EMC TEST REPORT – 368918-1TRFEMC

Applicant:

Deere & Company

Product name:

RTK Radio 450

Model:

SR54

Specifications:

- FCC 47 CFR Part 15, Subpart B – Verification

Date of issue: May 10, 2019

Test engineer(s):	Kevin Rose, Wireless/EMC Specialist	Signature:	
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist	Signature:	Andrey Adelberg

Lab and test locations

Company name	Nemko Canada Inc.			
Facilities	Ottawa site: 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	Montréal site: 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	**Cambridge site:** **1-130 Saltsman Drive** **Cambridge, Ontario** **Canada** **N3E 0B2** **Tel: +1 519 650 4811**	Almonte site: 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117 Fax: +1 613 256-8848

Test site registration	**Organization**	**Recognition numbers and location**
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Toronto)
Website	www.nemko.com	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart B – Verification	Title 47: Telecommunication; Part 15—Radio Frequency Devices

1.2 Exclusions

None

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.2 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Test report revision history

Table 1.4-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
TRF	May 10, 2019	Original report issued

Section 2 Summary of test results

2.1 Testing period

Test start date	March 4, 2019
Test end date	March 19, 2019

2.2 North America test results

Table 2.2-1: *FCC 47 CFR Part 15, Subpart B results*

Clause	Test description	Verdict
§15.109	Radiated emissions limits[1]	Pass
§15.107	Conducted emissions limits (AC mains) [1]	Not applicable [2]

Notes: [1] Product classification B
[2] The EUT is DC powered

Section 3 Equipment under test (EUT) details

3.1 Applicant

Company name	Deere & Company
Address	One John Deere Place, Moline, IL 61265 USA

3.2 Manufacturer

Company name	Deere & Company
Address	One John Deere Place, Moline, IL 61265 USA

3.3 Sample information

Receipt date	March 4, 2019
Nemko sample ID number	Item # 1

3.4 EUT information

Product name	RTK 450 Radio
Model	SR54
Serial number	PCSR54C590601
Part number	PFA10097
Power requirements	12–14 V_{DC}
Description/theory of operation	RF: 440–450 MHz, 19.2 kbps over the Air Data Rate, Licensed Band Wireless Data Transceiver, Board level, 6-27 volts, RS232 / RS485, Straight MCX connector.
Operational frequencies	26 MHz clock / Oscillator – Y2 Crystal 32.768 kHz – Y3 Operational RF frequency of device is within 440–450 MHz band.
Software details	Deere Version 2.65c

3.5 EUT setup details

EUT description of the methods used to exercise the EUT and all relevant ports:

- Method used is hyperterminal to send transmit parameters to EUT and verify connection during test.

EUT setup/configuration rationale:

- The EUT setup in a configuration that was expected to produce the highest amplitude emissions relative to the limit and that satisfy normal operation/installation practice by the end user.
- The type and construction of cables used in the measurement set-up were consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) have been noted below:
  - The following deviations were:
  - None
- The EUT was setup in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local AE and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
  - The following deviations were:
  - None

EUT monitoring method:

- Method used is hyperterminal to send transmit parameters to EUT and verify connection during test.

3.5 EUT setup details, continued

Table 3.5-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
RTK 450 Radio	John Deere	MN: XXXX, PN: PFA10095, SN: PCSR54B561903
Whip Antenna	John Deere	PN: PFP10612

Table 3.5-2: *EUT interface ports*

Description	Qty.
DC Power / Communication Bus	1
Antenna	1

Table 3.5-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop Computer	Dell	latitude
RTK 450 Radio	John Deere	MN: SR54, PN: PFA10097, SN: PCSR54C590609
Whip Antenna	John Deere	PN: PFP10612
USB to Serial Adapter	-	-

Table 3.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
DC Power / Communication Cable	DC Power / Communication Bus	USB to Serial Adapter	5

3.5 EUT setup details, continued

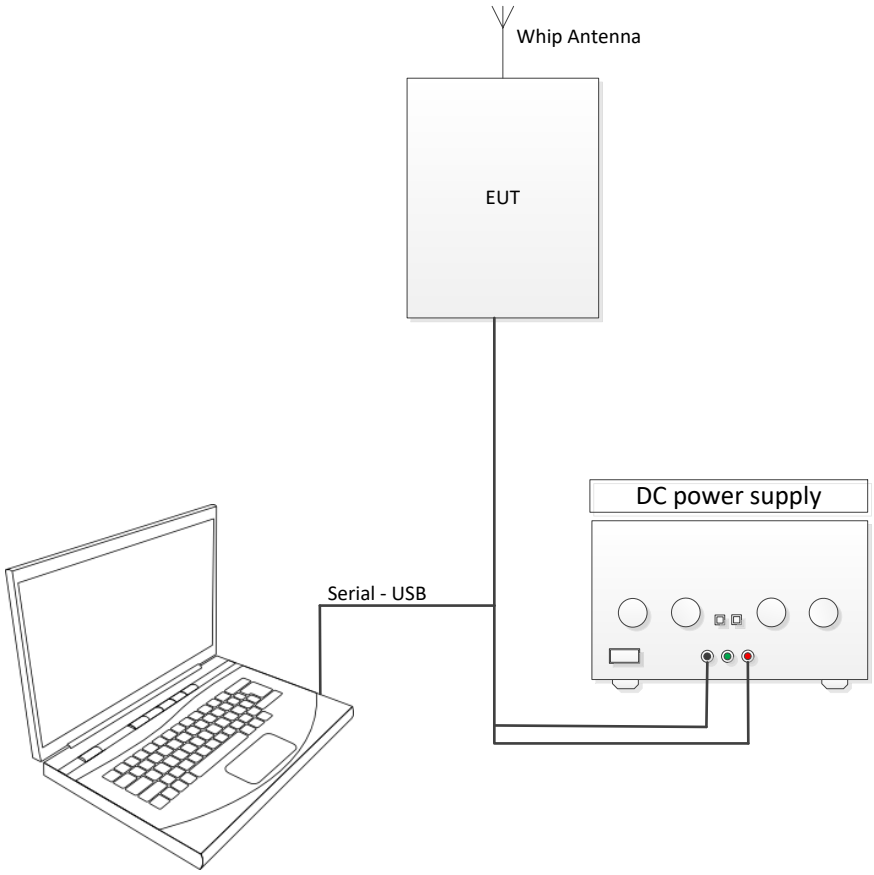


Figure 3.5-1: *block diagram*

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7 Terms and definitions

7.1 Product classifications definitions

7.1.1 Title 47: Telecommunication – Part 15-Radio Frequency devices, Subpart A – General – Equipment classification

Class A digital device	A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.
Class B digital device	A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public. Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

7.1.2 Title 47: Telecommunication – Part 15-Radio Frequency devices, Subpart A – General – Digital device definitions

Digital device (Previously defined as a computing device)	An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. A radio frequency device that is specifically subject to an emanation requirement in any other FCC Rule part or an intentional radiator subject to subpart C of this part that contains a digital device is not subject to the standards for digital devices, provided the digital device is used only to enable operation of the radio frequency device and the digital device does not control additional functions or capabilities. Note: Computer terminals and peripherals that are intended to be connected to a computer are digital devices.

Section 8 Testing data

8.1 Radiated emissions

8.1.1 References and limits

– FCC 47 CFR Part 15, Subpart B: Clause §15.109 (Test method ANSI C63.4:2014)

8.1.1 References and limits

Table 8.1-1: *Requirements as per FCC Part 15 Subpart B for radiated emissions at the frequencies up to 1 GHz at OATS/SAC from class B equipment*

Frequency range [MHz]	Measurement		Class B limits
	Distance [m]	Detector type/ bandwidth	[dBµV/m]
30–88	10	Quasi Peak/120 kHz	29.6
88–216			33.1
216–960			35.6
960–1000			43.6
30–88	3	Quasi Peak/120 kHz	40.0
88–216			43.5
216–960			46.0
960–1000			54.0

Notes:
– OATS – Open Area Test Site, SAC – Semi Anechoic Chamber
– Where there is a step in the relevant limit, the lower value was applied at the transition frequency.

Table 8.1-2: *Requirements as per FCC Part 15 Subpart B for radiated emissions at the frequencies above 1 GHz at FSOATS from class B equipment*

Frequency range[1] [MHz]	Measurement		Class B limits
	Distance [m]	Detector type/ bandwidth	[dBµV/m]
>1000	10	Linear average/1 MHz	43.6
		Peak/1 MHz	63.6
>1000	3	Linear average/1 MHz	54.0
		Peak/1 MHz	74.0

Notes:
– FSOATS – Free Space Open Area Test Site.
– Where there is a step in the relevant limit, the lower value was applied at the transition frequency.

[1]Upper Frequency of Radiated Measurement is 5th harmonic of the highest frequency or 40 GHz, whichever is lower.

8.1.2 Test summary

Verdict	Pass		
Test date	March 14, 2019	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	975 mbar
Test location	Cambridge	Relative humidity	34 %

8.1.3 Notes

- Where tabular data has not been provided no emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- Where less than 6 measurements per detector has been provided, fewer than 6 emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- The highest operating frequency of the EUT as provided by the client was 26 MHz. The spectrum was scanned to 1 GHz according to the EUT highest operating frequency.

Table 8.1-3: *Frequency range for FCC Part 15 Subpart B*

Highest internal frequency [F_X]	Highest measured frequency
$F_X \leq 108$ MHz	1 GHz
108 MHz < $F_X \leq 500$ MHz	2 GHz
500 MHz < $F_X \leq 1$ GHz	5 GHz
$F_X > 1$ GHz	5 × F_X up to a maximum of 40 GHz

Notes: Highest internal frequency [F_X] – highest fundamental frequency generated or used within the EUT or highest frequency at which it operates. This includes frequencies which are solely used within an integrated circuit.
For FM and TV broadcast receivers F_X is determined from the highest frequency generated or used excluding the local oscillator and tuned frequencies.

8.1.4 Setup details

Port under test	Enclosure Port
EUT power input during test	12 V_{DC}
EUT setup configuration	Table top
Test facility	Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1–4 m
Turn table position	0–360°
Measurement details	A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/spectrum analyzer settings for frequencies below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (Preview measurement), Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	100 ms (Peak preview measurement), 100 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (Preview measurement) Peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	100 ms (Peak preview measurement), 100 ms (Peak and CAverage final measurement)

Table 8.1-4: *Radiated emissions equipment list*

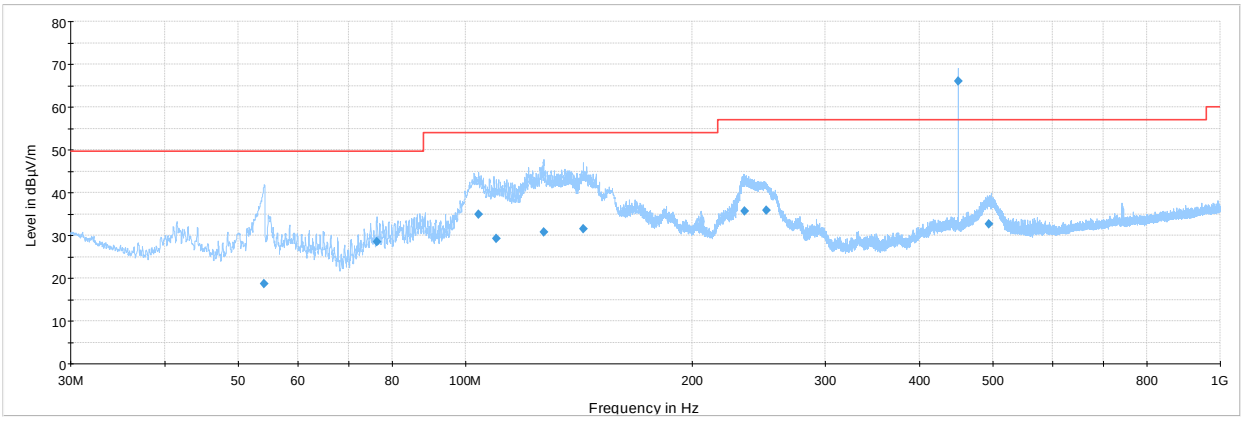
Equipment	Manufacturer	Model no.	Serial no.	Asset no.	Cal./Ver. cycle	Next cal./ver.
3 m EMI test chamber	TDK	SAC-3		FA003012	1 year	Aug. 22/19
Flush mount turntable	SUNAR	FM2022		FA003006	—	NCR
Controller	SUNAR	SC110V	050118-1	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	042418-5	FA003007	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	101367	FA002969	1 year	June 1/19
50 Ω coax cable	Huber + Suhner	None	457630	FA003047	1 year	Nov 12/19
50 Ω coax cable	Huber + Suhner	None	457624	FA003044	1 year	Nov 12/19
30 V_{DC} Power source	GwInstek	3060D	EH922508	—	—	NCR

Notes: NCR - no calibration required

Table 8.1-5: *Radiated emissions test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.40.10

8.1.5 Test data



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.

Figure 8.1-1: *Radiated emissions spectral plot (30 to 1000 MHz)*

Table 8.1-6: *Radiated emissions (Quasi-Peak) results*

Frequency (MHz)	Quasi-Peak field strength[1 and 4] (dBµV/m)	3 m Quasi-Peak limit [3] (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
54.180	18.75	49.6	30.85	100	120	119.00	V	300	8.6
76.320	28.53	49.6	21.07	100	120	108.00	V	86	9.0
104.130	34.87	54.0	19.13	100	120	110.00	V	0	12.6
109.920	29.18	54.0	24.82	100	120	100.00	V	68	13.9
127.020	30.78	54.0	23.22	100	120	115.00	V	104	15.3
143.340	31.54	54.0	22.46	100	120	100.00	V	280	14.4
234.150	35.74	56.9	21.16	100	120	155.00	H	10	13.4
250.260	35.80	56.9	21.10	100	120	183.00	V	294	13.8
494.190	32.73	56.9	24.17	100	120	189.00	H	0	20.2

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions have been recorded.

Sample calculation: 18.75 dBµV/m (field strength) = 10.15 dBµV (receiver reading) + 8.6 dB (Correction factor)

8.1.6 Setup photos

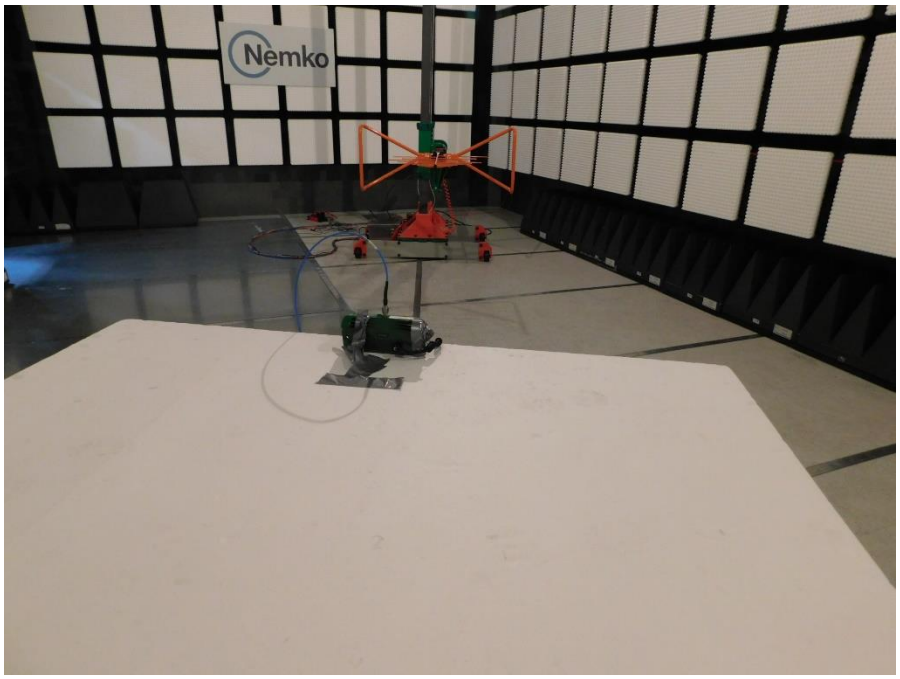


Figure 8.1-2: *Radiated emissions setup photo – below 1 GHz*

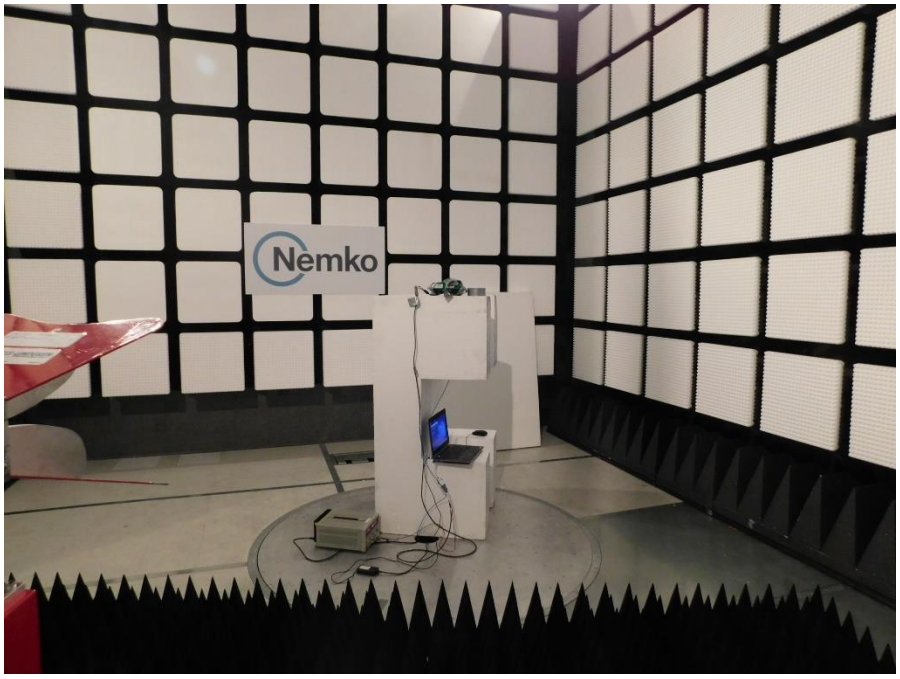


Figure 8.1-3: *Radiated emissions setup photo – above 1 GHz*

Section 9 EUT photos

9.1 External photos

Figure 9.1-1: *Front view photo*

Figure 9.1-2: *Rear view photo*

Figure 9.1-3: *Side view photo*

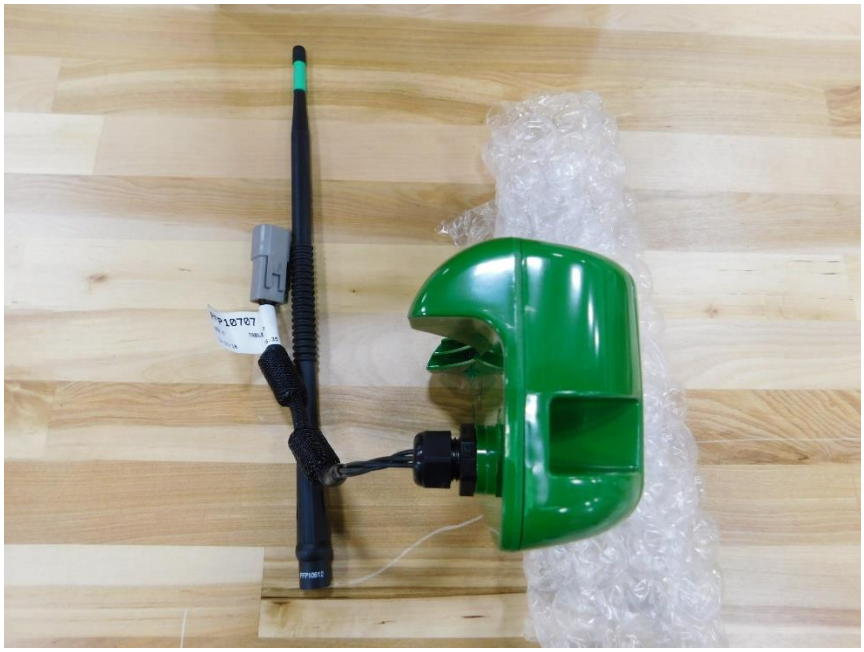


Figure 9.1-4: *Side view photo*

Figure 9.1-5: *Top view photo*

Figure 9.1-6: *Bottom view photo*