Advanced
Compliance Laboratory

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ELECTROMAGNETIC EMISSION COMPLIANCE REPORT

of

PRECISION SOIL SENSOR

MODEL: 53851

FCC ID: OF753851 & IC: 3575A-53851

March 6, 2012

This report concerns (check one): Original grant __x__ Class II change _____
Equipment type: Low Power Intentional Radiator

Deferred grant requested per 47 CF 0.457(d)(1)(ii)? yes _____ no __x__
If yes, defer until: _____ (date)
Company agrees to notify the Commission by _____ (date)
of the intended date of announcement of the product so that the grant can be issued on that date.
Transition Rules Request per 15.37? yes _____ no __x__

Test Specification:
47 CFR FCC Part 15C & Industry Canada RSS-210/RSS-Gen

Report prepared for:	THE TORO COMPANY
Report prepared by:	Advanced Compliance Lab
Report number:	0048-111021-01

NVLAP®

Lab Code: 200101 **The test result in this report IS supported and covered by the NVLAP accreditation**

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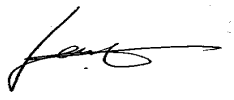
1. GENERAL INFORMATION

1.1 Verification of Compliance

EUT:	PRECISION SOIL SENSOR
Model:	53851
Applicant:	THE TORO COMPANY
Test Type:	FCC Part 15C CERTIFICATION IC RSS-210 (Issue 8) & RSS-Gen CERTIFICATION
Result:	PASS
Tested by:	ADVANCED COMPLIANCE LABORATORY
Test Date:	11/30/2010 - 01/24/2011
Report Number:	0048-111021-01

The above equipment was tested by Compliance Laboratory, Advanced Technologies, Inc. for compliance with the requirement set forth in the FCC/IC rules and regulations Part 15 subpart C. This said equipment in the configuration described in the report, shows the maximum emission levels emanating from equipment are within the compliance requirements.



Wei Li
Lab Manager
Advanced Compliance Lab

Date March 6, 2012

1.2 Equipment Modifications

N/A

1.3 Product Information

System Configuration

ITEM	DESCRIPTION	FCC/IC ID	CABLE
Product	PRECISION SOIL SENSOR (1)	FCC ID: OF753851 IC: 3575A-53851	
Housing	PLASTICS		
Power Supply	4.5VDC (3xAA Battery)		
Operation Freq.	906MHz ~ 922MHz		
Receiver	53851(RX)	Verification	

(1) EUT submitted for grant.

1.4 Test Methodology

Radiated tests were performed according to the procedures in ANSI C63.4-2003 at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The open area test site and conducted measurement facility used to collect the radiated and conducted data are located at Hillsborough, New Jersey. This site has been accepted by FCC to perform measurements under Part 15 or 18 (Registration No. 886209) and designated by IC as " Site IC 3130A". The NVLAP Lab code for accreditation of FCC EMC Test Method is: 200101-0.

1.6 Test Equipment

Manufacture	Model	Serial No.	Description	Cal Due dd/mm/yy
Hewlett-Packard	HP8546A	3448A00290	EMI Receiver	25/09/12
Agilent	E4440A	US40420700	3Hz-26.5GHz Spec. Analyzer	17/06/12
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	19/10/12
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	19/10/12
Fischer Custom	LISN-2	900-4-0008	Line Impedance Stabilization Networks	05/10/12
Fischer Custom	LISN-2	900-4-0009	Line Impedance Stabilization Networks	18/10/12
EMCO	3115	4945	Double Ridge Guide Horn Antenna	17/10/12

All Test Equipment Used are Calibrated Traceable to NIST Standards.

1.7 Statement for the Document Use

This report shall not be reproduced except in full, without the written approval of the laboratory. And this report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. / Canada Government.

2. PRODUCT LABELING

Toro Model: 53851
FCC ID: OF753851 IC: 3575A-53851

This device complies with FCC Part 15 & ICRSS-210/RSS-Gen Rules. Operating is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 2.1 ID Label
(Only ID shown on EUT)

Figure 2.2 Location of ID Label on EUT

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). And its antenna was permanently attached to the EUT with max length, 3".
Testing was performed as EUT was continuously operated at the following frequency channels:

Low=906MHz, Middle= 914MHz, High=922MHz.

If applicable, fresh external battery shall be used for extended operating time.

3.2 Special Accessories

N/A

3.3 Configuration of Tested System

Figure 3.1 illustrate this system, which is tested standing along.

Figure 3.1 Radiated Test Setup

NA

Figure 3.2 Conducted Setup- Front

NA

Figure 3.3 Conducted Setup- Rear

4. SYSTEM SCHEMATICS

See Attachment.

Figure 4.1 System Schematics

5. CONDUCTED EMISSION DATA

5.1 Test Methods and Conditions

The EUT was under normal operational mode during the conducted emission test. EMI Receiver was scanned from 150KHz to 30MHz with maximum hold mode for maximum emission. Recorded data was sent to the plotter to generate output in linear format. At the input of the spectrum analyzer, a HP transient limiter is inserted for protective purpose. This limiter has a 10 dB attenuation in the range of 150KHZ to 30MHZ. That factor was automatically compensated by the receiver, so the readings are the corrected readings. The reference of the plot is the CISPR 22 Class B limit in Figure 5.1 through Figure 5.2.

Conducted Emission Technical Requirements				
	Class A		Class B	
Frequency Range	Quasi-Peak dBuV	Average dBuV	Quasi-Peak DBuV	Average dBuV
150kHz –0.5MHz	79 (8912uV)	66 (1995uV)	66-56	56-46
0.5MHz-30MHz	73 (4467uV)	60 (1000uV)	---	---
0.5MHz- 5MHz	---	---	56	46 (250uV)
5MHz-30MHz	---	---	60	50

Emissions that have peak values close to the specification limit (if any) are also measured in the quasi-peak/average mode to determine compliance.

5.2 Test Data

Figure 5.1-5.2 show the neutral and line conducted emissions for the standard operation.

Highest Data for AC Line Conducted Emissions						
Frequency (MHz)						
Peak Reading (dBuV)						
Average Reading (dBuV*)						

* no need to show the average reading if the peak value is under average limit.

Test Personnel:

Tester Signature: _____

Typed/Printed Name: Edward Lee Date: March 6, 2012

THIS SECTION IS NOT APPLICABLE TO THIS EUT.

NA

Fig. 5.1 Conducted Emission-Line

NA

Fig. 5.2 Conducted Emission- Neutral

6. RADIATED EMISSION DATA

6.1 Field Strength Calculation

The corrected field strength is automatically calculated by EMI Receiver using following:

$$FS = RA + AF + CF + AG$$

where FS: Corrected Field Strength in dBμV/m
RA: Amplitude of EMI Receiver before correction in dBμV
AF: Antenna Factor in dB/m
CF: Cable Attenuation Factor in dB
AG: Built-in Preamplifier Gain in dB (Stored in receiver as part of the calibration data)

THE "DUTY CYCLE CORRECTION FACTOR" FOR SPURIOUS RADIATED EMISSIONS IS;
20 log * (23.8 ms / 100 ms) = -12.5 dB, WHICH WAS USED TO CORRECT THE AVERAGE RADIATED EMISSION READINGS.

6.2 Test Methods and Conditions

The initial step in collecting radiated data is a EMI Receiver scan of the measurement range below 30MHz using peak detector and 9KHz IF bandwidth / 30KHz video bandwidth. For the range 30MHz - 1GHz, 100KHz IF bandwidth / 100KHz video bandwidth are used. Both bandwidths are 1MHz for above 1GHz measurement. Up to 10^{th} harmonics were investigated.

6.3 Test Data

The following data lists the significant emission frequencies, polarity and position, peak reading of the EMI Receiver, the FCC/IC limit, and the difference between the peak reading and the limit. Explanation of the correction and calculation are given in section 5.1.

Test Personnel: 

Typed/Printed Name: Edward Lee Date: March 6, 2012

Radiated Test Data (CH-906MHz/914MHz/922MHz)

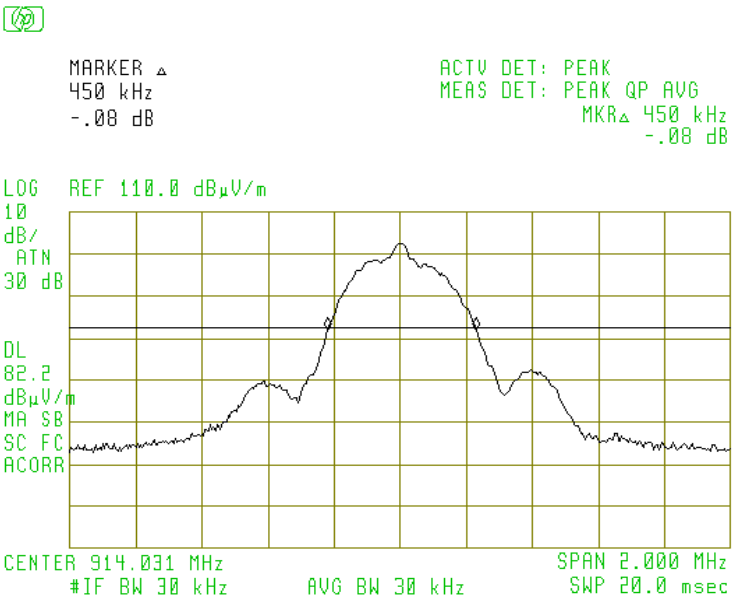
Frequency (MHz)	Polarity (V,H) Position (X,Y,Z)	Antenna Height (m)	Azimuth (Degree)	Peak Reading at 3m (2) (dBuV/m)	Peak Reading After Correction (dBuV/m)	FCC 3m Limit (1) (dBuV/m)	Difference (dBuV/m)
906	V	1.1	000	91.7	79.2	94	-14.8
1812	V	1.0	180	54.5	42.0	54	-12.0
2718	V	1.0	180	58.0	45.5	54	-8.5
906	H	1.0	090	94.3	81.8	94	-12.2
1812	H	1.0	045	55.3	42.8	54	-11.2
2718	H	1.0	045	57.6	45.1	54	-8.9
914	V	1.1	270	90.8	78.3	94	-15.7
1828	V	1.0	180	52.6	40.1	54	-13.9
2712	V	1.0	000	59.0	46.5	54	-7.5
914	H	1.0	090	93.5	81.0	94	-13.0
1828	H	1.0	090	55.7	43.2	54	-10.8
2742	H	1.0	270	57.2	44.7	54	-9.3
922	V	1.1	225	89.9	77.4	94	-16.6
1844	V	1.0	225	53.8	41.3	54	-12.7
2766	V	1.0	180	59.1	46.6	54	-7.4
922	H	1.0	180	90.3	77.8	94	-16.2
1844	H	1.0	270	55.5	43.0	54	-11.0
2766	H	1.0	180	57.6	45.1	54	-8.9

(1) The limit for emissions within the 902-928MHz band is 50mV(94dB) per FCC Part 15 Sec. 15.249 and IC RSS-210 Annex 2.9. The limit for its harmonics is 500uV (54dB). Other spurious emissions shall be lower than either its fundamental by 50dB or the limit defined in FCC Part 15 Sec. 15.209 and IC RSS-210 Annex 7, whichever is higher.
(2) If each peak reading is less than the FCC/IC average limit, it'll be not necessary to show the measured/ calculated average reading.

Other Spurious outside of the band 902-928MHz
(the worst case of investigated L, M, H channel operation modes)

Frequency (MHz)	Polarity (V,H) Position X	Antenna Height (m)	Azimuth (Degree)	Peak Reading at 3m (2) (dBuV/m)	Peak Reading After Correction (dBuV/m)	FCC 3m Limit (1) (dBuV/m)	Difference (dBuV/m)
35.0	V	1.1	180	30.9		40.0	-9.1
139.9	V	1.1	180	33.1		43.5	-10.4
160.1	V	1.1	010	34.5		43.5	-9
48.2	H	1.4	210	30.0		40.0	-10
173.0	H	1.4	090	34.0		43.5	-9.5

Comparing to the limit defined in FCC Part 15 Sec. 15.209 and IC RSS-210, no other significant emissions were found.

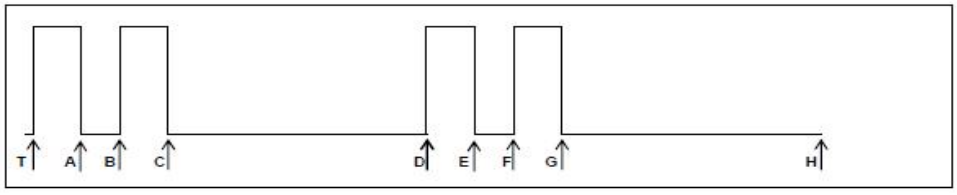


20dB Bandwidth Plot

Pulse Train and Duty Cycle Calculation over 100ms Worst Case Window

FCC: OF753851, OF753852

IC: 3575A-53851, 3575A-53852



T -> A (D->E) :: 11.9ms (11.9ms= max 24bytes @ 396us/byte + 2.4ms preamble)

A -> B (E->F) :: 10 ms

B -> C (F->G) :: 11.9ms (fixed repeat, no acknowledgement sent)

C -> D (G->H) :: 66.2 ms

T -> D (D->H) :: 100ms

Typical message: T->D. Repeat as needed: D->H

Duty Cycle :: 23.8% = (11.9 + 11.9) / 100

Typical Operation (1 way)
(Repeat every 12 minutes)
Sensor → User Interface
T->H

When there is no Acknowledgement of transmitted message but if additional data is required to be exchanged worst case it will be follow in the T->H format, waiting 66.2ms and not consisting of more then 24 bytes of data (maximum payload size), for D->E or F-G.

Duty Cycle Plot

6.4 EUT RECEIVING MODE VERIFICATION

Radiated Test Data for Receiving Mode
(the worst case of investigated L, M, H channel operation modes)

Frequency (MHz)	Polarity (V,H) Position X	Antenna Height (m)	Azimuth (Degree)	Peak Reading at 3m (2) (dBuV/m)	Peak Reading After Correction (dBuV/m)	FCC 3m Limit (1) (dBuV/m)	Difference (dBuV/m)
34.3	V	1.1	180	30.3		40.0	-9.7
139.7	V	1.1	180	32.3		43.5	-11.2
160.9	V	1.1	000	34.1		43.5	-9.4
338	V	1.0	045	27.4		46.5	-19.1
374	V	1.0	045	27.6		46.5	-18.9
872	V	1.0	180	31.2		46.5	-15.3
48.7	H	1.4	225	29.5		40.0	-10.5
122.2	H	1.4	090	28.4		43.5	-15.1
173.2	H	1.4	090	33.2		43.5	-10.3
384	H	1.0	090	27.4		46.5	-19.1
498	H	1.0	225	26.6		46.5	-19.9
896	H	1.0	045	31.1		46.5	-15.4

(1) Receiving mode spurious emissions shall be lower than the limit defined in FCC Part 15 Sec. 15.209 and IC RSS-Gen.
(2) If each peak reading is less than the FCC/IC average limit, it'll be not necessary to show the measured/ calculated average reading.