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Project 13862-10

Tideland Signal Corporation
E-Navcon System

FCC/IC
Test Report

Prepared for:
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Houston, TX 77092

By

Professional Testing (EMI), Inc.
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April 10, 2014

Reviewed by:

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Regulatory Design Engineer

Written by:

Eric Lifsey
EMC Engineer

Revision History			
Revision	Date	Author	Description of Change(s)
00	March 4, 2014	Eric Lifsey	First Draft
01	April 8, 2014	Eric Lifsey	Revised per Larry Finn comments.
02	April 10, 2014	Eric Lifsey	Revised per Dale Williams comments.

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NOTICE

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(2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc.

(3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.

1.0 Scope

This is a report on testing for the Tideland E-Navcon navigational aid for the regulatory requirements of USA/FCC and Canada/IC.

2.0 Applicable Standards

Table 2-1: Applicable Standards for E-Navcon

Standard	Description
CFR Title 47 15.209	Radiated Emission limits; general requirements.
CFR Title 47 1.1310	Radiofrequency Exposure Limits
CFR Title 47 Part 80	Stations in the Maritime Services
RSS-Gen Issue 3:2010	General Requirements and Information for the Certification of Radio Apparatus
RSS-102 Issue 4:2010	Radio Frequency (RF) Exposure, Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-182 Issue 5:2012	Maritime Radio Transmitters and Receivers in the Band 156-162.5 MHz

2.1 Required RF Tests

Ensuring the output power correlates with the previously measured data is intended to support the use of existing test reports for the E- Navcon FCC submission without full retesting.

The TCB, ACB, has indicated this is a viable approach to demonstrate that the hardware has not changed since the previous analysis.

Table 2-2: Required RF Tests

Test	Description	Method Standard
Power	Output Power, AIS AtoN (156MHz – 162.5MHz)	80.215, IEC 60232-2 Ed. 1
Power	Output Power, Racon X Band (9300MHz – 9500MHz)	80.215(n)(3)
MPE	RF Exposure Calculation	FCC 1.1310, RSS-102, EN 62311

2.2 Required EMC Tests

Table 2-3: Required EMC Tests

Test	Description	Method Standard
Emissions	Conducted Emissions, DC Power Port; 10kHz – 30MHz	CISPR 16-2
Emissions	Radiated emissions, Enclosure; 150kHz to 2GHz	CISPR 16-2, ANSI C63.4
Emissions	Radiated emissions; Enclosure; 2GHz – 40GHz	ANSI C63.4

2.3 Applicable Previous Certifications

Table 2-4: Referenced Certifications

EUT Section Maker Description	Existing Agency Identifiers
Alltek Marine Electronics Corp., AIS AtoN (156MHz – 162.5MHz)	FCC ID: WZ7ATON-301-303
Tideland Signal Corporation, Racon X Band (9300MHz – 9500MHz)	FCC ID: FAZSBCN2SYS6A

2.4 Certificated Equipment Included In Design

This device is a composite of two previously certified devices combined into a single sealed enclosure; the individual device certifications are described below.

2.4.1 AIS AtoN

The integrated AIS AtoN device has been previously evaluated for compliance to the relevant test standards. Expertise 11-114370 from Phoenix Test Lab (EU ID 0700) attests to the compliance of the Mando 301/303 AIS AtoN device (also referred to as the Informer V10-1 and V10-3). FCC ID: WZ7ATON-301-303.

2.4.2 Racon

The integrated X-band Racon uses the same hardware as was previously certified under FCC ID: FAZSBCN2SYS6A. The only difference between the Racon integrated into the E-Navcon is the removal of the S-band modules. As the X-band and S-band RF modules operated independently of one another, the depopulated X-band Racon is considered electrically identical to that of the original device.

3.0 Equipment Under Test

3.1 Description

The E-Navcon device is a maritime navigational aid comprised of an AIS AtoN device and an X-Band Racon. Both devices are housed in the same sealed and pressurized enclosure. Each device functions independently of the other. Both are powered by 12 VDC from a common external source, typically a battery.

The device is intended for use on land, stationary off-shore platforms, buoys or other stationary locations where a navigational aid is required.

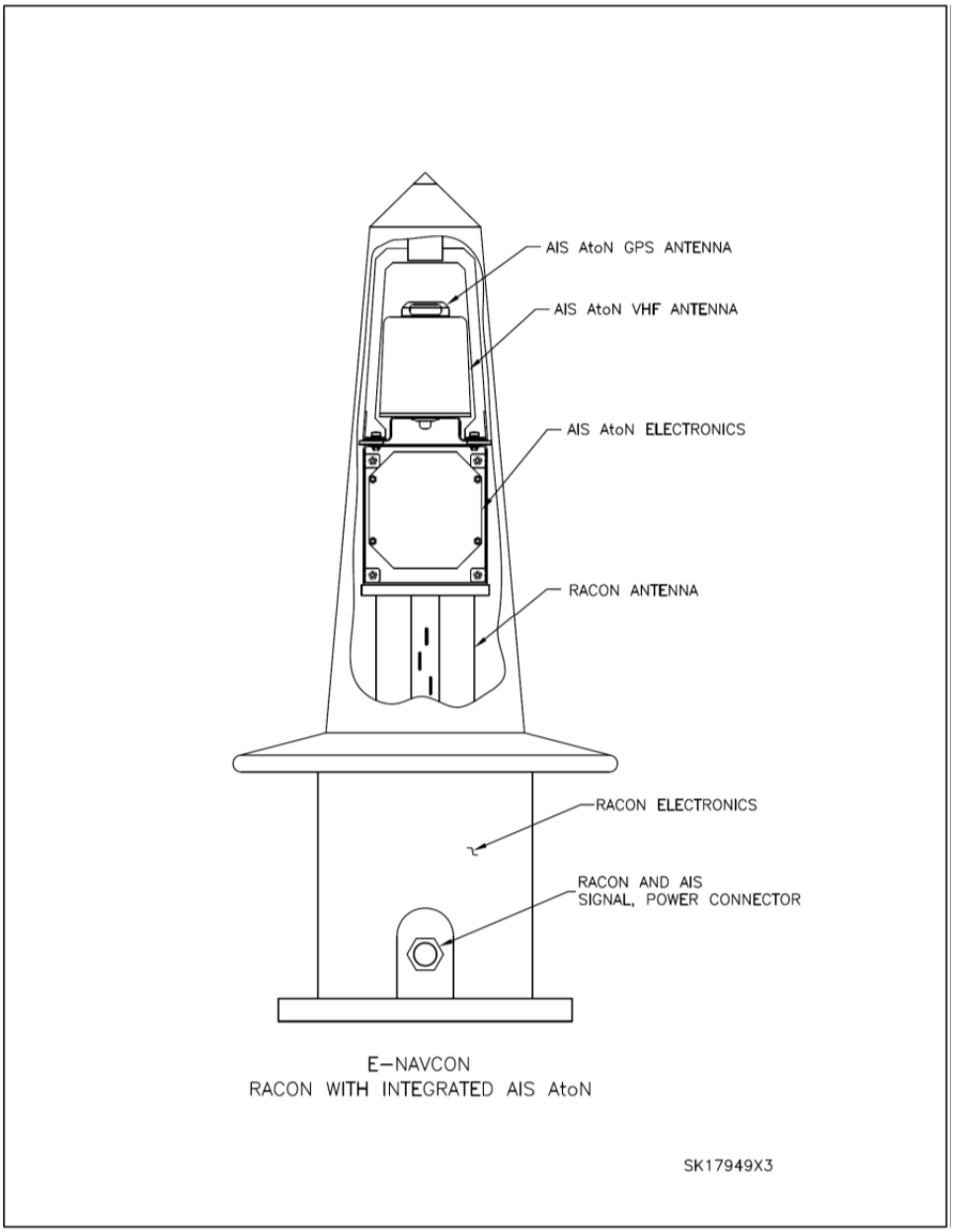


Figure 1: E-Navcon System Cutaway View Diagram

3.2 Integrated X-Band Racon Specifications

- Frequency of Operation
  - X-Band 9300 to 9500 MHz
- Frequency Matching Accuracy
  - Long Radar Pulses ± 2 MHz
  - Short Radar Pulses ± 2 MHz
- Minimum Output Power to Antenna: > 0.56 Watts (27.5 dBm)
- Pulse width Response: 50 nanoseconds to 200 nanoseconds
- Racon Response Display Scaling:
  - [Pulse width (± 50 nanoseconds typical) Racon Response (± 5 µs typical)]
  - 745 to 200 nanoseconds: 100% of selected value
  - 405 to 745 nanoseconds: 75% of selected value
  - 195 to 405 nanoseconds: 50% of selected value
  - 50 to 195 nanoseconds: 25% of selected value
- System sensitivity:
  - X-Band <-45 dBm
- Maximum Response Rate (either band): 8 KHz
- Maximum Response Delay: < 667 nanoseconds (100 meters on display)
- Radar Blanking connections available
- Programmable ON/OFF Times:
  - Quiescent Period: 0 – 60 seconds
  - Extended Quiescent Period Selectable
  - Active Period: 0 – 60 seconds
- Antenna Specifications:
  - X-Band:
    - Gain: 6 dBi
    - Horizontal Polarization
    - Vertical Divergence: 22 degrees
    - Effective Radiated Power: > 2.25 Watts

3.3 Integrated AIS AtoN Specifications

- The AIS AtoN is fully compliant to the technical specifications:
  - Defined in IEC 62320-2
  - Defined in ITU-R M.1371-3
  - IALA A-126
- TDMA Transmitter
  - TX Frequency: 156.025 MHz -162.025 MHz
  - Transmitter Power: 12.5 W max.
  - Channel Bandwidth: 25 kHz
- AIS Output
  - As defined in ITU-R.M.1371: Message 6, Message 8, Message 12, Message 14, Message 21, and Message 25

3.4 System (Common) Specifications

- Power Supply Input Voltage (standard): 9.0 – 15.6 VDC
- Power Supply Input Voltage (optional): 9.0 – 36.0 VDC

- Nominal Racon Power Consumption:
  Light Traffic: 0.75 Watts
  Heavy Traffic: 1.06 Watts
  Quiescent Power Consumption: 0.05 Watts

- Nominal AIS Power Consumption for Message 21:
  Type 1 Typical Power Consumption: < 0.5 Ah/day @13.6 v
  Type 3 Typical Power Consumption: < 1.0 Ah/day @13.6 v

- Lightning Surge Protection: 1 millisecond at 3000 volts; IEC 60945; CE
- Rated IP-66 (320 k/h driving rain)/ IP68 (submersion to 10 meters indefinitely)
- Unit can be pressurized for additional protection.
- Diameter (including lift ring): 353 mm (13.9 in)
- Height: 797 mm (31.4 in)
- Weight (includes 4.5 m cable and mounting hardware): 13 kg (28 lbs)
- Base Housing Material: Aluminum
- Temperature Operating Range: -40°C to +55°C

3.5 Intentionally Generated Frequencies

Table 3-3: Intentionally Generated Signals

Type	Name	Frequency	Description
Carrier	AIS AtoN TX	156 – 162.5MHz	RF Output of AIS AtoN
Carrier	Racon	9300 – 9500 MHz	RF Output of Racon

9500MHz is the highest frequency generated by the EUT. For FCC emissions measurements, the EUT will be investigated up to 40GHz per 47 CFR 15.33a(1).

4.0 EUT Essential Operation

4.1 EUT Test Setup

4.1.1 Racon Device Testing

For immunity and output power testing, the Racon will be pinged with a signal generator to initiate a return message. The Racon responds at 9.39982 GHz regardless of the frequency in which it is interrogated. The signal generator should be configured to a frequency between 9300 and 9500MHz (well away from 9.39982GHz), with a pulse width of 50 to 200ns. A signal is sent to the Racon from a signal generator and horn antenna. A 2nd horn antenna is connected to a spectrum analyzer to measure radiated power and capture the transmitted Morse-coded CW response.

4.1.2 AIS AtoN Device Testing

The AIS device transmits autonomously on a periodic basis, and does so only when a GPS signal is acquired. The AIS EUT for this test is specifically programmed to transmit on additional time slots to facilitate measurement of power. This EUT transmits on 162.025MHz.

5.0 Antenna Construction Review

The antenna construction is reviewed to determine whether the design allows for unauthorized modification or substitution of the EUT antennas.

This procedure is to the requirements of FCC 15.203.

5.1 Results

As shipped from the factory, the entire device including all antennas, is enclosed in a non-conductive gas-pressurized vessel. It has a single external connector that carries only DC power and serial port signals. The user and installer have no access to the antennas or antenna ports internal to the EUT.

The EUT meets the relevant requirements.

6.0 Emission Tests

The following sections report measurements of unintentional emissions.

The EUT was configured and operated in a manner consistent with typical applications.

6.1 Conducted Emissions, DC Power Port; 10 kHz – 30 MHz

The EUT DC power supply cord was cut to the required length to reach from wiring termination box to the LISN. Power supply cords for any peripheral equipment were powered from an auxiliary LISN. Excess interface cable lengths were coiled on the reference plane surface. The conducted emissions were maximized, by varying the operating states and configuration of the EUT.

The tests were performed in an 8’ x 8’ RayProof modular shielded room. The EUT was placed on a metallic reference plane. Where earth bonding was provided on the EUT, the earth connection was attached to the reference plane.

Once normal EUT operation was verified on the diagnostic port, the laptop computer was removed from the test setup. The diagnostic port is used only during installation or update of the EUT settings.

Results of the emission measurements appear in the following pages. The EUT satisfied the relevant requirements.

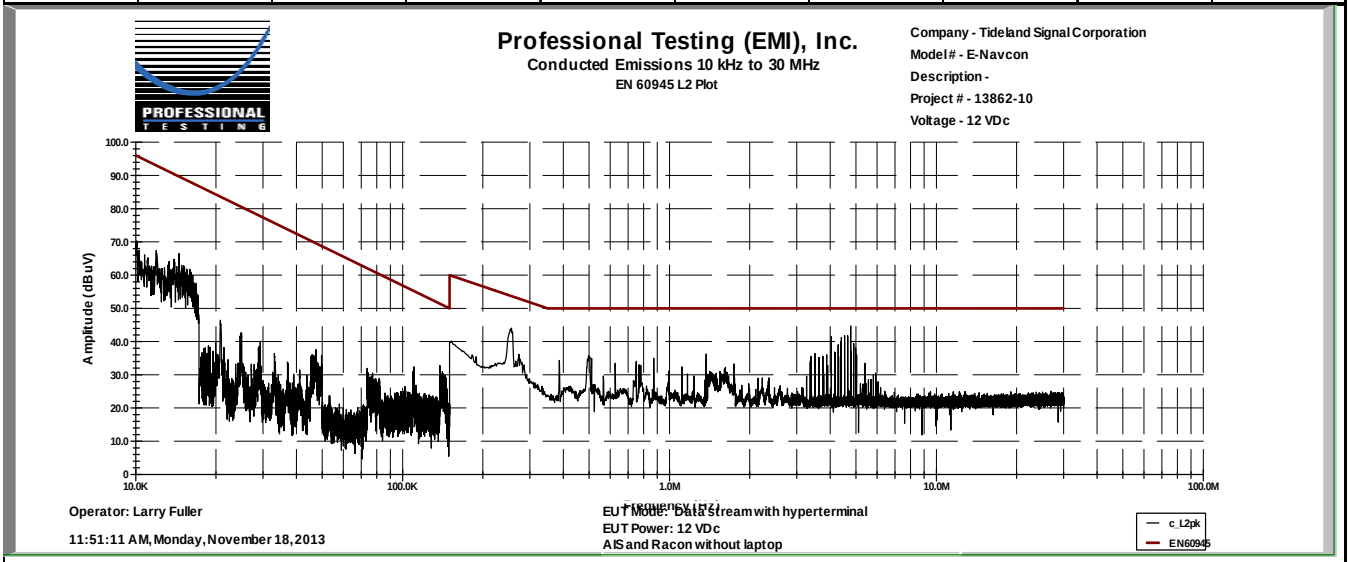
Professional Testing, EMI, Inc.

Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/18/2013	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Larry Fuller
Purchase Order #:	116585 Rev 1	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	Paul Meuller

Conducted Emissions Test Results Data Sheet - Neutral Lead **Page: 1 of 2**

EUT Line Voltage: 12 VDC **EUT Line Frequency:** N/A Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.139574		25.437	51.224	-25.787	Pass				
0.139655		16.407	51.214	-34.807	Pass				
0.140485		15.845	51.113	-35.268	Pass				
0.142055		16.023	50.924	-34.902	Pass				
0.142268		25.882	50.899	-25.017	Pass				
0.26307		42.748	53.37	-10.622	Pass				
4.04651		29.431	50	-20.569	Pass				
4.39094		30.052	50	-19.948	Pass				
4.56398		33.978	50	-16.022	Pass				
4.66926		31.311	50	-18.689	Pass				
4.79348		32.745	50	-17.255	Pass				



Measured Conducted Emissions - Phase Lead (Line 1)

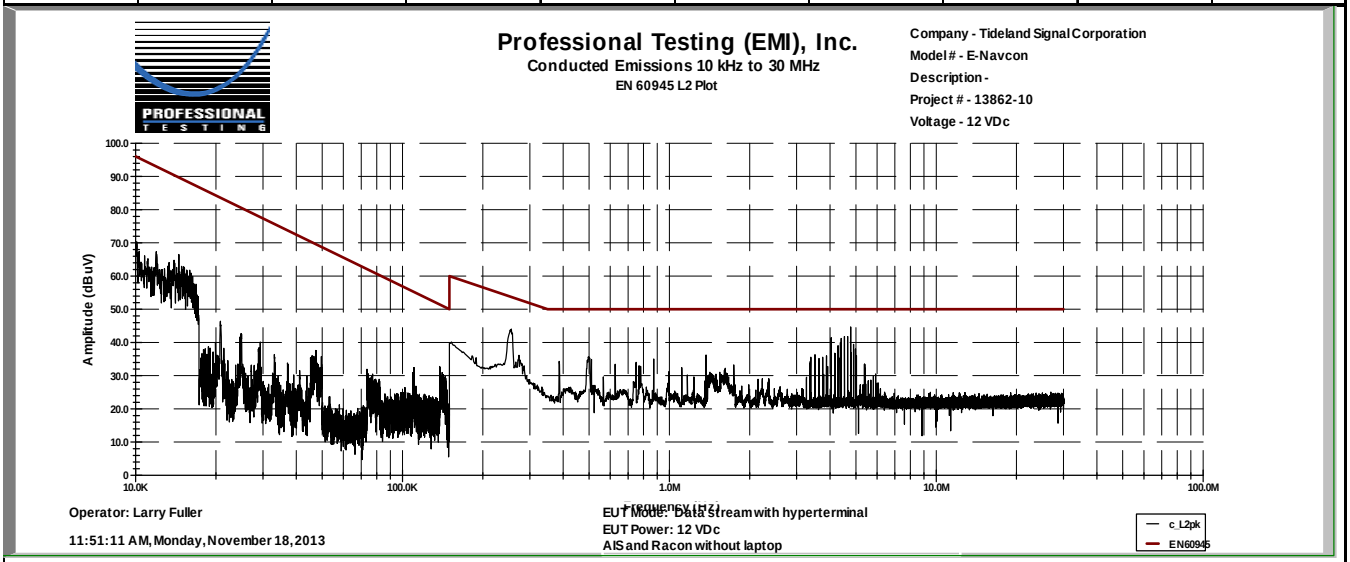
Professional Testing, EMI, Inc.

Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/18/2013	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Larry Fuller
Purchase Order #:	116585 Rev 1	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	Paul Meuller

Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) **Page: 2 of 2**

EUT Line Voltage:	**12**	**VDC**	**EUT Line Frequency:**	**N/A**	**Hz**

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.131264		18.349	52.266	-33.918	Pass				
0.131338		15.949	52.257	-36.308	Pass				
0.132536		24.487	52.103	-27.615	Pass				
0.132854		24.437	52.062	-27.625	Pass				
0.132998		15.597	52.043	-36.446	Pass				
0.26632		41.969	53.225	-11.256	Pass				
0.66167		24.589	50	-25.411	Pass				
3.44792		23.621	50	-26.379	Pass				
4.45369		30.256	50	-19.744	Pass				
4.5479		33.369	50	-16.631	Pass				
4.56418		32.75	50	-17.25	Pass				



Measured Conducted Emissions - Phase Lead (Line 1)

Professional Testing, EMI, Inc.

Test Method:	**CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity**		
In accordance with:	**IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results**		
Section:	**Section 9 Electromagnetic emission – Methods of testing and required test results**		
Test Date(s):	**11/18/2013**	**EUT Serial #:**	**7066**
Customer:	**Tideland Signal Corporation**	**EUT Part #:**	**None**
Project Number:	**13862-10**	**Test Technician:**	**Larry Fuller**
Purchase Order #:	**116585 Rev 1**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**E-Navcon**	**Witness' Name:**	**Paul Meuller**

Conducted Emissions Test Equipment List

Tile! Software Version:	**4.1.A.0, April 14, 2009, 11:01:00PM**
Test Profile:	**Profile#: CE_2010.til, dated December 16, 2010**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spectrum Analyzer	2732A03633	5/17/2014
0045	HP	85662A	Spec Anal Dsply for AN1842	2816A16413	N/A
0990	HP	85685A	RF Preselector	3010A01119	8/29/2014
1281	HP	85650A	Quasi Peak Adapter	2043A00063	6/5/2014
C109	HP	none	Cable 19 inch BNC (grey)	none	7/10/2014
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	7/10/2014
C108	Pomona	RG-223	Cable 5.5 ft BNC RG-223 (black)	none	7/10/2014
0939	EMCO	3825/2	LISN, 10kHz-100MHz	9603-2521	10/31/2014
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	10/31/2014

6.2 Radiated emissions, Enclosure; 150 kHz – 2 GHz, and 2 GHz – 26.5 GHz

The tests were performed in a 10 meter semi-anechoic shielded room. The EUT was placed on a rotatable non-metallic table 80 cm above the reference plane. Where earth bonding was provided on the EUT, the earth connection was attached to the reference plane.

Support and 12 VDC power source, including a laptop verifying operation of the EUT, were placed in the chambers sub-chamber area below the reference plane.

The E-Navcon device is required to conform to the limits shown below in table 5-1 for conducted and radiated emissions limits in the 'Exposed' category. The conducted limits apply only to the DC input power connection of the EUT. Measurements are to be performed as specified in IEC 60945-1 ed.4.

Table 5-1: Emissions Limits

	Portable	Protected	Exposed	Submerged
Conducted emissions (9.2)		10 kHz – 150 kHz 150 kHz – 350 kHz 350 kHz – 30 MHz	63 mV – 0,3 mV (96 dBµV – 50 dBµV) 1 mV – 0,3 mV (60 dBµV – 50 dBµV) 0,3 mV (50 dBµV)	
Radiated emissions (9.3)	150 kHz – 300 kHz 300 kHz – 30 MHz 30 MHz – 2 GHz 156 MHz – 165 MHz	10 mV/m – 316 µV/m (80 dBµV/m – 52 dBµV/m) 316 µV/m – 50µV/m (52 dBµV/m – 34 dBµV/m) 500 µV/m (54 dBµV/m) except for 16 µV/m (24 dBµV/m) quasi-peak or 32 µV/m (30 dBµV/m) peak		

Radiated emissions above 2 GHz are required to be below 500µV/m when measured at a distance of 3m per 47 CFR 15.209.

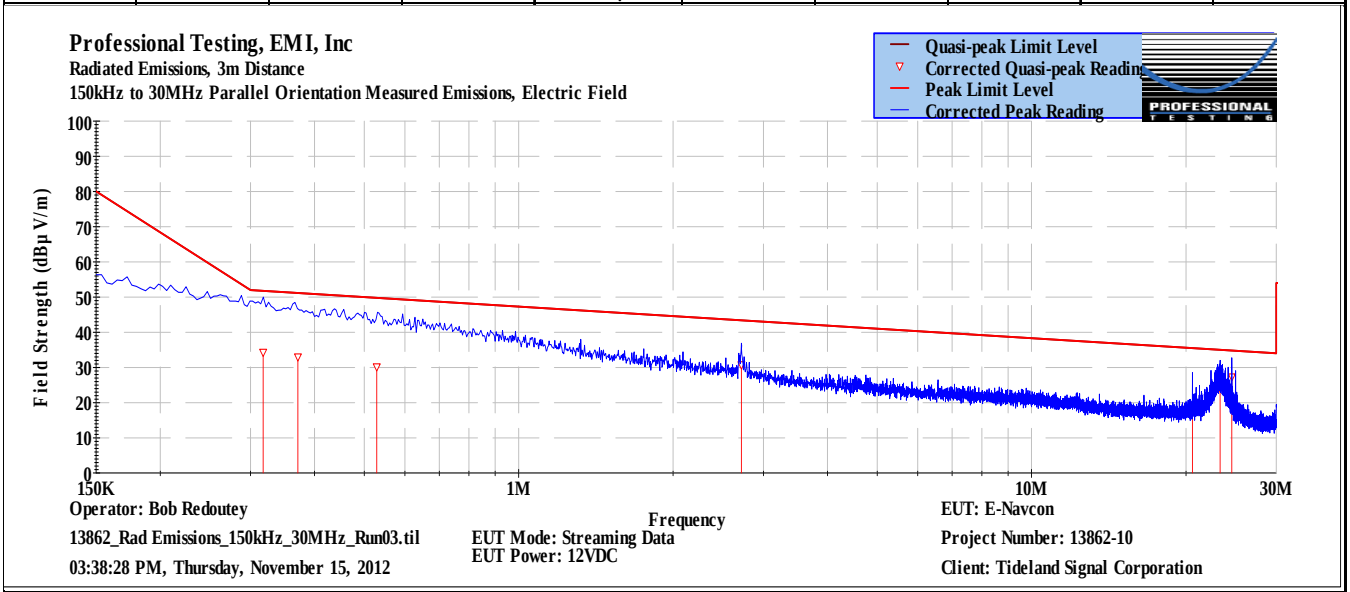
Results of the emission measurements appear in the following pages. The EUT satisfied the relevant requirements.

6.2.1 Radiated emissions, Enclosure; 150 kHz to 30 MHz

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Parallel	Frequency Range:	Below 30MHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
0.317578	3	60	1	Quasi-peak	24.4	34.29	51.8	-17.5	Pass
0.371176	3	316	1	Quasi-peak	23.2	32.979	51.2	-18.2	Pass
0.528827	3	292	1	Quasi-peak	20.2	30.158	49.8	-19.6	Pass
2.71872	3	111	1	Quasi-peak	20.8	30.712	43.4	-12.7	Pass
20.5828	3	315	1	Quasi-peak	10.3	17.605	35.5	-17.9	Pass
23.3125	3	217	1	Quasi-peak	17.8	24.224	35.0	-10.8	Pass
24.5784	3	348	1	Quasi-peak	21.4	27.272	34.8	-7.5	Pass



≤ 30MHz Parallel Antenna Orientation Measured Emissions

Professional Testing, EMI, Inc.

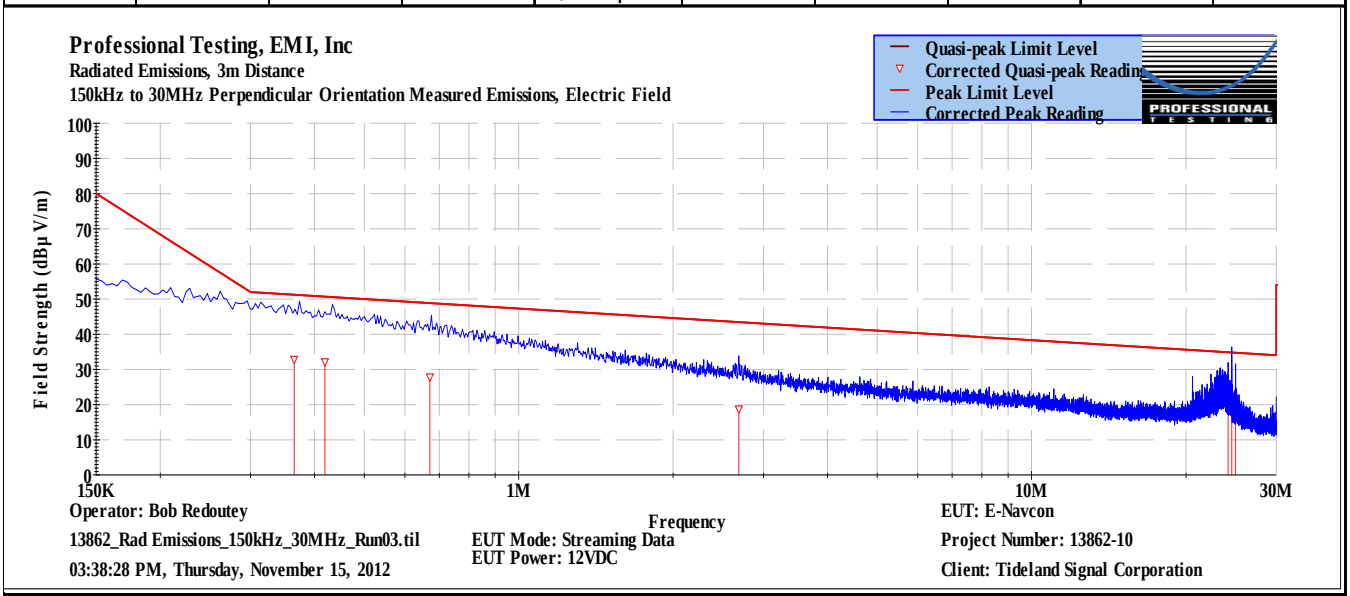
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results

Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Perpendicular	**Frequency Range:**	Below 30MHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
0.365052	3	319	1	Quasi-peak	23.1	32.9	51.2	-18.4	Pass
0.418898	3	217	1	Quasi-peak	22.4	32.2	50.7	-18.5	Pass
0.671316	3	336	1	Quasi-peak	17.9	27.9	48.8	-21.0	Pass
2.68709	3	212	1	Quasi-peak	8.8	18.7	43.4	-24.7	Pass
24.1627	3	259	1	Quasi-peak	12.8	18.9	34.8	-16.0	Pass
24.5783	3	303	1	Quasi-peak	16.8	22.6	34.8	-12.2	Pass
24.9999	3	182	1	Quasi-peak	12.1	17.6	34.7	-17.1	Pass



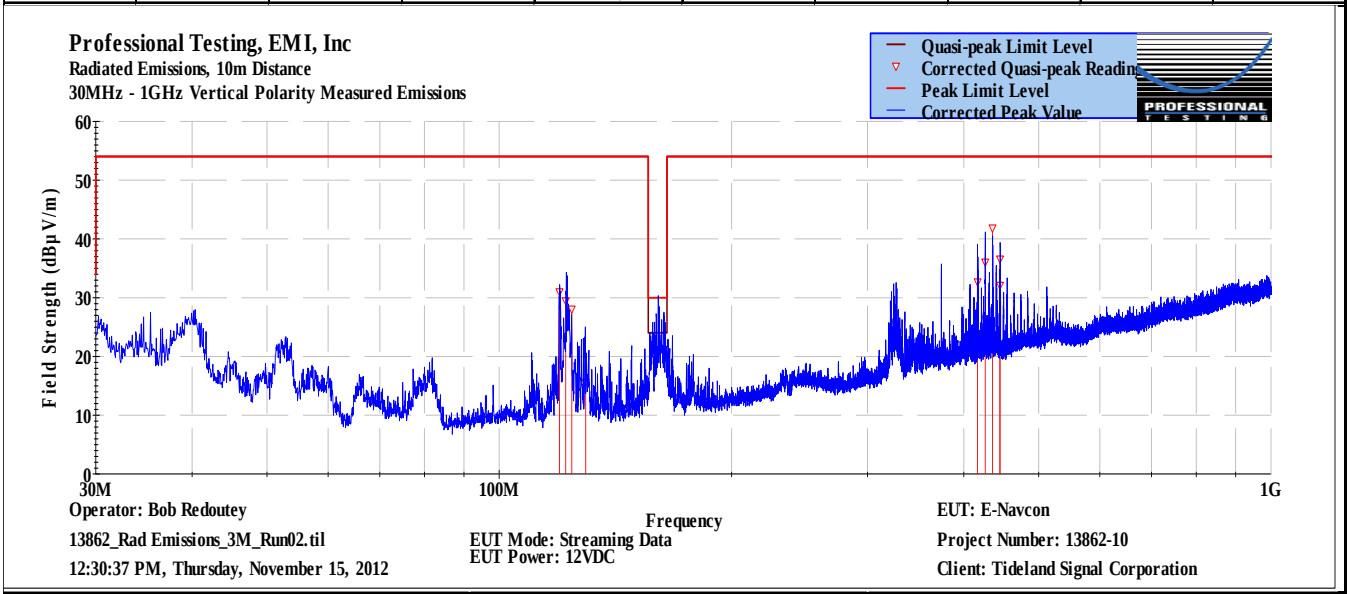
≤ 30MHz Perpendicular Antenna Orientation Measured Emissions

6.2.2 Radiated emissions, Enclosure; 30 MHz to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
119.697	3	39	1.9	Quasi-peak	47.1	30.98	54.0	-23.0	Pass
121.971	3	34	2.87	Quasi-peak	45.6	29.469	54.0	-24.5	Pass
124.131	3	141	2.69	Quasi-peak	44.2	28.054	54.0	-25.9	Pass
129.412	3	219	2.06	Quasi-peak	31.8	15.571	54.0	-38.4	Pass
416.695	3	52	1.57	Quasi-peak	37.4	32.666	54.0	-21.3	Pass
426.371	3	274	2.28	Quasi-peak	40.4	36.055	54.0	-17.9	Pass
435.678	3	209	2.09	Quasi-peak	46.1	41.844	54.0	-12.2	Pass
445.406	3	282	2.57	Quasi-peak	36.2	32.104	54.0	-21.9	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

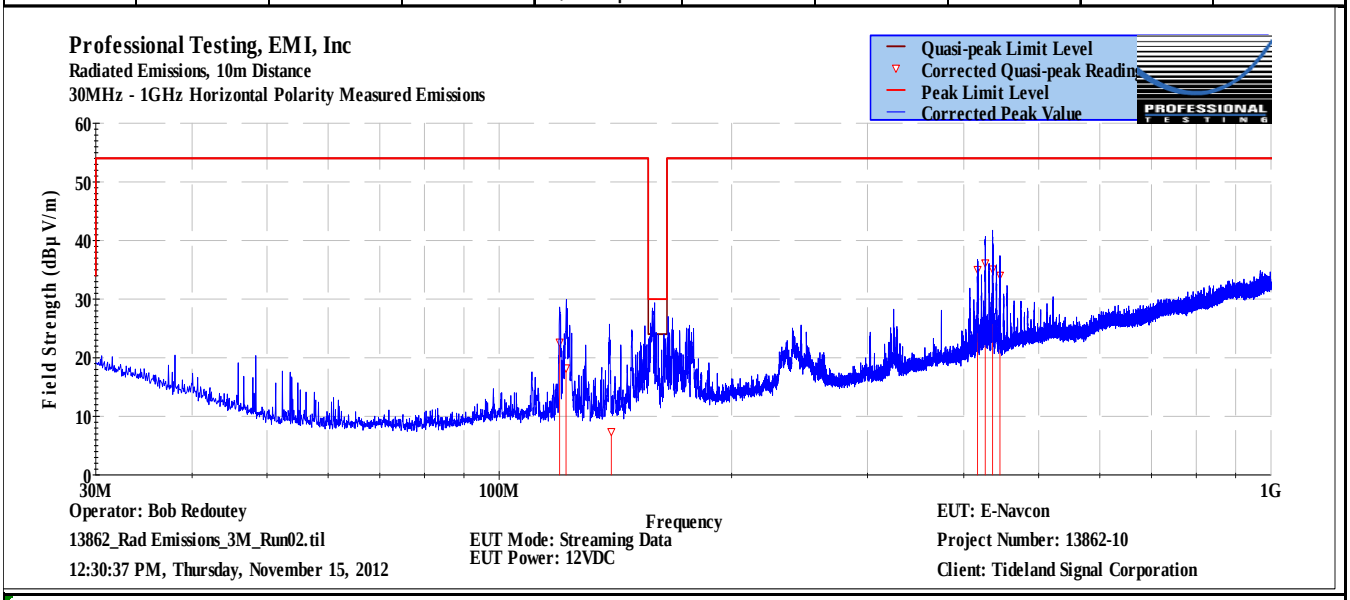
Professional Testing, EMI, Inc.

Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
119.716	3	305	2.97	Quasi-peak	38.8	22.7	54.0	-31.3	Pass
122.077	3	24	2.5	Quasi-peak	34.4	18.3	54.0	-35.7	Pass
139.704	3	197	1.89	Quasi-peak	23.1	7.4	54.0	-46.6	Pass
416.646	3	124	2.58	Quasi-peak	39.7	35.0	54.0	-19.0	Pass
426.366	3	346	2.04	Quasi-peak	40.5	36.2	54.0	-17.8	Pass
435.891	3	350	1.6	Quasi-peak	39.3	35.1	54.0	-18.9	Pass
445.586	3	98	1.89	Quasi-peak	38.2	34.1	54.0	-19.9	Pass



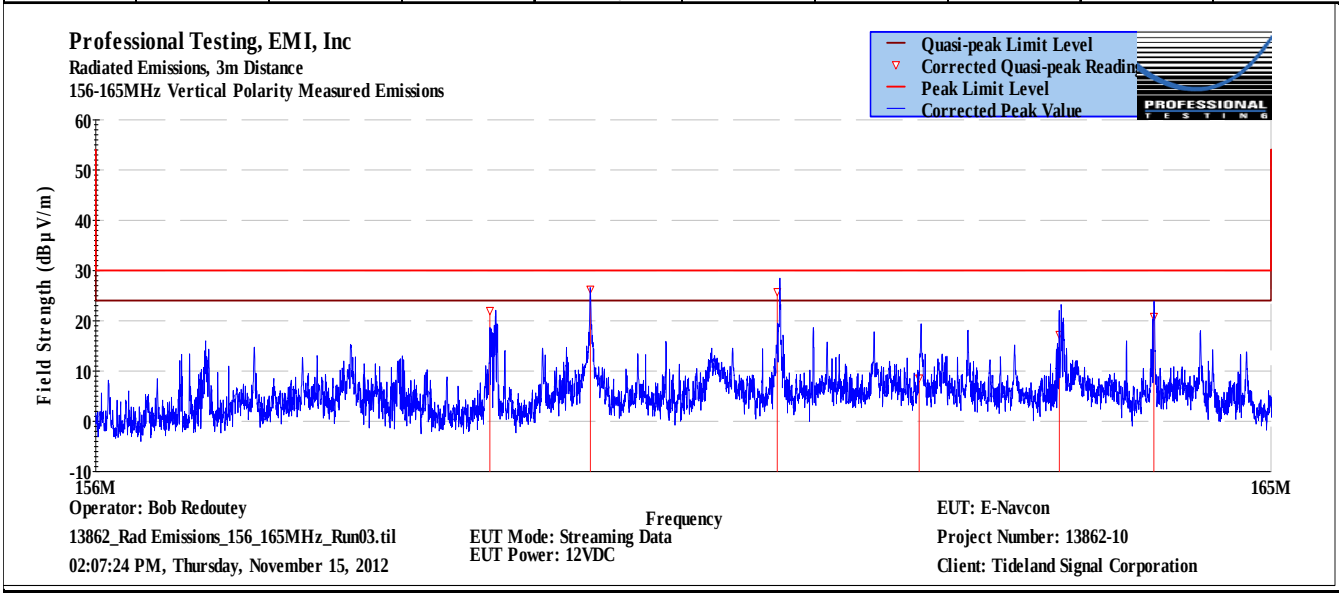
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.2.3 Radiated emissions, Enclosure; 156 MHz to 165 MHz

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
158.963	3	99	2.47	Quasi-peak	36.6	22.03	24.0	-2.0	Pass
159.726	3	51	1.82	Peak	41.3	26.3	30.0	-3.7	Pass
161.158	3	26	2.03	Peak	14.6	28.1	30.0	-1.9	Pass
162.253	3	100	3.08	Quasi-peak	22.9	8.627	24.0	-15.4	Pass
163.343	3	252	1.75	Quasi-peak	31.4	17.273	24.0	-6.7	Pass
164.081	3	131	1.56	Quasi-peak	34.9	20.858	24.0	-3.1	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

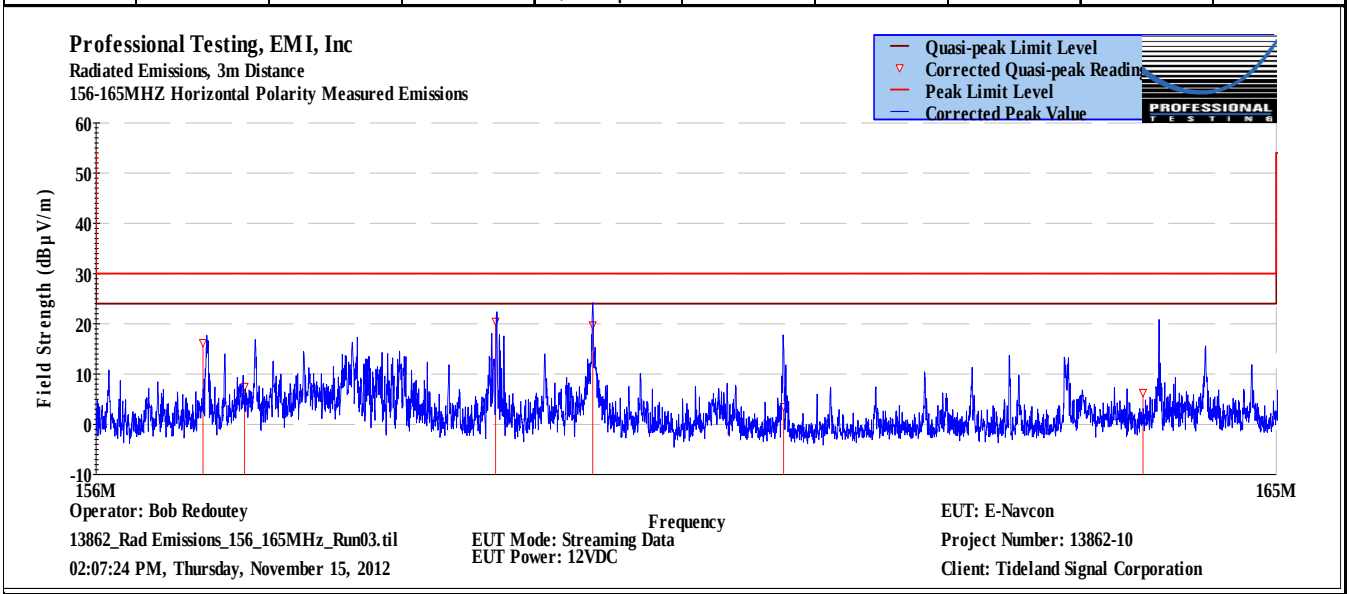
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results

Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
156.794	3	337	2.58	Quasi-peak	30.9	16.3	24.0	-7.7	Pass
157.105	3	346	1.7	Quasi-peak	22.2	7.6	24.0	-16.4	Pass
158.99	3	332	2.16	Quasi-peak	35.1	20.5	24.0	-3.5	Pass
159.726	3	350	3.24	Quasi-peak	34.3	19.8	24.0	-4.2	Pass
161.182	3	34	3.5	Quasi-peak	17.9	3.6	24.0	-20.4	Pass
163.958	3	188	2.04	Quasi-peak	20.4	6.3	24.0	-17.7	Pass



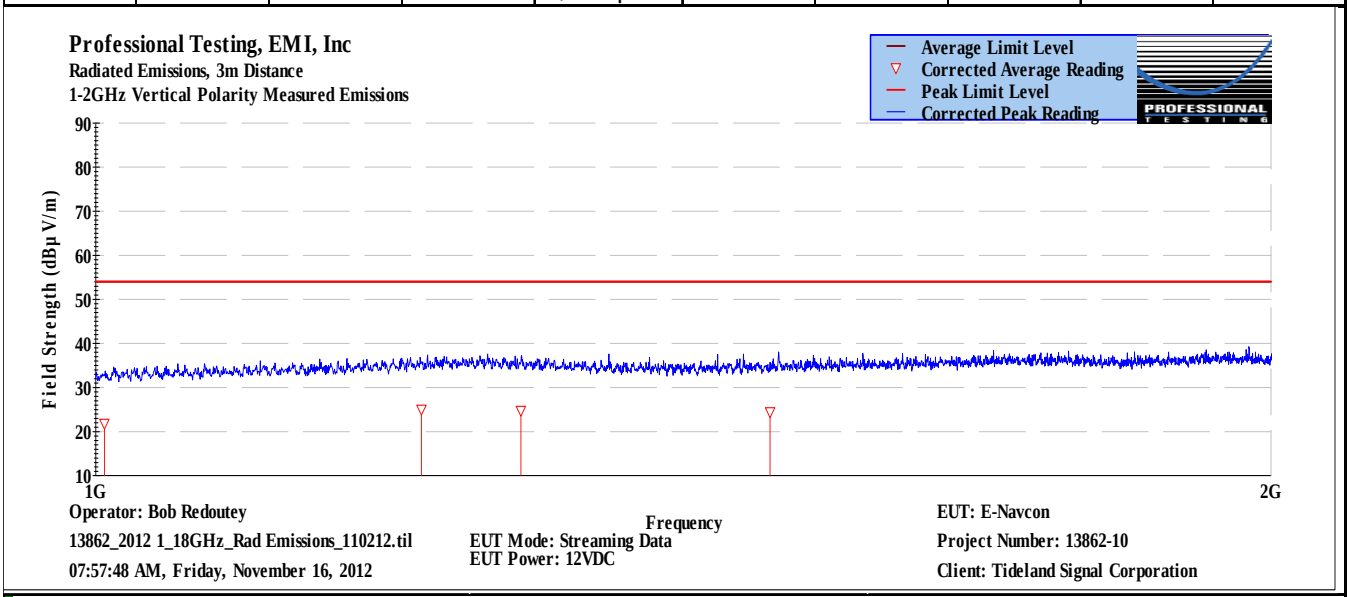
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.2.4 Radiated emissions, Enclosure; 1 GHz to 2 GHz

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1005.11	3	204	1	Quasi-peak	84	30.58	54.0	-23.4	Pass
1211.79	3	219	1	Quasi-peak	84	32.637	54.0	-21.4	Pass
1284.98	3	267	1	Quasi-peak	84.1	32.951	54.0	-21.0	Pass
1488.44	3	249	1	Quasi-peak	83.5	31.576	54.0	-22.4	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

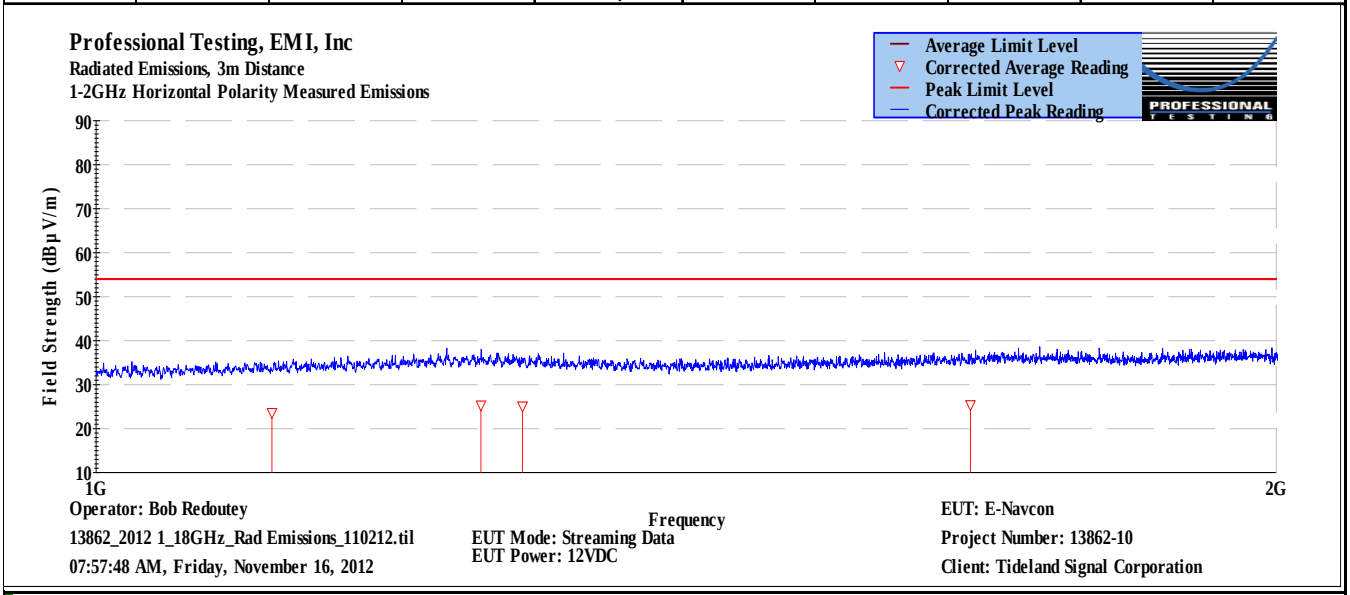
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results

Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1108.79	3	136	1	Quasi-peak	83.1	30.7	54.0	-23.3	Pass
1253.61	3	72	1	Quasi-peak	84.2	33.2	54.0	-20.8	Pass
1284.58	3	301	1	Quasi-peak	84	32.8	54.0	-21.1	Pass
1671.22	3	76	1	Quasi-peak	84.1	33.2	54.0	-20.8	Pass



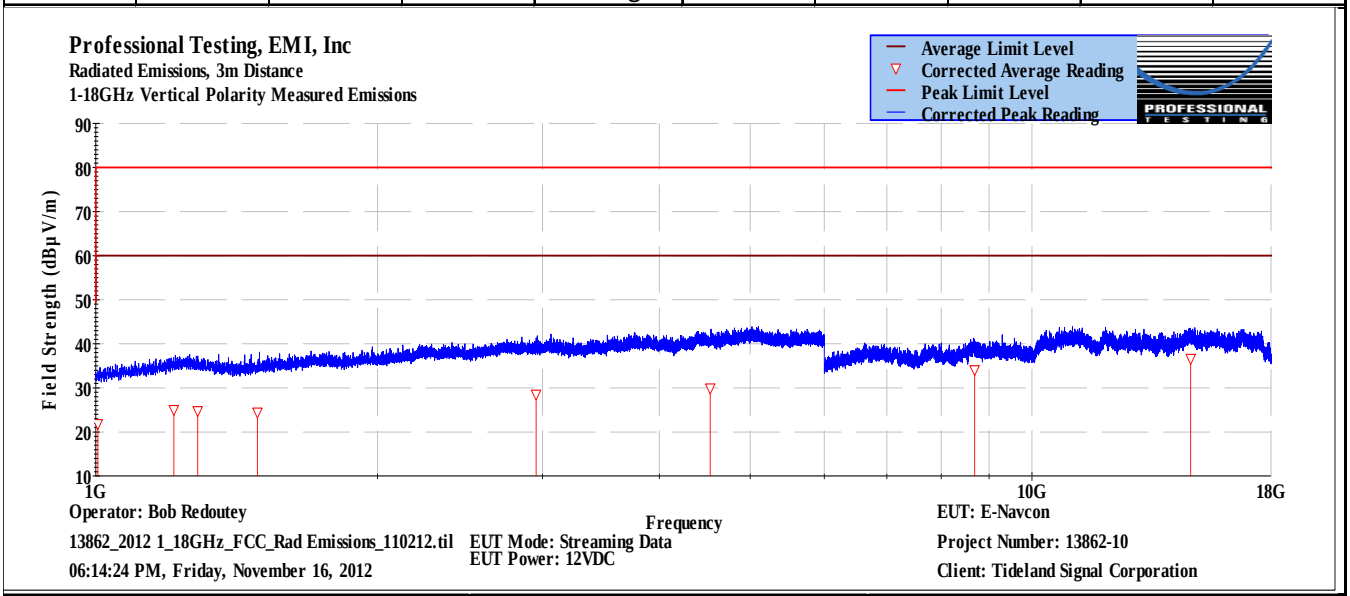
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.2.5 Radiated emissions, Enclosure; 1 GHz to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1005.11	3	204	1	Average	75.3	21.84	60.0	-38.1	Pass
1211.79	3	219	1	Average	76.4	25.016	60.0	-34.9	Pass
1284.98	3	267	1	Average	75.9	24.769	60.0	-35.2	Pass
1488.44	3	249	1	Average	76.4	24.442	60.0	-35.5	Pass
2953.88	3	294	1	Average	75.3	28.503	60.0	-31.5	Pass
4532.72	3	293	1	Average	74.7	29.925	60.0	-30.0	Pass
8685.15	3	325	1	Average	63.9	34.048	60.0	-25.9	Pass
14774.9	3	304	1	Average	60.2	36.637	60.0	-23.3	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

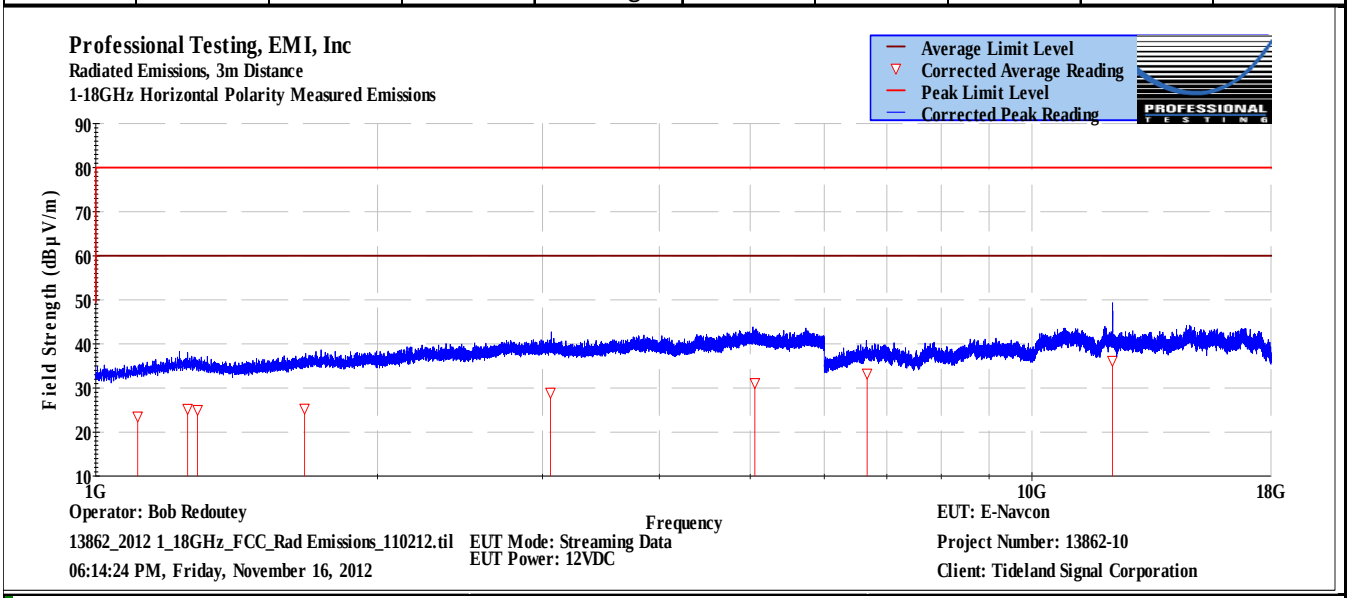
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits
Section:	15.109

Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1108.79	3	136	1	Average	76	23.6	60.0	-36.4	Pass
1253.61	3	72	1	Average	76.3	25.3	60.0	-34.7	Pass
1284.58	3	301	1	Average	76.2	25.1	60.0	-34.9	Pass
1671.22	3	76	1	Average	76.3	25.4	60.0	-34.6	Pass
3059.53	3	294	1	Average	75.8	29.0	60.0	-31.0	Pass
5059.48	3	183	1	Average	74.7	31.2	60.0	-28.8	Pass
6665.88	3	318	1	Average	71.8	33.3	60.0	-26.6	Pass
12187	3	115	1	Average	61.2	36.2	60.0	-23.8	Pass



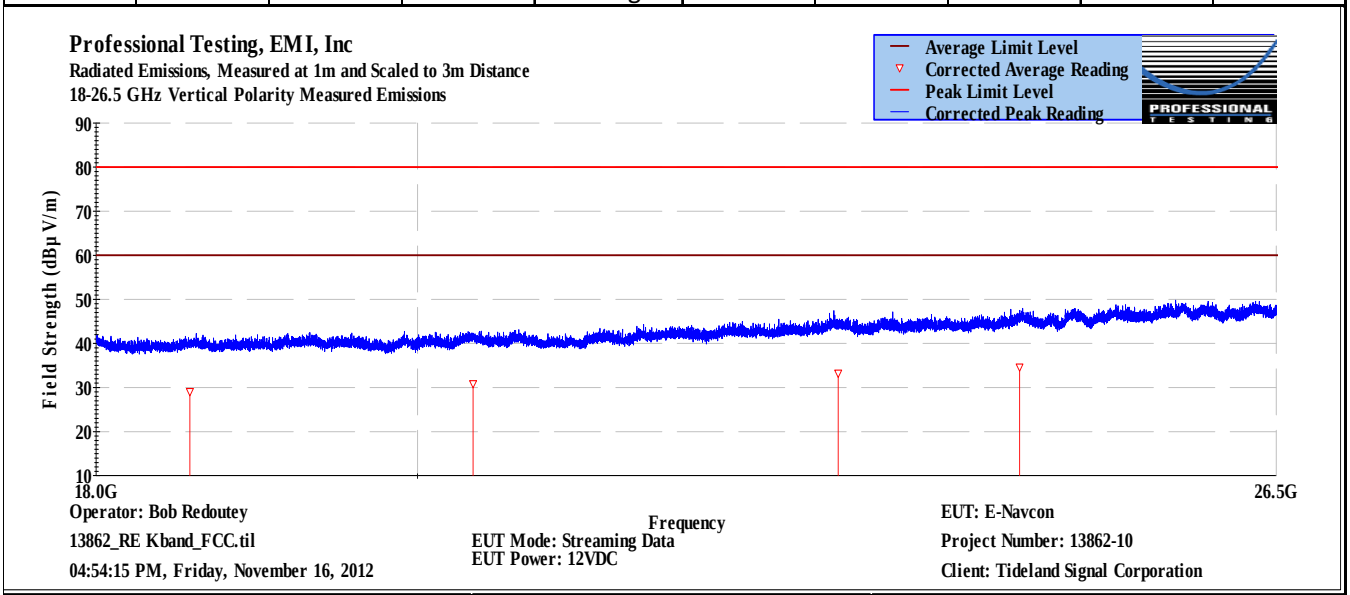
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.2.6 Radiated emissions, Enclosure; 18 GHz to 26.5 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
18562.3	3	104	1	Average	33.3	29.00	60.0	-31.0	Pass
20366.4	3	111	1	Average	34.6	30.8	60.0	-29.2	Pass
22956.3	3	262	1	Average	34.9	33.2	60.0	-26.8	Pass
24361.5	3	143	1	Average	35.2	34.6	60.0	-25.4	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

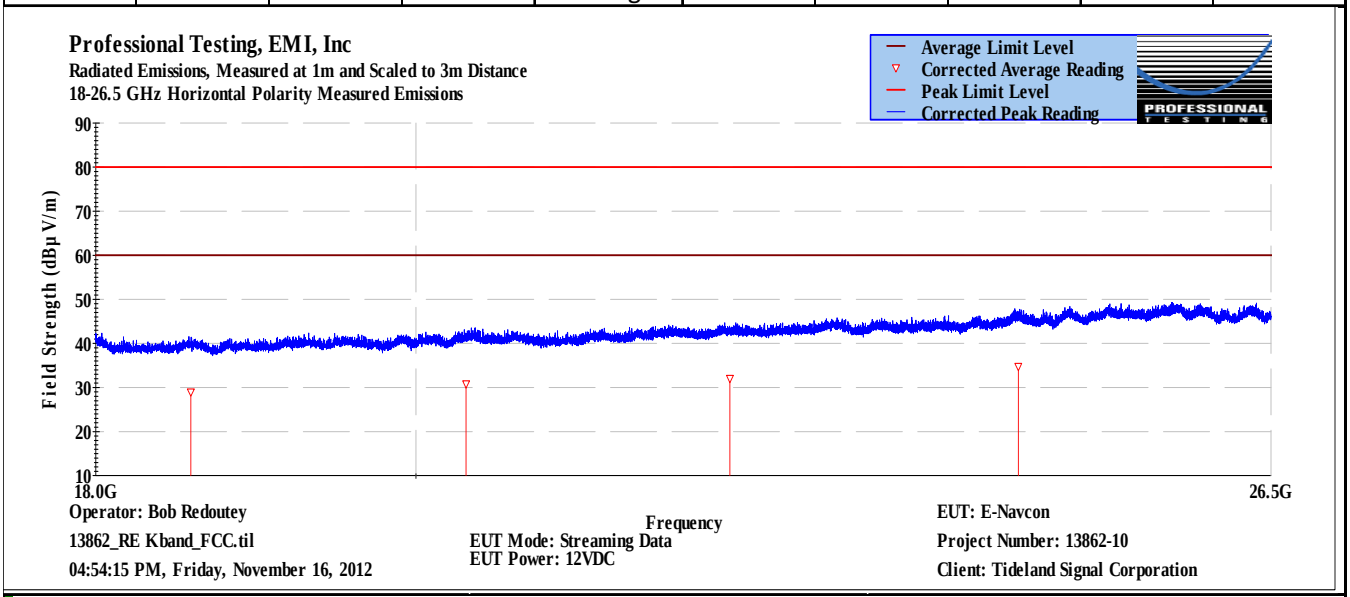
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits
Section:	15.109

Test Date(s):	11/15/2012 - 11/16/2012	**EUT Serial #:**	7066
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Bob Redoutey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	- N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Streaming Data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
18571.9	3	310	1	Average	33.1	29.0	60.0	-31.0	Pass
20333.2	3	302	1	Average	34.6	20.3	60.0	-39.6	Pass
22177.9	3	75	1	Average	34.7	22.2	60.0	-37.8	Pass
24385.9	3	234	1	Average	35.3	34.7	60.0	-25.2	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

6.2.7 Radiated emissions, Enclosure; Measurement Bandwidths

Professional Testing, EMI, Inc.			
Test Method:	**CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity**		
In accordance with:	**IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results**		
Section:	**Section 9 Electromagnetic emission – Methods of testing and required test results**		
Test Date(s):	**11/15/2012 - 11/16/2012**	**EUT Serial #:**	**7066**
Customer:	**Tideland Signal Corporation**	**EUT Part #:**	**None**
Project Number:	**13862-10**	**Test Technician:**	**Bob Redoutey**
Purchase Order #:	**None Listed**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**E-Navcon**	**Witness' Name:**	**None**

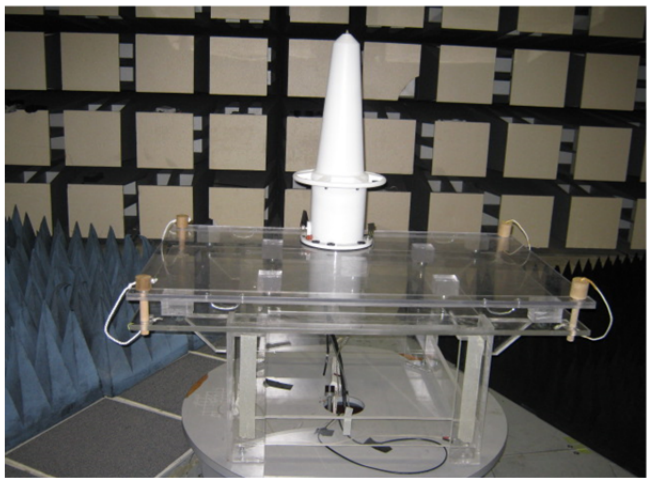
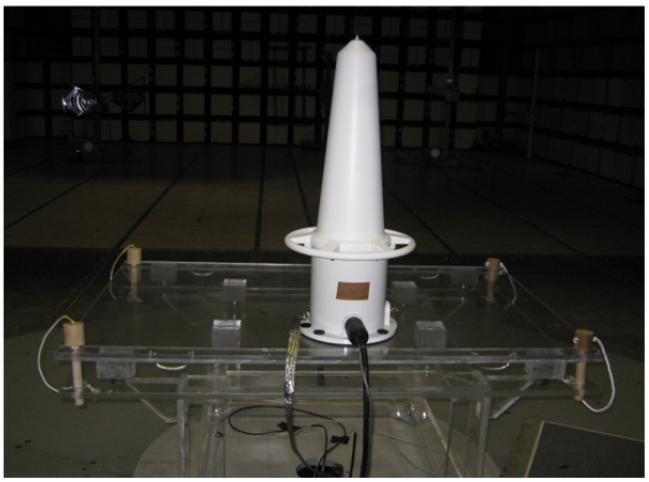
Radiated Emissions Bandwidth and Measurement Time Used for Testing - Peak Scan

Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

6.2.8 Radiated emissions, Enclosure; Setup Photographs

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	11/15/2012 - 11/16/2012	EUT Serial #:	7066
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Bob Redoutey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Photographs	Page: 1 of 1
	
Front	Rear
	
Support Equipment	

6.2.9 Radiated emissions, Enclosure; Equipment List

Professional Testing, EMI, Inc.			
Test Method:	**CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity**		
In accordance with:	**IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results**		
Section:	**Section 9 Electromagnetic emission – Methods of testing and required test results**		
Test Date(s):	**11/15/2012 - 11/16/2012**	**EUT Serial #:**	**7066**
Customer:	**Tideland Signal Corporation**	**EUT Part #:**	**None**
Project Number:	**13862-10**	**Test Technician:**	**Bob Redoutey**
Purchase Order #:	**None Listed**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**E-Navcon**	**Witness' Name:**	**None**

Radiated Emissions Test Equipment List	
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**
Test Profile:	**Radiated Emissions_Profile Version October 12, 2011**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/27/2013
0586	HP	8447D	Preamp, 0.1-1300MHz, 26dB	1726A01364	12/21/2012
1930	Agilent	E4440A-239	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY45304903	6/19/2013
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/24/2013
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/7/2013
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
6	EMCO	6502	Antenna, Loop, Active, .01-30MHz	1030	4/26/2013
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	4/8/2013
1594	Miteq	AFS44-00102650	Amplifier, 1-26.5GHz, 42dB	none	10/15/2013
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/12/2012
C030	N/A	0	Cable Coax, N-N, 30m	none	9/7/2013
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	00110313	1/19/2013
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A

6.3 Radiated emissions, Enclosure; 26.5 to 40 GHz

The tests were performed in a semi-anechoic shielded room. The EUT was placed on a rotatable non-metallic table 80 cm above the reference plane. Where earth bonding was provided on the EUT, the earth connection was attached to the reference plane.

Support equipment, including a laptop verifying operation of the EUT, were placed on the table. The lead-based 12 Volt battery source was placed on the lower section of the turntable.

Measurement equipment was also located inside the chamber such that signals were captured directly from horn antenna to the external harmonic mixer. The spectrum analyzer hosting the harmonic mixer was supplied with the conversion loss data for the harmonic mixer. To overcome path loss the measurement distance was 0.5 meters. The number of sweep points was increased from default 600 to 2000 to improve frequency granularity.

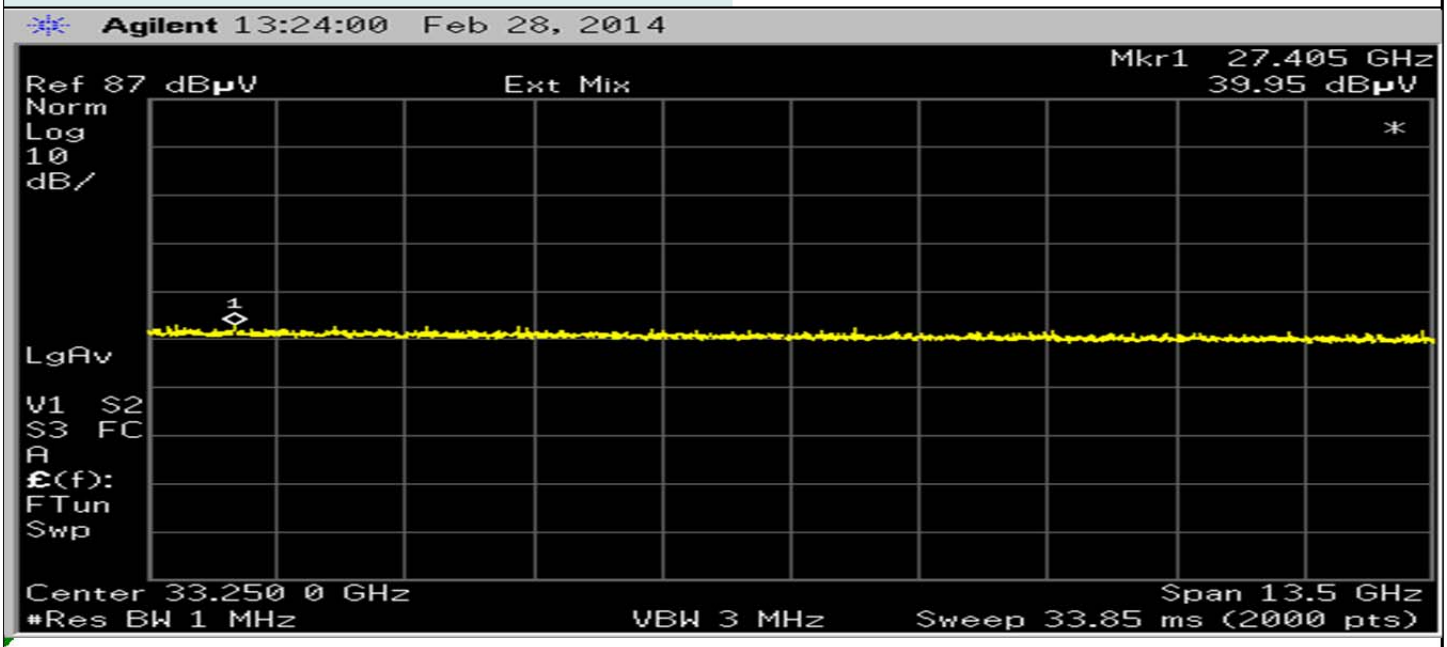
Radiated emissions above 26.5 GHz are required to be under 500 µV/m as measured at a distance of 3 meters per 47 CFR 15.209. This limit becomes 69.6 dBµV/m at 0.5 meters.

Results of the emission measurements appear in the following pages. Measurement was performed using peak detection and max-hold during the entire turntable rotation. No emissions were identified from the EUT. The EUT satisfied the relevant requirements.

6.3.1 Radiated emissions, Enclosure; 26.5 to 40 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/28/2014	EUT Serial #:	7065
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Eric Lifsey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

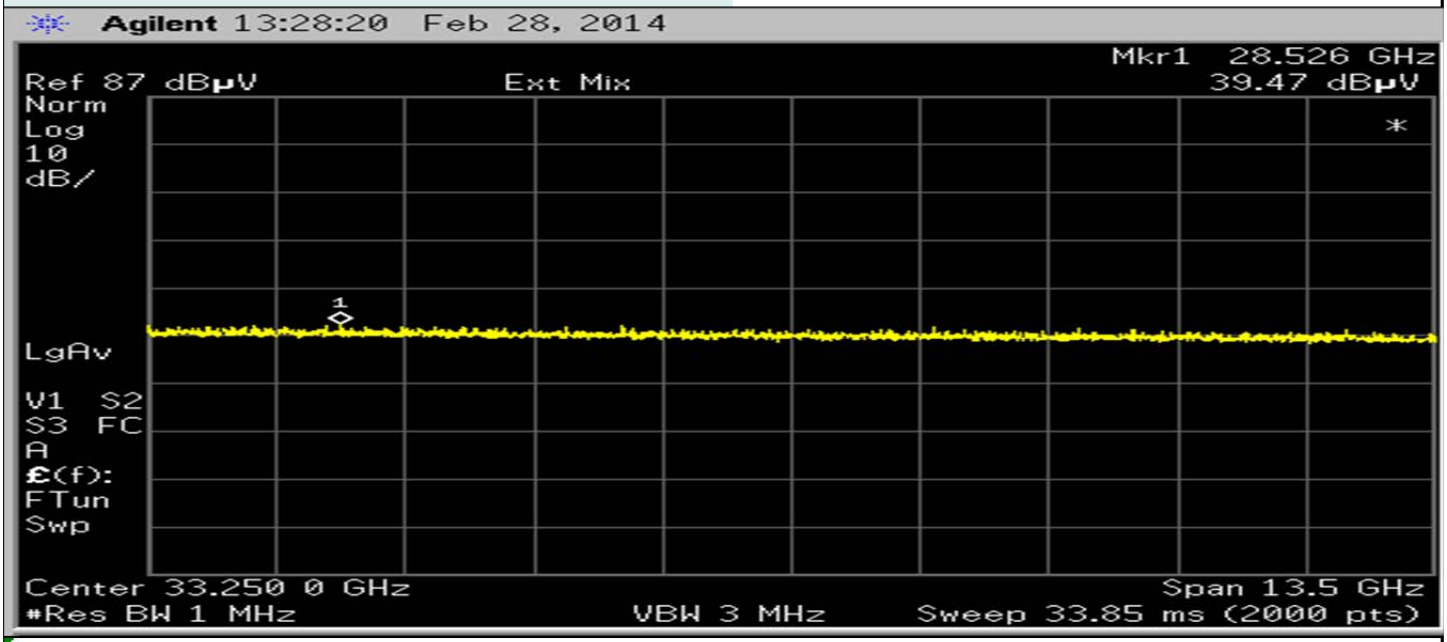
Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Streaming Data	



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/28/2014	**EUT Serial #:**	7065
Customer:	Tideland Signal Corporation	**EUT Part #:**	None
Project Number:	13862-10	**Test Technician:**	Eric Lifsey
Purchase Order #:	None Listed	**Supervisor:**	Rob McCollough
Equip. Under Test:	E-Navcon	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	**12**	**VDC**	**EUT Power Frequency:**	**-**	**N/A**
Antenna Orientation:	**Horizontal**		**Frequency Range:**	**Above 1GHz**	
EUT Mode of Operation:			**Streaming Data**		



> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Radiated emissions, Bandwidths

Professional Testing, EMI, Inc.			
Test Method:	**CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity**		
In accordance with:	**IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results**		
Section:	**Section 9 Electromagnetic emission – Methods of testing and required test results**		
Test Date(s):	**2/28/2014**	**EUT Serial #:**	**7065**
Customer:	**Tideland Signal Corporation**	**EUT Part #:**	**None**
Project Number:	**13862-10**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**None Listed**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**E-Navcon**	**Witness' Name:**	**None**

Radiated Emissions Bandwidth and Measurement Time Used for Testing - Peak Scan

Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
26500	40000	1000	1	Multiple Sweeps

6.3.3 Radiated emissions, Enclosure; Equipment List

Professional Testing, EMI, Inc.			
Test Method:	**CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity**		
In accordance with:	**IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results**		
Section:	**Section 9 Electromagnetic emission – Methods of testing and required test results**		
Test Date(s):	**2/28/2014**	**EUT Serial #:**	**7065**
Customer:	**Tideland Signal Corporation**	**EUT Part #:**	**None**
Project Number:	**13862-10**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**None Listed**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**E-Navcon**	**Witness' Name:**	**None**

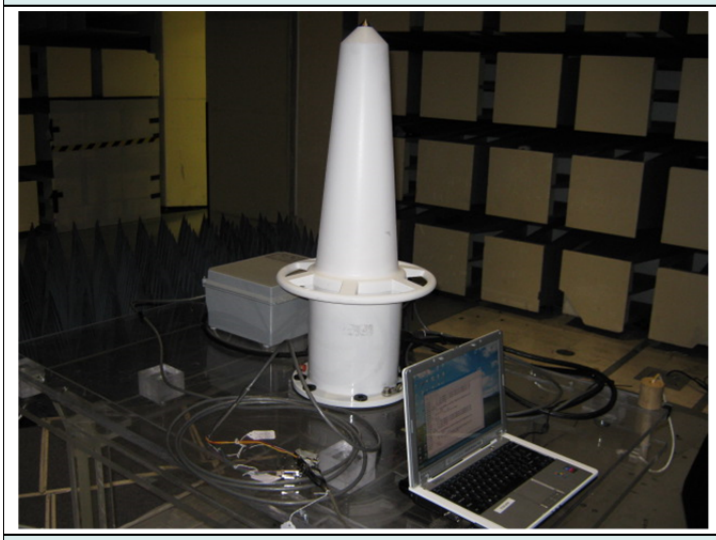
Radiated Emissions Test Equipment List	
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**
Test Profile:	**Radiated Emissions_Profile Version October 12, 2011**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1930	Agilent	E4440A-239	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY45304903	7/11/2015
942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
2063	HP	11970A	Mixer, Harmonic, 26.5 - 40 GHz	3003A08717	N/A
1735	Pasternack	PE9850-20	Antenna, horn, WR28	N/A	N/A

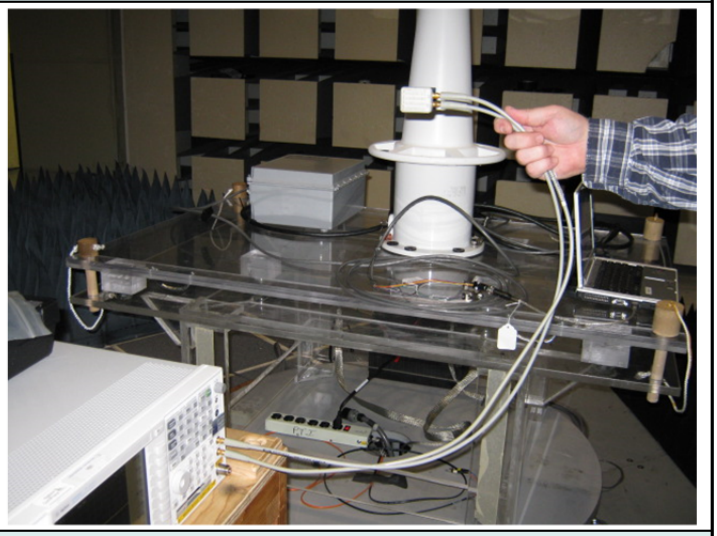
6.3.4 Radiated emissions, Enclosure; Setup Photographs

Professional Testing, EMI, Inc.			
Test Method:	CISPR 16-2: Specification for radio disturbance and immunity measuring apparatus and methods - Part 2: Methods of measurement of disturbance and immunity		
In accordance with:	IEC 60945, Fourth Edition, 2002-08 Maritime navigation and radio communication equipment and systems - General Requirements - Methods of testing and required test results		
Section:	Section 9 Electromagnetic emission – Methods of testing and required test results		
Test Date(s):	2/28/2014	EUT Serial #:	7065
Customer:	Tideland Signal Corporation	EUT Part #:	None
Project Number:	13862-10	Test Technician:	Eric Lifsey
Purchase Order #:	None Listed	Supervisor:	Rob McCollough
Equip. Under Test:	E-Navcon	Witness' Name:	None

Radiated Emissions Photographs — Page: 1 of 1



EUT



EUT and Measurement Equipment

7.0 Fundamental Output Power, AIS AtoN

7.1 Procedure

The EUT was placed on a non-conductive support 3 meters from the measurement antenna and turned a full rotation to find and record the maximum emission.

7.2 Results

To function/transmit, the EUT required an outdoor measurement to enable the AIS transmitter as a GPS signal is required for the AIS protocol to synchronize to the selected TDMA time slot.

Professional Testing (EMI), Inc.
Radiated Emissions Measured Outdoors
V 3.0

Client:	Tideland	Polarity:	Vertical	Distance:	3 meter
Test Date:	May 20, 2013	EUT:	E-Navcon, AIS AtoN		
Voltage:	Battery Powered	Serial #:	7065		
Frequency:	n/a	Project #:	13862-15		
Technician:	Eric Lifsey	Test Type:	RF Power	Class:	N/A

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	EIRP (W)		Detector Function
0.161976	0	1	112.64	0.0	12.9	1.40	126.9	1.47		Peak

Professional Testing (EMI), Inc.
Radiated Emissions Measured Outdoors
V 3.0

Client:	Tideland	Polarity:	Horizontal	Distance:	3 meter
Test Date:	May 20, 2013	EUT:	E-Navcon, AIS AtoN		
Voltage:	Battery Powered	Serial #:	7065		
Frequency:	n/a	Project #:	13862-15		
Technician:	Eric Lifsey	Test Type:	RF Power	Class:	N/A

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	EIRP (W)		Detector Function
0.16204	90	1	102.72	0.0	12.9	1.40	117.0	0.15		Peak

Results Compared to Regulatory Limit FCC 80.215(c)(2) Marine utility stations.

EIRP Measured, Peak	EIRP Limit, Peak
1.47 W (31.7 dBm)	10 W (40 dBm)

Equipment List

Asset Number	Make / Model	Description	Calibration Due
C235	Unknown	Cable SMA-SMA	9/3/2013
0943	EMCO 3110B	Antenna, Bicon	12/04/2013
Rental	Rohde FSP-30	Spectrum Analyzer	1/29/2015

8.0 Fundamental Output Power, RACON, X Band

8.1 Procedure

The EUT is placed on a motorized 80 cm high non-conductive turntable, 1 meter from the measurement antenna, and turned a full rotation to find to record the maximum emission. The EUT transmits only when it receives a pulsed signal in the X band. A signal generator is connected to an extra horn antenna to direct a pulse modulated in-band signal at the EUT to create an artificial interrogation signal. The EUT transmitted response is recorded for peak amplitude and recorded in the time domain to verify the Morse code signal which clearly identifies the EUT as source of the signal.

8.2 Results

The interrogation signal successfully provoked the EUT into transmitting the expected Morse code signal which decoded as the Morse letter Q. Maximum polarity was determined manually then the measurement was recorded.

Calibration of the interrogation signal generator and stimulation antenna was not required as they did not affect the measurement.

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors

V 3.0

Client:	Tideland	Polarity:	Horizontal	Distance: 1	meter
Test Date:	February 18, 2013	EUT:	E-Navcon, RACON Section		
Voltage:	Battery Powered	Serial #:	7065		
Frequency:	n/a	Project #:	13862-15		
Technician:	Eric Lifsey	Test Type:	RF Power	Class:	N/A

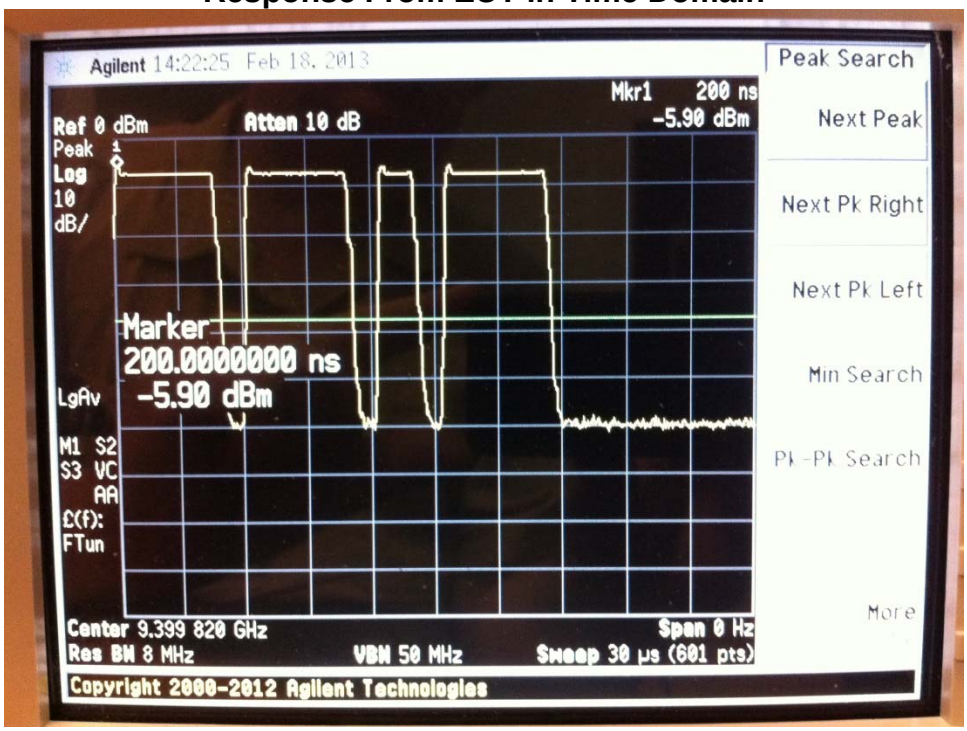
Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency: MHz	Height / Table	FS in dBm Measured	FS in dBµV Converted	Cable Loss	Antenna Factor	FS in dBµV/m Corrected	EIRP dBm			
9399.82	1.3 / 340	-5.9	101.1	6.7	37.7	145.5	40.73			

Results Compared to Regulatory Limit FCC 80.215(n)(3)

EIRP Measured, Peak	EIRP Limit, Peak
11.83 W (40.73 dBm)	20 W (43 dBm)

Response From EUT in Time Domain



Equipment List

Asset Number	Make / Model	Description	Calibration Due
C092	Pasternack	Cable	2/18/2013
0267	EMCO 3115	Antenna, Horn	11/15/2013
MY46180615	Agilent E4446A	Spectrum Analyzer	2/14/2013
0547	Gigatronics	Signal Generator	NCR*
Unspecified	EMCO unspecified horn	Antenna, Horn	NCR*

*Calibration not required for this test.

9.0 RF Exposure Calculation

Collocated RF exposure will be calculated using the maximum output power as measured elsewhere in this report. As this device is to be fielded and used without operator intervention and in locations typically not accessed by personnel, the exposure distance to be used for MPE calculations will be 1 meter. The Racon and AIS AtoN output field density shall be summed to calculate the combined maximum RF exposure and demonstrate compliance with applicable standards.

The results of power measurement and intended use/proximity are compared against the requirements for safety of RF exposure. The co-location sum of exposure is performed.

9.1 Criteria

Section Reference	Date
FCC 2.1091, FCC OET Bulletin 65, RSS-102, EN 62311	March 4, 2014

9.2 Procedure

Using measurement of peak power and intended application, determine the permissible exposure level or whether additional exposure tests (SAR) are indicated. Justify conclusion for selected exposure area and separation distance.

9.3 Results

This composite device is located in typically remote locations on waterway navigational hazards or buoys. It is installed or serviced by trained individuals only. A separation distance of 1 meter was selected for Occupational Controlled exposure and applied to limit calculation.

Antenna port power was determined from a radiated measurement. As both devices operate/transmit independently and closely colocated, the evaluation requires the exposure contributions to be summed.

156 MHz AiS

Measured Power EIRP
1469.3 mW*

*This is the peak measurement.

9300 MHz RACON

Measured Power EIRP
11830 mW*

*This is the peak measurement.

Limit of MPE for SAR Exclusion Threshold for 156-162 MHz, Occupational/Controlled:

$f_{(MHz)}$ = 30 - 300 MHz = 1.0 mW/cm^2 Ref. FCC Bulletin OET-65 Table 1(A)

Field density is determined at 100 cm as:

S = EIRP / (4 π 100^2) Ref. FCC Bulletin OET-65 Equation (4)
S = 1469.3 mW / 125663.7 cm^2
S = 0.0117 mW/cm^2
Percentage of Exposure: 0.0117 / 1.0 = 1.17%

Limit of MPE for SAR Exclusion Threshold for 9300 MHz, Occupational/Controlled:

5.0 mW/cm^2 Ref. FCC Bulletin OET-65 Table 1(A)

Field density is determined at 100 cm as:

S = EIRP / (4 π 100^2) Ref. FCC Bulletin OET-65 Equation (4)
S = 11830 mW / 125663.7 cm^2
S = 0.0941 mW/cm^2
Percentage of Exposure: 0.0941 / 5.0 = 1.88%

Percentages are summed below to determine co-location total exposure.

Total exposure: 1.17% + 1.88% = 3.05%

The summed power is below the SAR Exclusion Threshold of 100%, it therefore meets the criteria for exclusion from SAR testing.