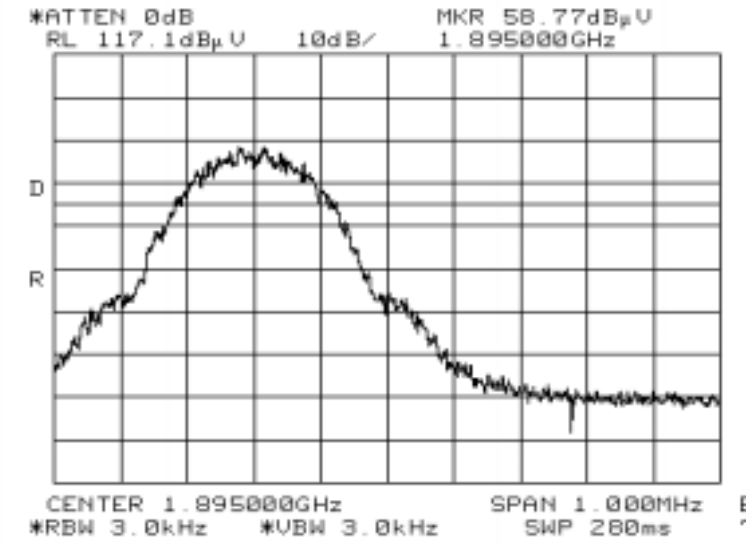
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1894.700	104.6		-	-	PK	227	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1895.0	58.8	H	-44.2	7.8	-36.4	-38.6	-13.0	-23.4	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Block C Low channel

All Field strenght levels measured in a RBW=VBW=1MHz to capture the peak evelope of the signal.

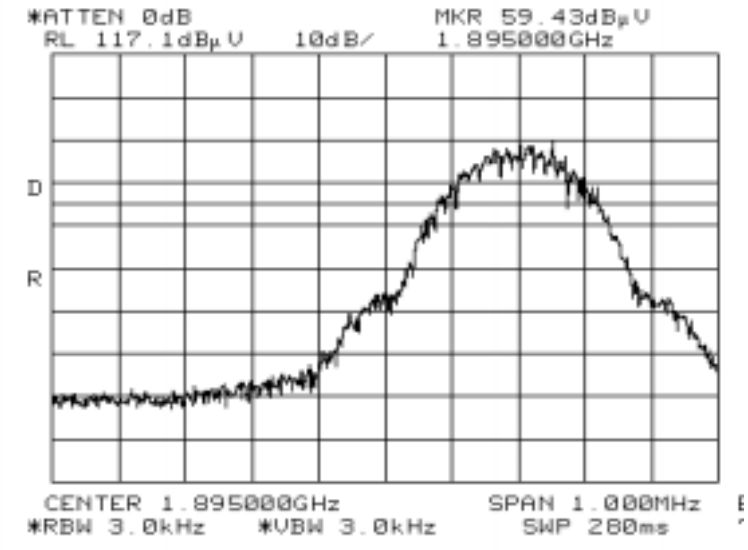
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1895.200	104.8	h	-	-	PK	223	1.0	

Harmonics Emissions (Substitution Method)

Substitution [Note 1]

Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1895.0	59.4	H	-43.8	7.8	-36.0	-38.2	-13.0	-23.0	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



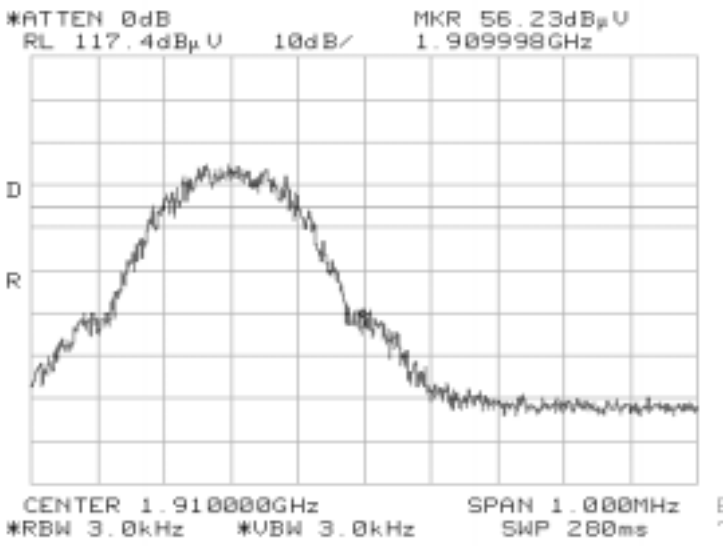
Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

High channel Block C (REF LEV: 31.8 dB)

Harmonics Emissions (Substitution Method)

			Substitution Note 1						
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
1910.0	56.2	H	-45.9	7.8	-38.1	-40.3	-13.0	-25.1	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)

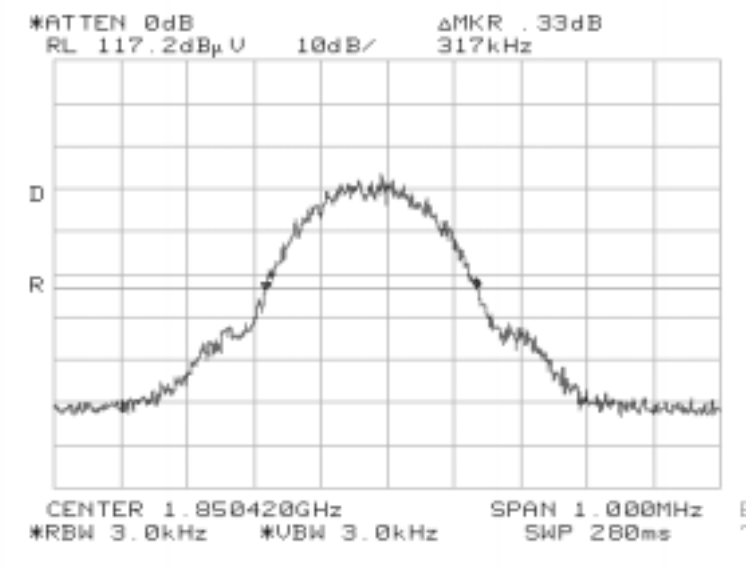


Note 1:	The Antenna factor and cable loss has been inlcuded in the plot above by using the REF LEV OFFSET

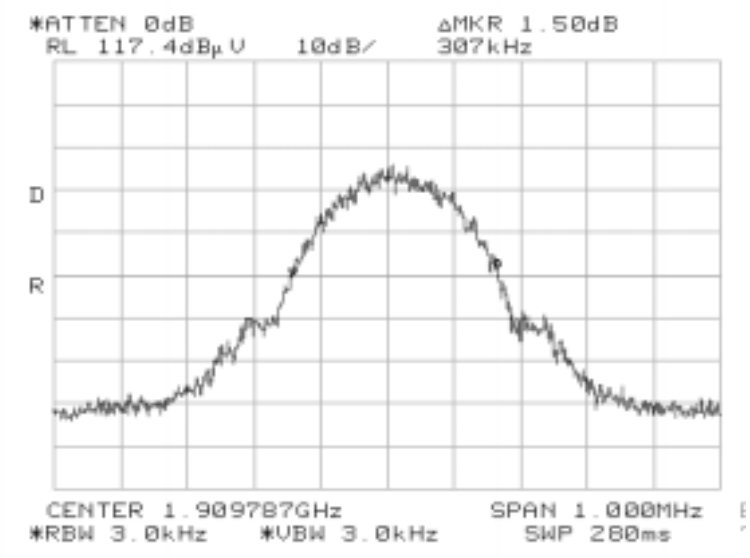
Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Run# 3: Out of Band Emission and 99% BW.

Low channel Block A 99% BW



High Channel Block C 99% BW



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Radiated Harmonic 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: 9/4/2003
Test Engineer: jmartinez
Test Location: FT Chamber# 5
Config. Used: 1
Config Change: None
EUT Voltage: 120Vac, 60Hz

General Test Configuration

The EUT was located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3m from the EUT for the frequency range 1 - 20 GHz.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT. For any Spurious emission more than 20-dB of the field strenght limit, substitution was performed. If the Spurious emissions are 20-dB below the field strength limit, substituion does not have to be performed.

Ambient Conditions:

Temperature: 17 °C
Rel. Humidity: 51 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1-3	RE, 30 - 19000 MHz, Out-of-band Emissions	24.238(a) & RSS-133	Pass	-7.0 dB @ 7531.1 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:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

Run #1: Preliminary Radiated Emissions, 30-19000 MHz
Frequency 1850.2MHz (Low Channel)

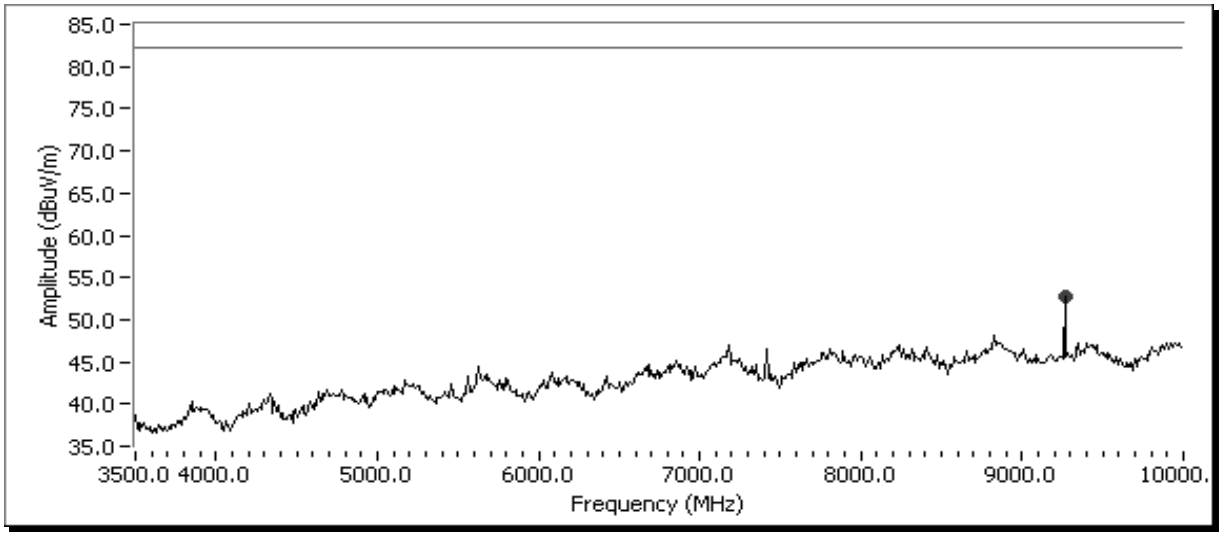
Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
9264.559	52.7	V	84.4	-31.7	Peak	258	1.3	
11131.45	65.6	H	84.4	-18.8	Peak	301	1.3	

Note 1:	Add note here
Note 2:	

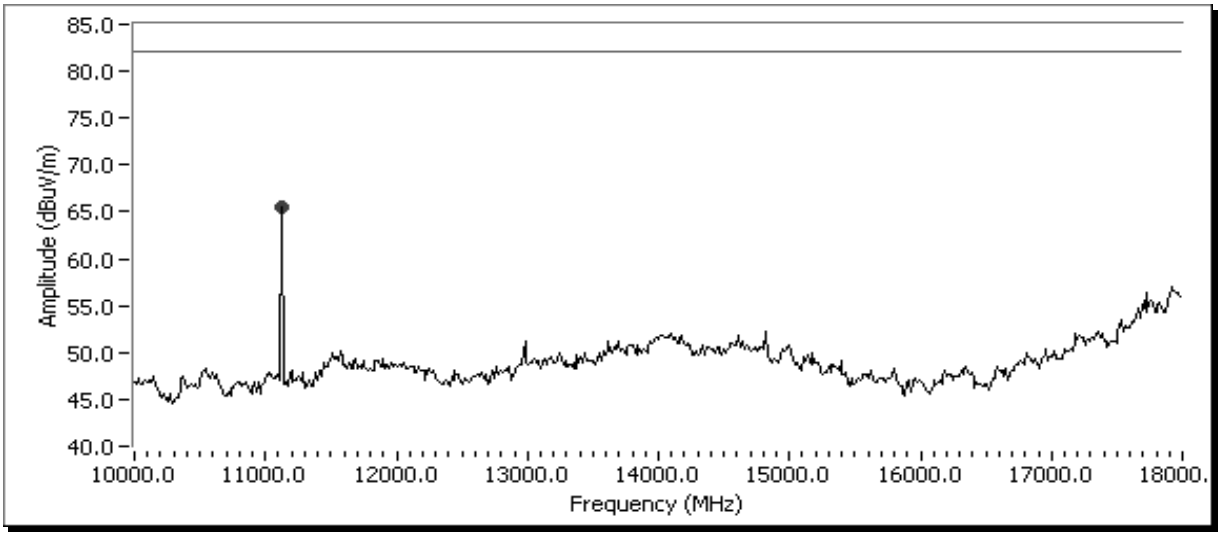
Harmonics Emissions (Substitution Method)

			Substitution Note 1						
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
11131.5	65.6	H	-41.5	11.6	-29.9	-32.1	-13.0	-16.9	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio



Run #2: Preliminary Radiated Emissions, 30-19000 MHz
Frequency 1886MHz (Middle Channel)

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7531.100	71.7	V	84.4	-12.7	Peak	278	1.6	
9416.000	62.6	V	84.4	-21.8	Peak	226	1.6	
11304.49	64.6	H	84.4	-19.8	Peak	351	1.6	

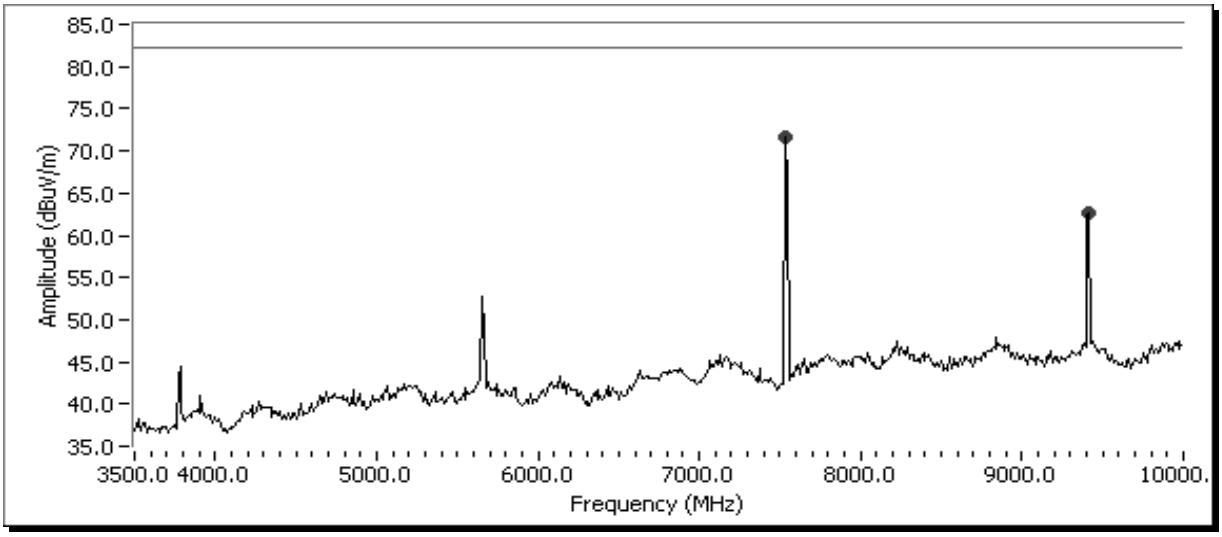
Note 1:	Add note here
Note 2:	

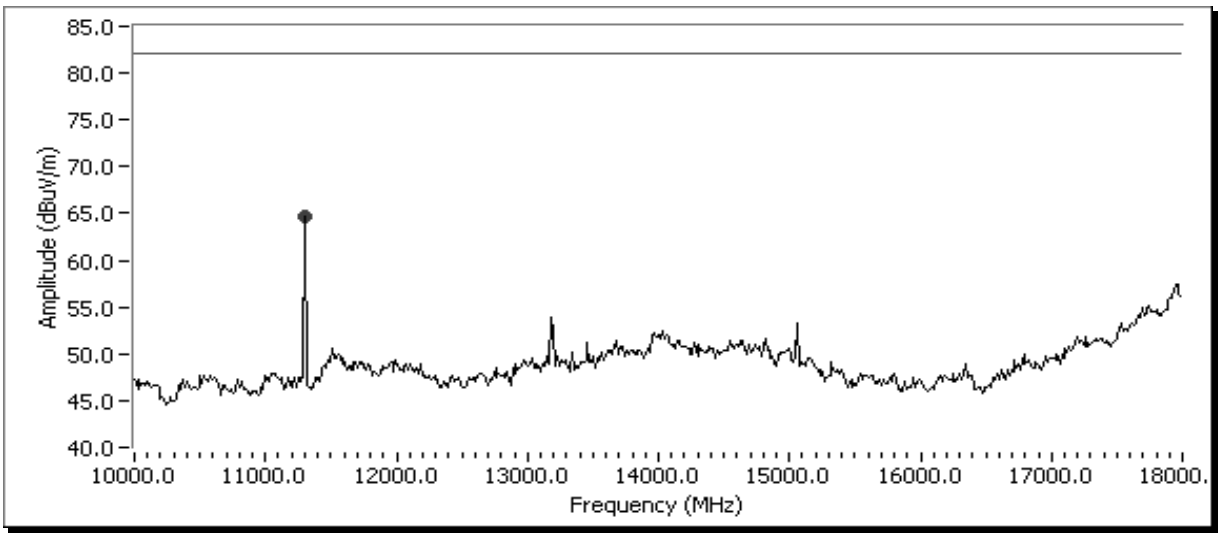
Harmonics Emissions (Substitution Method)

			Substitution Note 1						
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
11304.5	64.6	H	-41.5	11.8	-29.7	-31.9	-13.0	-16.7	Note 1
7531.1	71.7	V	-31.2	11.2	-20.0	-22.2	-13.0	-7.0	Note 1
9416.0	62.6	V	-44.1	11.4	-32.7	-34.9	-13.0	-19.7	Note 1

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)

Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio





Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

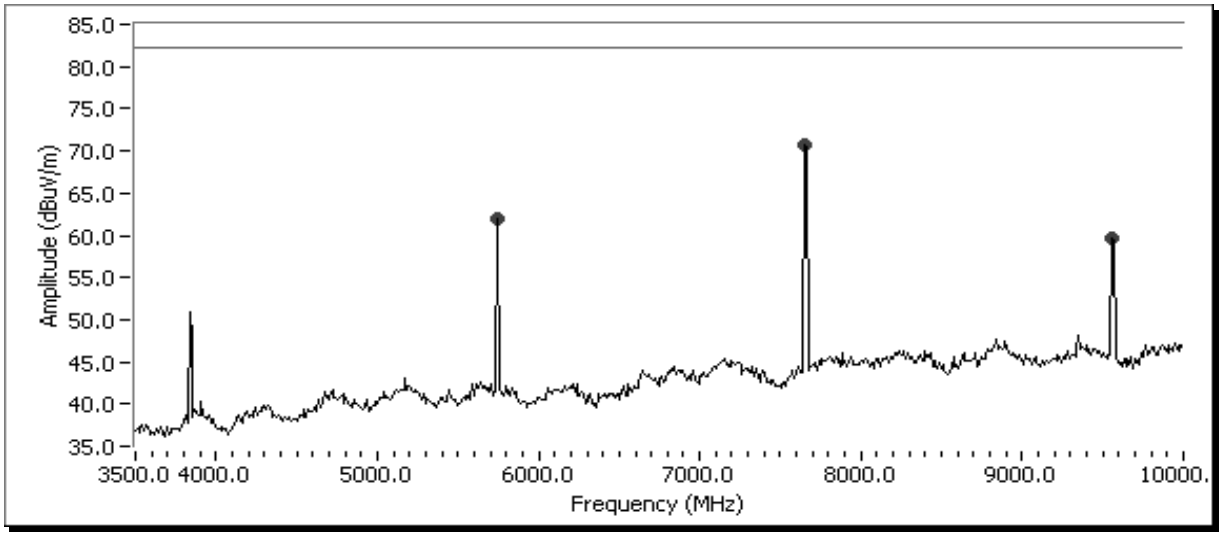
Run #3: Preliminary Radiated Emissions, 30-19000 MHz
Frequency 1909.7MHz (High Channel)

Frequency	Level	Pol	FCC 24E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5738.769	61.9	H	84.4	-22.5	Peak	305	2.2	
7653.078	70.8	V	84.4	-13.6	Peak	281	2.2	
9556.572	59.6	H	84.4	-24.8	Peak	281	1.0	
11490.85	63.7	H	84.4	-20.7	Peak	283	1.6	

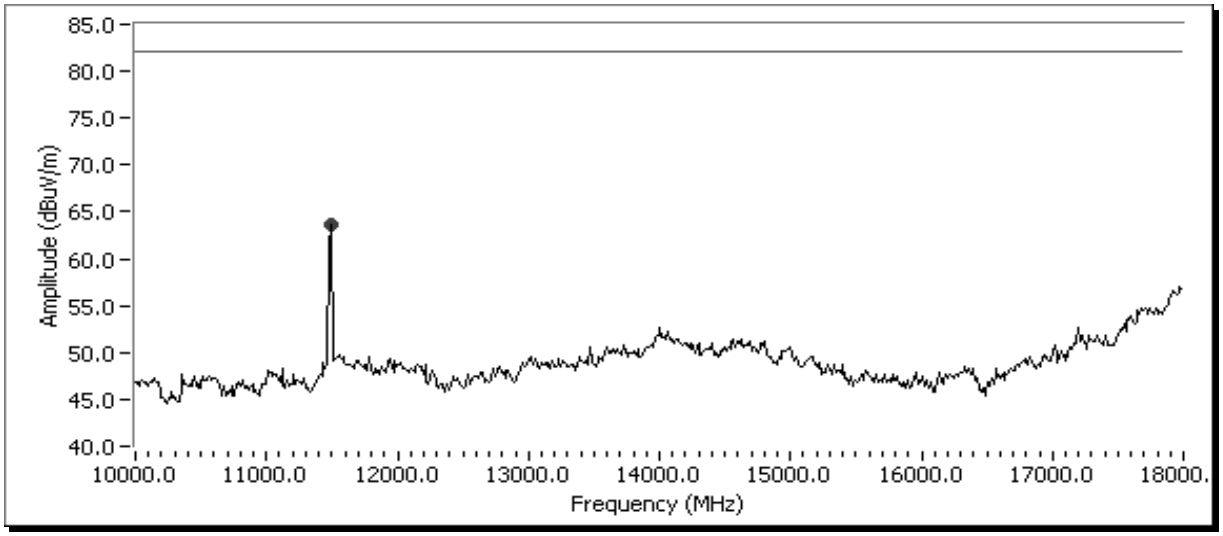
Harmonics Emissions (Substitution Method)

			Substitution Note 1						
Frequency	Level	Pol	Pin	Gain	EIRP	ERP	Limit	Margin	Comment
MHz	dBµV/m	v/h	dBm	dBi	dBm	dBm	(dBm)	(dB)	
11490.9	63.7	H	-47.4	11.8	-35.6	-37.8	-13.0	-22.6	Note 1
7653.1	70.8	V	-34.9	11.2	-23.7	-25.9	-13.0	-10.7	Note 1
5738.8	61.9	H	-42.0	10.2	-31.8	-34.0	-13.0	-18.8	
9556.6	59.6	H	-46.0	11.4	-34.6	-36.8	-13.0	-21.6	

Note 1:	Pin is the power input (dBm) to the substitution antenna to obtain the field strength recorded from the EUT. G is the gain (dBi) for the substitution antenna.ERP is the effective radiated power (Pin + GdBi - 2.2) from the substitution antenna. EIRP is calculated as follows (Pin+GdBi)



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Account Manager:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio



Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Proj Eng:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 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: 9/4/2003
Test Engineer: jmartinez
Test Location: FT Chamber# 5

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: 17 °C
Rel. Humidity: 51 %

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

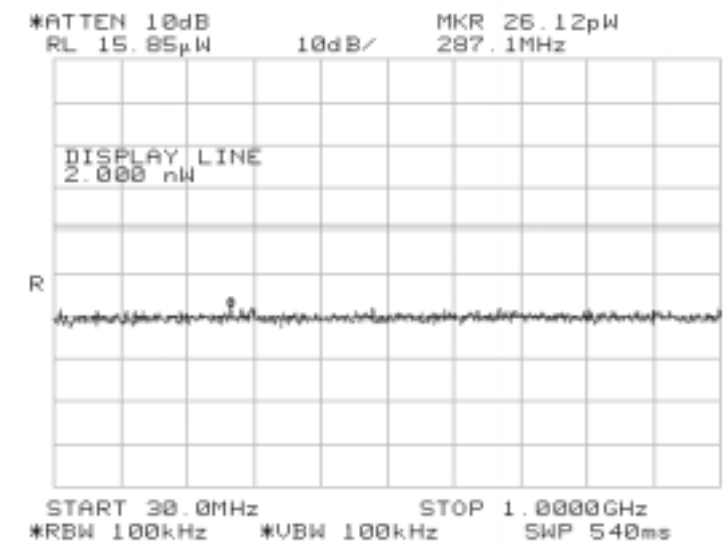
Deviations From The Standard

No deviations were made from the requirements of the standard.

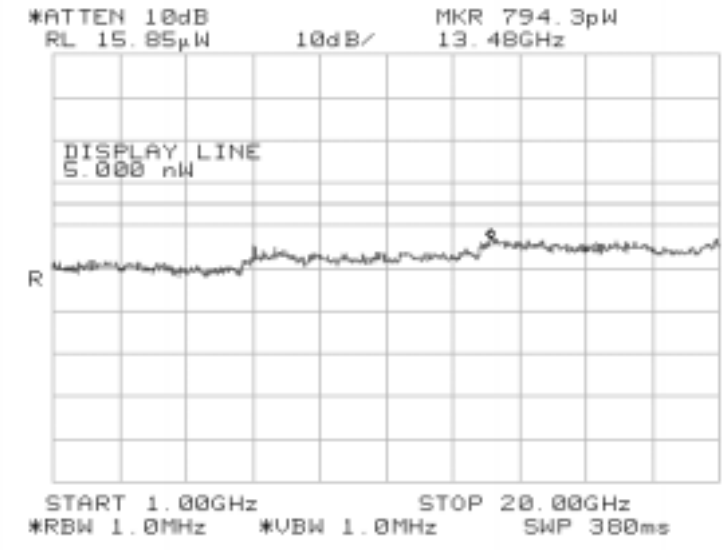
Client:	Thales Navigation	Job Number:	J52303
Model:	Z_Max GPS Receiver Project	T-Log Number:	T52433
		Proj Eng:	Mike Conrad
Contact:	Christian Legras		
Spec:	Part 24E & RSS-133	Class:	Radio

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

RSS-133 (9)(ii) Rx



RSS-133 (9)(ii) Rx



Frequency Stability

Contents

Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, see EXHIBIT 12, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a Hewlett Packard 8922H GSM MS Test Set.

1. Measure the carrier frequency at room temperature.

2. Subject the mobile station to overnight soak at -30 C.

3. With the mobile station, powered via 4.8 Volts, connected to the 8922H and in a simulated call on channel 662 (center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.

4. Repeat the above measurements at 10 C increments from -30 C to +60 C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

5. Re-measure carrier frequency at room temperature with nominal 4.8 Volts. Vary supply voltage from minimum 3 Volts to maximum 6 Volts, in 0.2 Volt increments re-measuring carrier frequency at each voltage.

6. Subject the mobile station to overnight soak at +60 C.

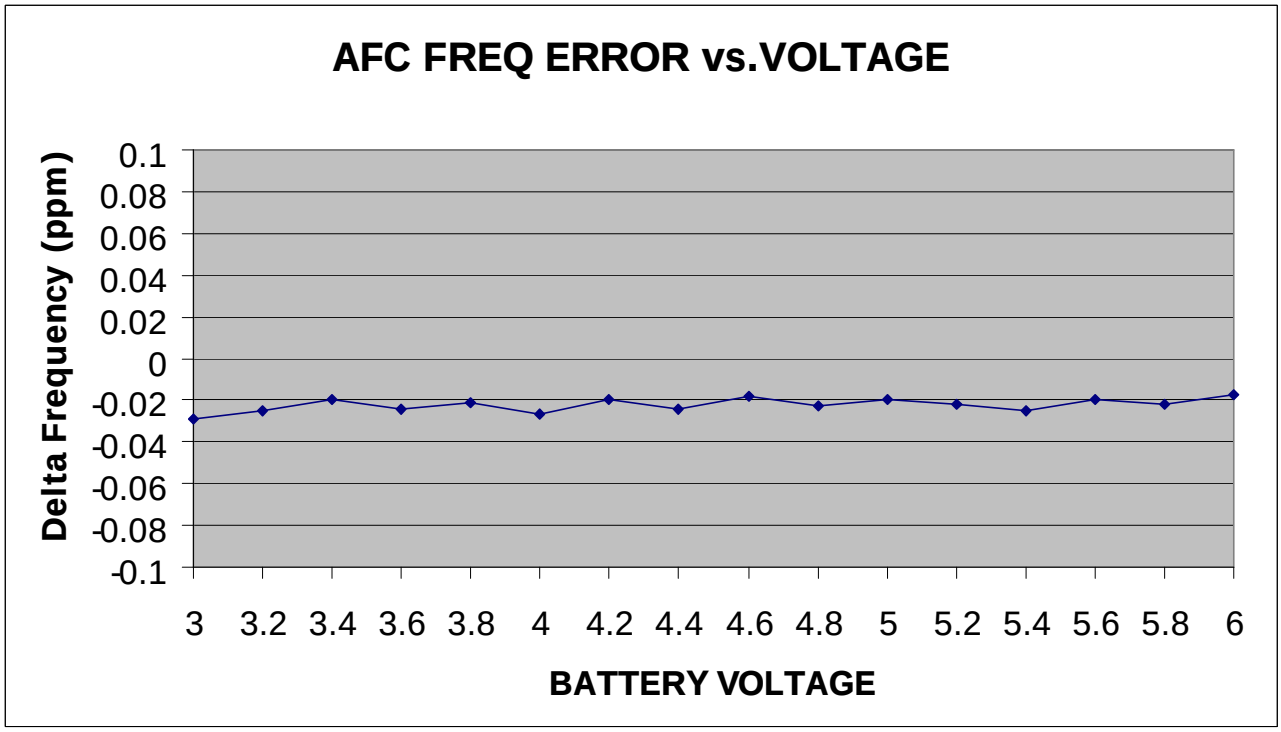
7. With the mobile station, powered via 3 Volts, connected to the 8922H and in a simulated call on channel 662 (center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.

8. Repeat the above measurements at 10 C increments from +60 C to -30 C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

Measurement Limit

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
As this transceiver is considered "Hand carried, battery powered equipment… ," Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3 Vdc and 6 Vdc, with a nominal voltage of 4.8 Vdc (based on operation off of a 3-cell Nickel-Metal Hydride battery pack). Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of + 25 % and - 18 %. For the purposes of measuring frequency stability these voltage limits are to be used.


AFC FREQ ERROR vs.VOLTAGE
Delta Frequency (ppm)
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
3 3.2 3.4 3.6 3.8 4 4.2 4.4 4.6 4.8 5 5.2 5.4 5.6 5.8 6
BATTERY VOLTAGE

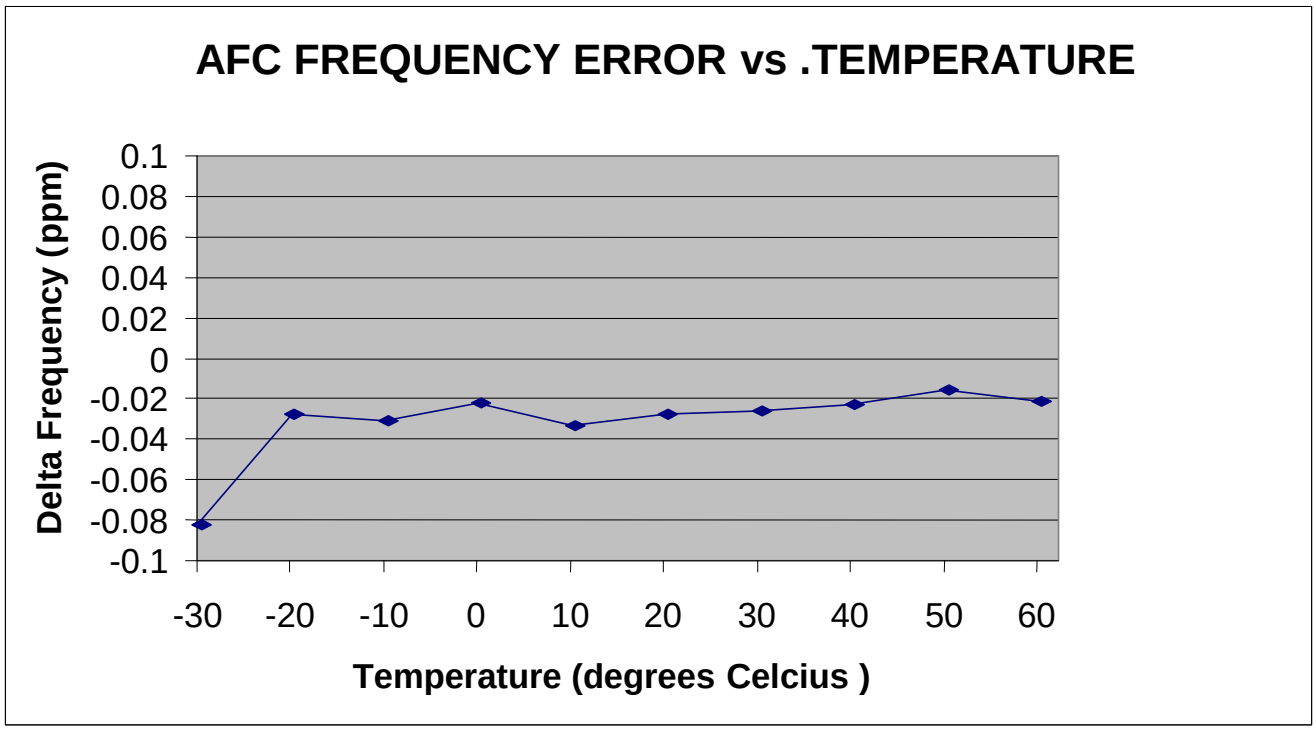

AFC FREQUENCY ERROR vs .TEMPERATURE
Delta Frequency (ppm)
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-30 -20 -10 0 10 20 30 40 50 60
Temperature (degrees Celcius)

EXHIBIT 3: Test Configuration Photos

EXHIBIT 4: FCC ID Label and Label Location

EXHIBIT 5: Detailed Photographs

EXHIBIT 6: Schematics

EXHIBIT 7: Theory of Operation

EXHIBIT 8: User Manual