Israel Testing Laboratories

ACCREDITED

Cert. No. 1152.01
Electrical (EMC)

DATE: 02 September 2008

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Roseman Engineering Ltd.

Equipment under test:

Wireless Nozzle Reader

WNR 2.4 GHz

Written by: _____
D. Shidlowsky, Documentation

Approved by: _____
A. Sharabi, Test Engineer

Approved by: _____
I. Raz, EMC Laboratory Manager

Cert. No. 1152.01
Electrical (EMC)

Measurement/Technical Report for

Roseman Engineering Ltd.

Wireless Nozzle Reader

WNR 2.4 GHz

FCC ID: JAKWNR24

02 September 2008

This report concerns: Original Grant: X
Class I Change:
Class II Change

Equipment type: Frequency Hopping Spread Spectrum Transmitter
Limits used:
47CFR15 Section 15.247

Measurement procedure used is ANSI C63.4-2003.

Application for Certification
prepared by:
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Applicant for this device:
(different from "prepared by")
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1. General Information

1.1 Administrative Information

Manufacturer:	Roseman Engineering Ltd.
Manufacturer's Address:	65 Weizman St. Givataim 53468 Israel Tel: +972-3-573-1801 Fax: +972-3-573-1807
Manufacturer's Representative:	Lior Yehoshua Ziv Bakal
Equipment Under Test (E.U.T):	Wireless Nozzle Reader
Equipment Model No.:	WNR 2.4 GHz
Equipment Serial No.:	Not Designated
Date of Receipt of E.U.T:	14.04.08
Start of Test:	14.04.08
End of Test:	26.06.08
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	See Section 2

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), File No. IC 4025.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 Product Description

Wireless Nozzle Reader

The wireless nozzle reader is an active stand-alone device mounted on the nozzle.

The Nozzle reader can read all the vehicle identification devices including the SVID.

When a nozzle is inserted into a vehicle fuelling tank it reads the vehicle identification device data and transmits an RF on signal to the WAF unit to start the fueling process and at the end of the fueling it transmits an RF off signal to stop the fueling.

The nozzle reader is based upon our proven electromagnetic identification technology. This technology provides reliable and robust communication that has been proven for several years without any interference with ancillary devices and is complete with an internal battery that lasts in excess of five years.

Advantages

- High immunity and reliability
- Low current consumption
- Long life inner self power supply battery
- Easy to mount and to replace
- No wires connections or any installation required

Specifications

- Dimensions: 80 x 65 x 50 mm
- Weight: 180 g
- Operation Temperature: -5^0F to $+130^0$F
- Power supply: Internal Battery
- Battery Life: 3 years (assuming
- 100 minutes of activity per day)

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4: 2003. Testing was also performed according to DA 00-705 March 30, 2000 concerning frequency hopping spread spectrum systems. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing August 22, 2006).
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 Measurement Uncertainty

Radiated Emission

The Open Site complies with the ±4 dB Normalized Site Attenuation requirements of ANSI C63.4-2003. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

2. System Test Configuration

2.1 Justification

Several changes were made in order to prepare the EUT for the tests.

4 different modes of operation were created so that the unit could be tested.

To switch between the modes of operation we placed a 16 position switch.

MODE 1 :transmission of low frequency

MODE 2 :transmission of mid frequency

MODE 3 :transmission of high frequency

MODE 4 :transmission of all 16 hopping channels

The E.U.T. was orientated simulating its position on a nozzle.

2.2 EUT Exercise Software

In order to measure the transmitted channels we changed The software duty cycle of transmission to 25 percent during modes one to three, and 50 percent during mode four.

Frequency Hopping Parameters

The maximum occupancy time on any frequency is 3 X 5 ms = 15 ms within a 5 second period. This is under the limit of section 15.247(a)1 (0.4 sec of 30 sec). The FH carrier hops on a predetermined, pseudo random pattern (see table below). All channels are used equally, Each transmission frame is transmitted at different frequency (1 out of 16).

2.3 Special Accessories

No special accessories were needed to achieve compliance.

2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

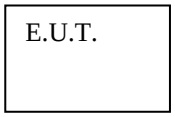


Figure 1. Configuration of Tested System

3. Theory of Operation

3.1 Theory of Operation

The device is a complete RF transmitter, it has its own reference oscillator and permanently attached antenna. The device has internal power supply battery of 3.6VDC.

When fueling process begins the WNR start the transmission from a random channel between 1 that indicates transmission frequency low of 2.401 GHz to channel 16 that indicates transmission frequency high of 2.478 GHz.

Channel transmission last for 5 ms and another 5ms wait for answer which gives a total of 10 ms. Multiply by 16 channels equals 160ms (if no answer from RFU occur).

This transmission happens for 3 retries equals 480 ms maximum of transmission.

If no answer yet the WNR wait for 5 sec and check again if the vehicle is in the area to start transmission again.

If answer occurs the next transmission will be in 12 sec or until end of the fueling transmission.

The opposite side is the RFU, who changes every 2 sec its receiver channel/frequency in order to avoid noisy or bad channel.

Current consumption at standby mode (standby mode) is 2-3 uA AVG.

Current consumption at work mode (vehicle is in the station) is 12-15 uA AVG.

4. Spurious Radiated Emission in the Restricted Band Below 1 GHz

4.1 Test Specification

9kHz-1000 MHz, F.C.C., Part 15, Subpart C

4.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The frequency range 9 kHz-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30 MHz, the loop antenna was rotated on its vertical axis, The antenna height (center of loop) was 1 meter.

In the frequency range 30-1000 MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods:

Turning the E.U.T on and off.
Using a frequency span less than 10 MHz.
Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

The E.U.T. was tested at the operating frequencies of 2401, 2442, and 2478 MHz.

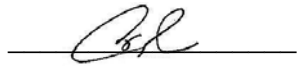
4.3 Test Data

JUDGEMENT: Passed

In the frequency band 9.0 kHz – 1.0 GHz no signals were found.
The results for all three operating frequencies and modulations were the same.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

TEST PERSONNEL:

Tester Signature:  Date: 03.09.08

Typed/Printed Name: A. Sharabi

4.4 Test Equipment Used, Radiated Measurements Below 1 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	November 12, 2007	1 year
RF Section	HP	85420E	3705A00248	November 12, 2007	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	March 23, 2008	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 22, 2007	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 15, 2007	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

5. Spurious Radiated Emission in the Restricted Band, Above 1 GHz

5.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.
In the frequency range 1-2.9 GHz, a computerized EMI receiver complying to CISPR 16 requirements was used.
In the frequency range 2.9-25.0 GHz, a spectrum analyzer including a low noise amplifier was used.

During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 10 Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.
The test distance was 3 meters.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)
The E.U.T. was tested at the operating frequencies of 2401, 2442, and 2478 MHz.

5.2 Test Data

JUDGEMENT: Passed by 13.8 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C.

for 2402.00 MHz, 30.2 dB margin at 4801.97.00 MHz frequency, vertical polarization.

for 2442.00 MHz, 25.7 dB margin at 4883.75 MHz frequency, vertical polarization.

for 2478.00 MHz, 13.8 dB margin at 4956.42 MHz frequency, vertical polarization.

TEST PERSONNEL:

Tester Signature: _____ Date: 03.09.08

Typed/Printed Name: A. Sharabi

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak
Operation Frequency: 2402 MHz

Freq.	Polarity	Peak Amp	Peak. Specification	Peak. Margin
(MHz)	(H/V)	(dBµV/m)	(dB µV/m)	(dB)
4801.97	H	41.8*	74.0	-32.2
4801.97	V	42.5*	74.0	-31.5

Figure 2. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Peak Amp" includes correction factor.

* "Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average
Operation Frequency: 2402 MHz

Freq.	Polarity	Average Amp	Average Specification	Peak. Margin
(MHz)	(H/V)	(dBµV/m)	(dB µV/m)	(dB)
4801.97	H	23.6*	54.0	-30.4
4801.97	V	23.8*	54.0	-30.2

Figure 3. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL Detector: Average

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Average Amp" includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak
Operation Frequency: 2442 MHz

Freq.	Polarity	Peak Amp	Peak. Specification	Peak. Margin
(MHz)	(H/V)	(dBµV/m)	(dB µV/m)	(dB)
4883.75	H	44.0*	74.0	-30.0
4883.75	V	44.8*	74.0	-29.2

Figure 4. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Peak Amp" includes correction factor.

* "Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average
Operation Frequency: 2442 MHz

Freq. (MHz)	Polarity (H/V)	Average Amp (dBµV/m)	Average Specification (dB µV/m)	Peak. Margin (dB)
4883.75	H	28.2*	54.0	-25.8
4883.75	V	28.3*	54.0	-25.7

Figure 5. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Average

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Average Amp" includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak
Operation Frequency: 2478 MHz

Freq. (MHz)	Polarity (H/V)	Peak Amp (dBµV/m)	Peak. Specification (dB µV/m)	Peak. Margin (dB)
4956.42	H	41.7*	74.0	-32.3
4956.42	V	41.5*	74.0	-32.5
2483.5	V	58.9	74.0	-15.1
2483.5	H	54.0	74.0	-20.0

Figure 6. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Peak Amp" includes correction factor.

* "Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average
Operation Frequency: 2478 MHz

Freq. (MHz)	Polarity (H/V)	Average Amp (dBµV/m)	Average Specification (dB µV/m)	Peak. Margin (dB)
4956.42	H	23.5*	54.0	-30.5
4956.42	V	23.6*	54.0	-30.4
2483.5	V	40.2	54.0	-13.8
2483.5	H	41.0	54.0	-14.0

Figure 7. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Average

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

"Average Amp" includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

5.3 Test Equipment Used, Radiated Measurements Above 1 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	85422E	3906A00276	November 12, 2007	1 year
RF Section	HP	85420E	3705A00248	November 12, 2007	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357	N/A	N/A
Antenna-Log Periodic	A.H.System	SAS-200/511	253	February 4, 2007	2 year
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 16, 2008	2 year
Horn Antenna	ARA	SWH-28	1008	December 8, 2006	2 year
Horn Antenna	Narda	V637	0410	December 8, 2006	2 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 2, 2007	1 year
Low Noise Amplifier	Sophia Wireless	LNA-28-B	0232	January 9, 2008	1 year
Spectrum Analyzer	HP	8592L	3926A01204	March 5, 2008	1 year

6. Number of Hopping Frequencies Section 15.247(a)(1)(iii)

6.1 Test Specification

F.C.C., Part 15, Subpart C

6.2 Test Procedure

The E.U.T. was set to hopping mode.
The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable.
The spectrum analyzer was set to the following parameters:

Span: 100MHz
Band of Operation: 2402-2481 MHz
RBW: 2MHz
VBW: 3MHz
Detector Function: Peak
Trace: Maximum Hold

The number of hopping frequencies is 16 (See plot below).

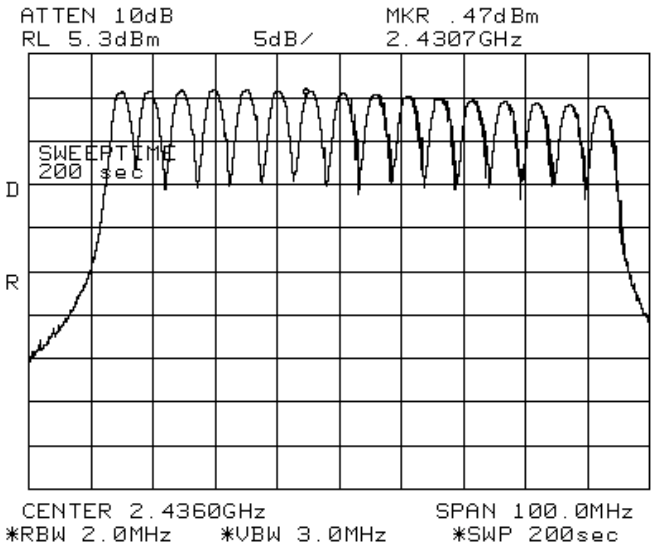


Figure 8.No. of Hops = 16

Number of Hopping Frequencies

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

6.3 Results table

E.U.T. Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: FCC Part 15, Subpart C, 15.247(a)(1)(iii)

Number of Hopping Frequencies	Specification
16	>15

Figure 9 Number of Hopping Frequencies

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

6.4 Test Instrumentation Used.

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

7. Dwell Time on Each Channel Section 15.247(a)(1)(iii)

7.1 Test procedure

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

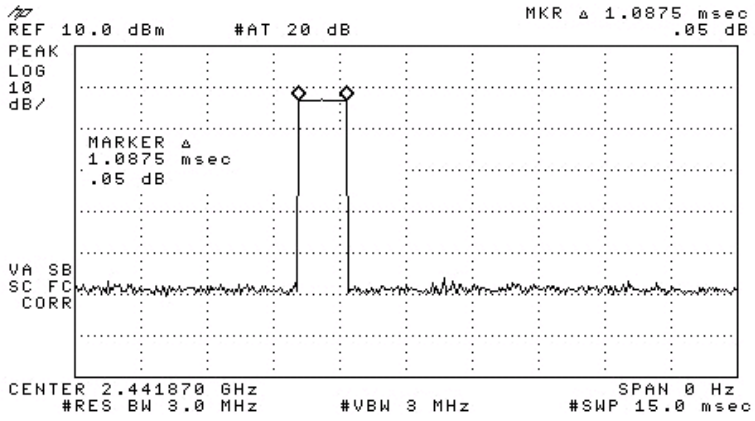


Figure 10. Emission Width 1.085 msec.

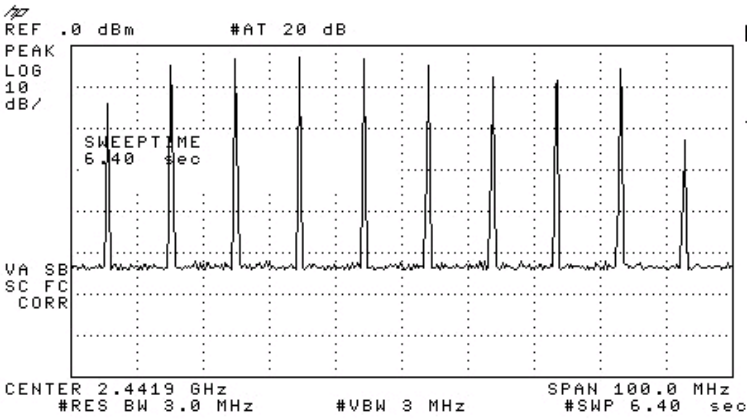


Figure 11. No. of Hops in 6.4 seconds,
average time of occupancy = 10x1.0875 = 0.010875 < 0.4 Sec, total number of hops 10

Dwell Time On Each Channel

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

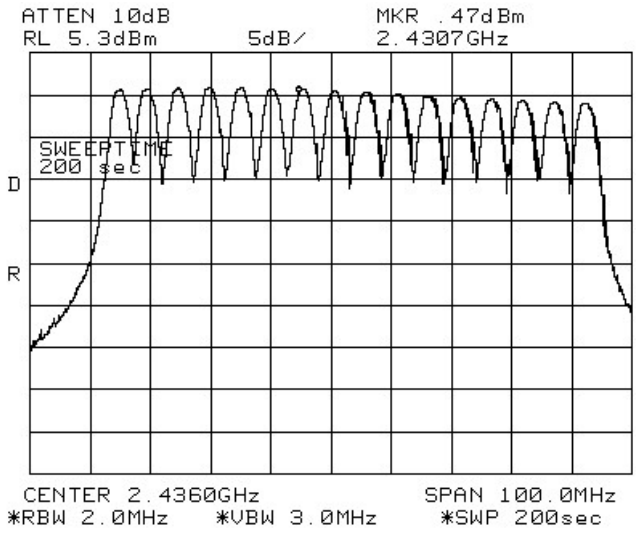


Figure 12. 16 hops X 0.4 sec = 6.4 sec.

7.2 Results table

E.U.T. Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: FCC Part 15, Subpart C, 15.247(a)(1)(iii)

JUDGEMENT: Passed

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

7.3 Test Instrumentation Used.

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8592L	3826A01204	March 5, 2008	1 year
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

8. Channel Frequency Separation

8.1 Test procedure

The E.U.T. was set to hopping mode.
The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable.
The spectrum analyzer was set to the following parameters:

Span: 2 MHz
RBW: 10kHz
VBW: 10kHz
Detector Function: Peak
Trace: Maximum Hold

The marker delta function to determine the separation between the peaks of the adjacent channels was used.

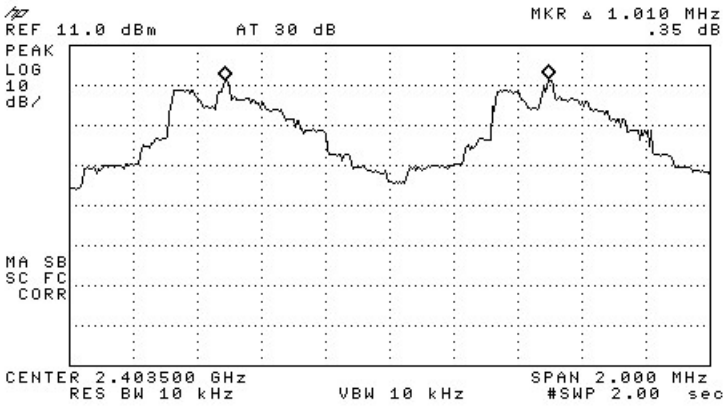


Figure 13. 2441.0-2443.0 MHz.

Channel Frequency Separation

8.2 Results table

E.U.T. Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: FCC Part 15, Subpart C (15.247(a) (1)

Channel Frequency Separation (kHz)	Specification (kHz)	Margin (kHz)
1010.0	>757*	253

Figure 14 Channel Frequency Separation

*NOTE: Limit according to the 20dB bandwidth
JUDGEMENT: Passed by 253 kHz

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

8.3 Test Equipment Used

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8592L	3826A01204	March 5, 2008	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

9. Maximum Transmitted Peak Power Output

9.1 Test procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (10 dB) appropriate RF cable= 1 dB. Special attention was taken to prevent Spectrum Analyzer RF input overload. The Spectrum Analyzer was set to 1.0 MHz RBW. Peak power level was measured at selected operation frequencies.

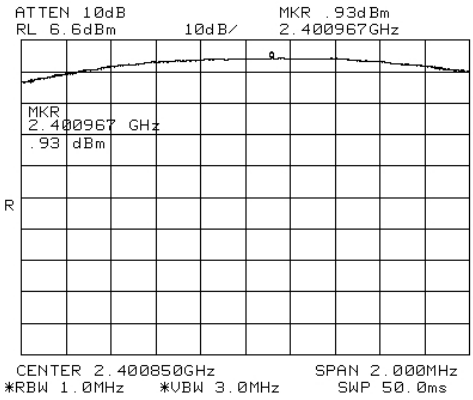


Figure 15 2401 MHz

Maximum Transmitted Peak Power Output

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

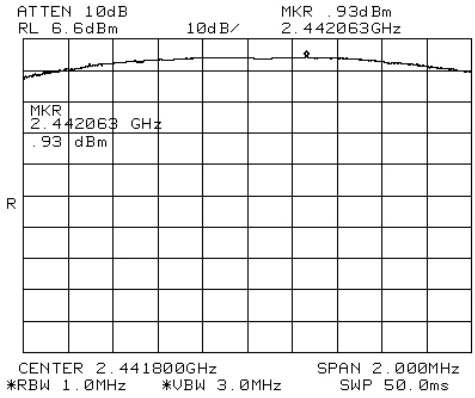


Figure 16 2442 MHz

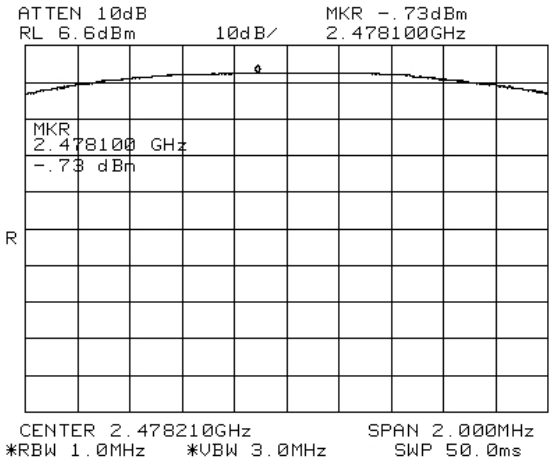


Figure 17 2478 MHz

Maximum Transmitted Peak Power Output

9.2 Results table

E.U.T. Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: F.C.C. Part 15, Subpart C

Operation Frequency (MHz)	Peak Power Output (dBm)	Specification (dBm)	Margin (dB)
2401.0	0.9	20.96	-20.06
2442.0	0.9	20.96	-20.06
2478.0	-0.7	20.96	20.21

Figure 18 Maximum Transmitted Peak Power Output

Note: Antenna Gain is 0 dBi

JUDGEMENT: Passed by 20.06 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

9.3 Test Equipment Used.

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

10. Peak Power Output Out of 2400-2483.5 MHz Band

10.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (10 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 1 kHz RBW for the frequency range 9 kHz to 500 kHz, and 100 kHz RBW for the frequency range 500 kHz to 25.0 GHz. The frequency range from 9 kHz to 25.0 GHz was scanned. The level of spectrum components out of the 2400-2481 MHz was measured at the selected operation frequencies.

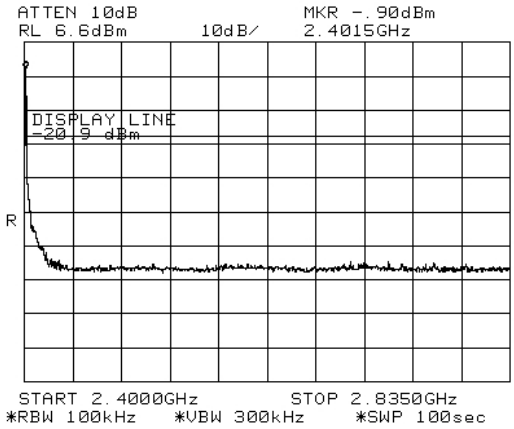


Figure 19 — 2401 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

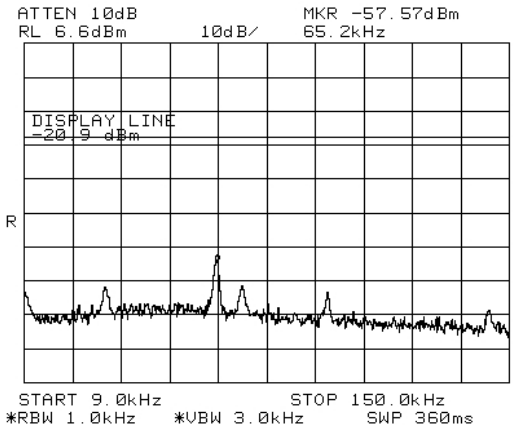


Figure 20 — 2401 MHz

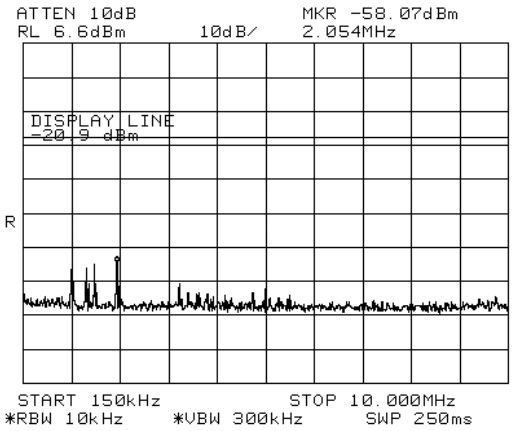


Figure 21 — 2401 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

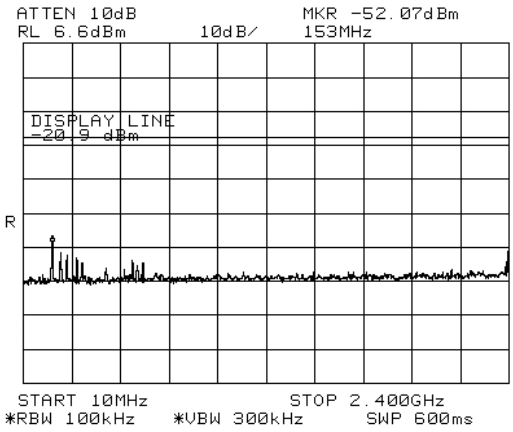


Figure 22 — 2401 MHz

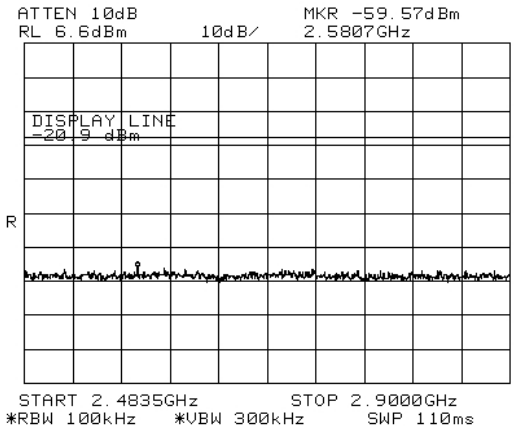


Figure 23 — 2401 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

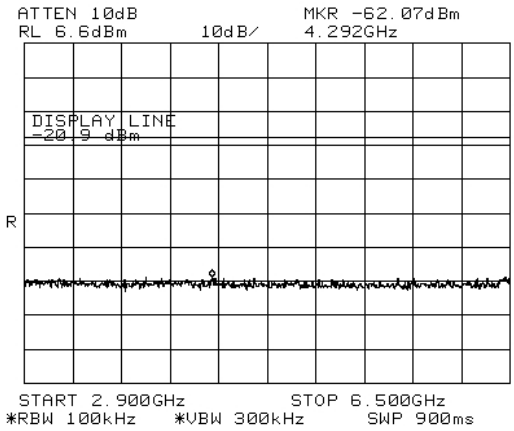


Figure 24 — 2401 MHz

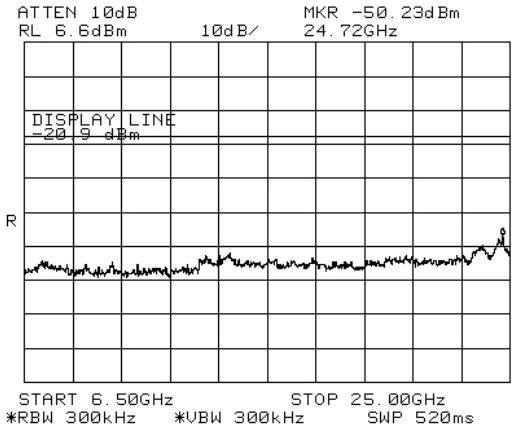


Figure 25 — 2401 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

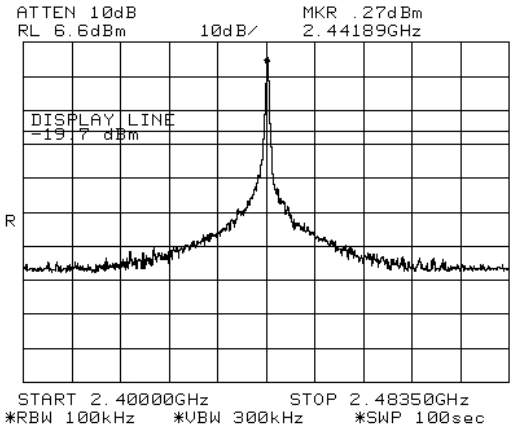


Figure 26 — 2442 MHz

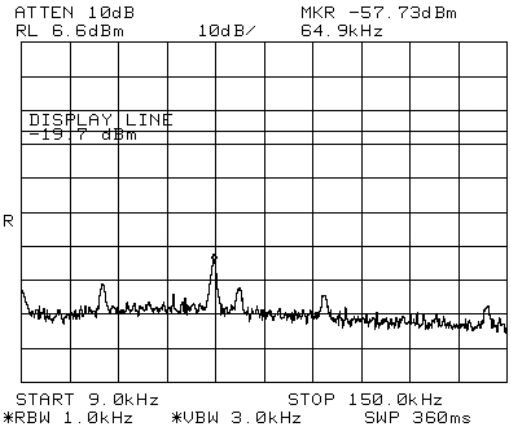


Figure 27 — 2442 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

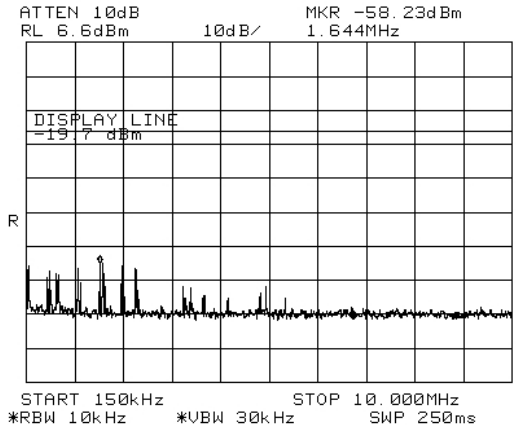


Figure 28 — 2442 MHz

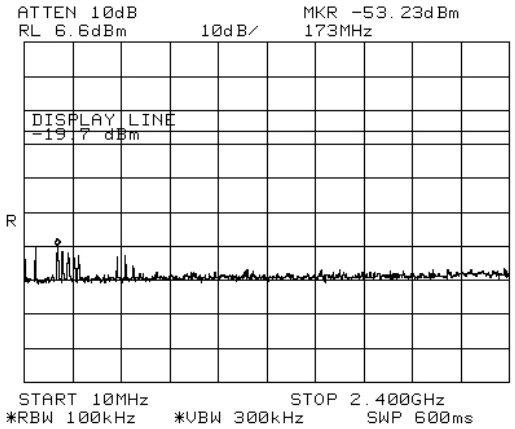


Figure 29 — 2442 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

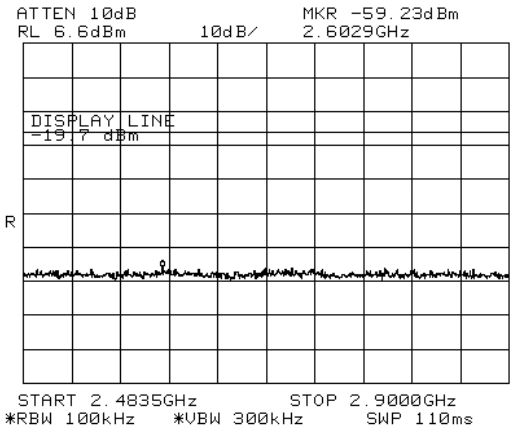


Figure 30 — 2442 MHz

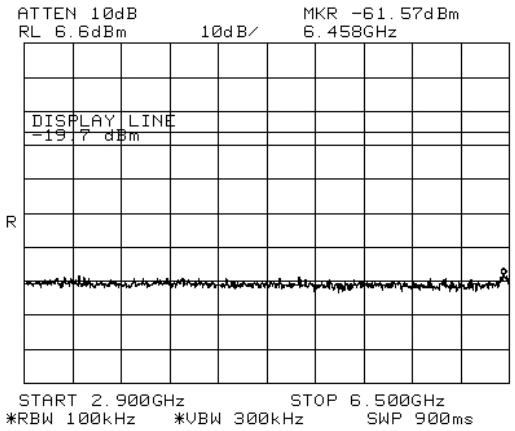


Figure 31 — 2442 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

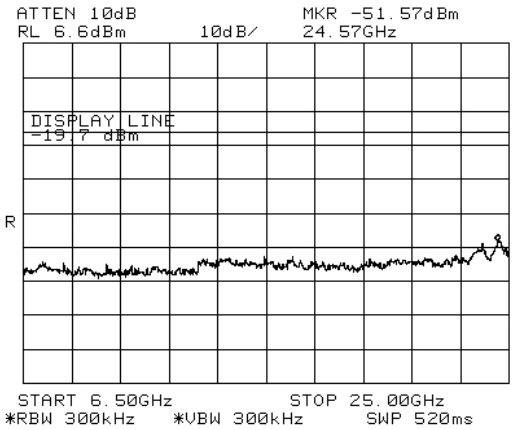


Figure 32 — 2442 MHz

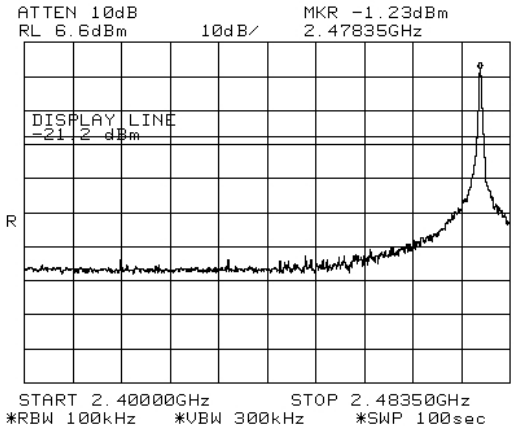


Figure 33 — 2478 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

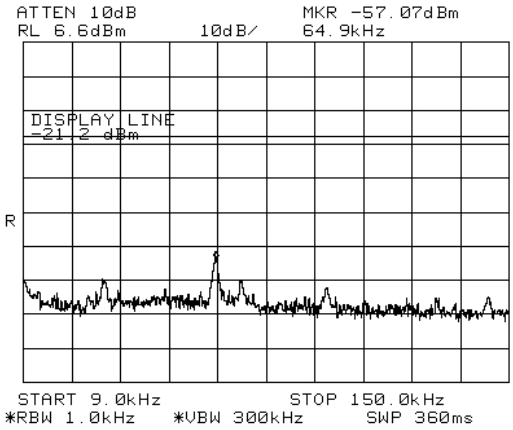


Figure 34 — 2478 MHz

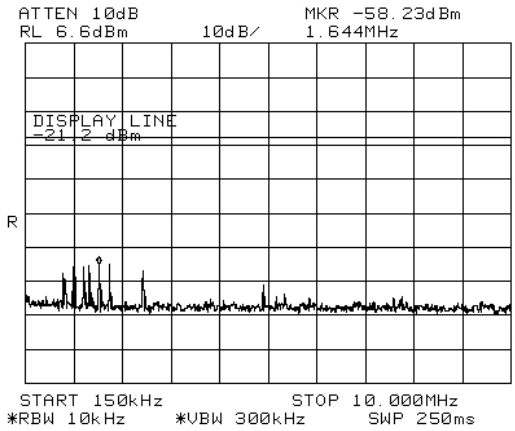


Figure 35 — 2478 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

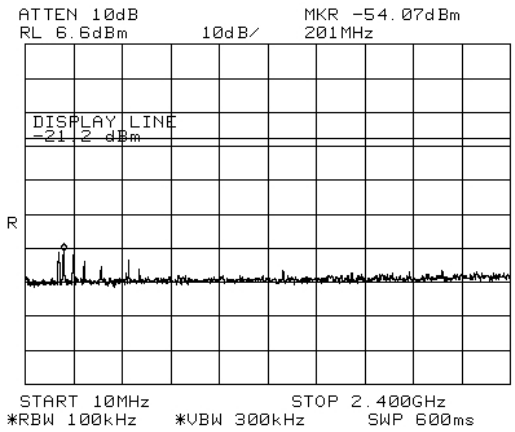


Figure 36 — 2478 MHz

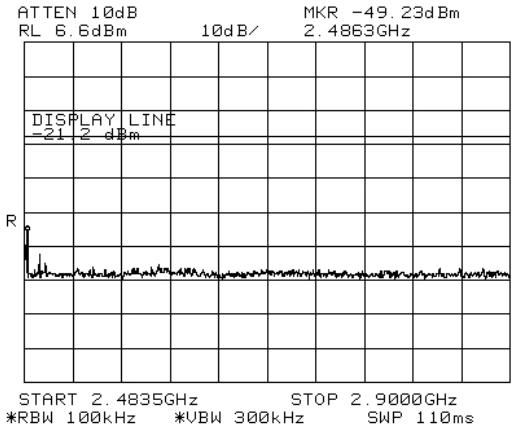


Figure 37 — 2478 MHz

Peak Power Output Out of Band

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

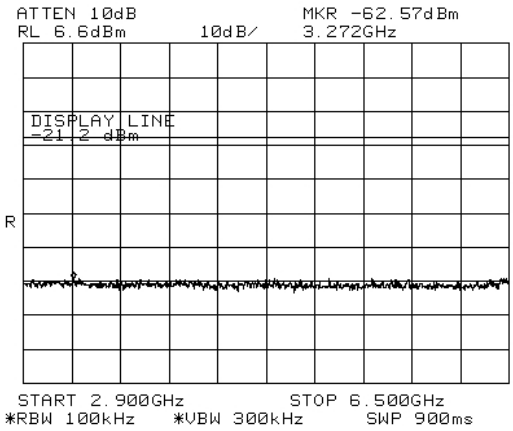


Figure 38 — 2478 MHz

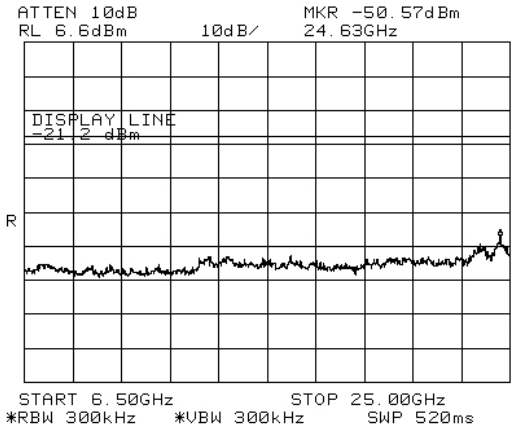


Figure 39 — 2478 MHz

Peak Power Output Out of Band

10.2 Results table

E.U.T Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Reading (dBc)	Specification (dBc)	Margin (dB)
2401.0	-50.23	20.0	-29.33
2442.0	-51.57	20.0	-31.87
2478.0	-49.23	20.0	-28.03

Figure 40 Peak Power Output of 2400.0-2483.5 MHz Band

JUDGEMENT: Passed by 28.03 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

10.3 Test Equipment Used

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

11. 20 dB Bandwidth

11.1 Test procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate RF cable (cable loss 1 dB). The spectrum analyzer was set to 30 kHz resolution BW. The spectrum bandwidth of the E.U.T. at the point of 20 dB below maximum peak power was measured and recorded.

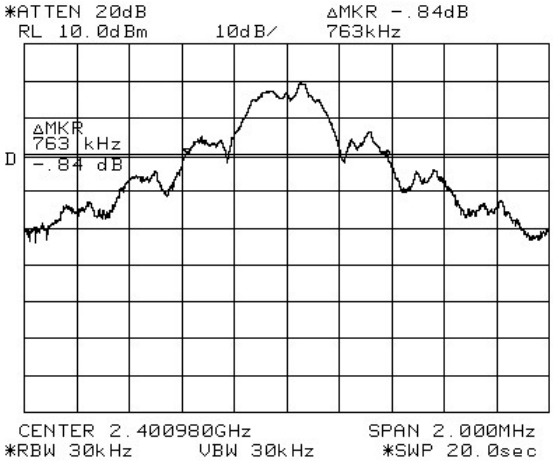


Figure 41 — 2401.0 MHz

20 dB Bandwidth

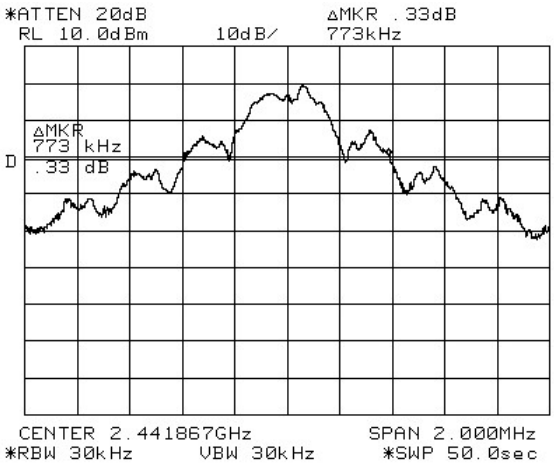


Figure 42 — 2442.0 MHz

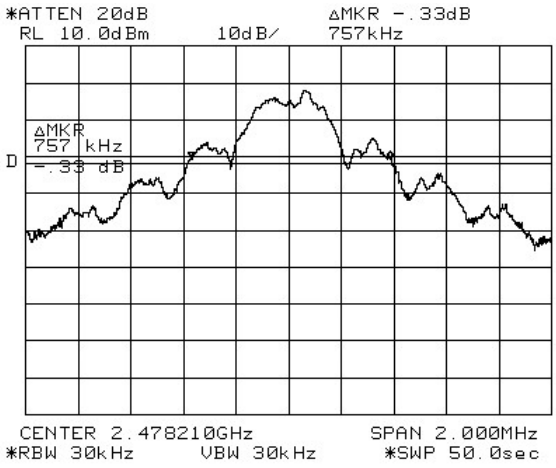


Figure 43 — 2478.0 MHz

20 dB Bandwidth

11.2 Results table

E.U.T Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: FCC Part 15, Subpart C (15.247-a2)

Operation Frequency (MHz)	Reading (kHz)
2401.0	763
2442.0	773
2478.0	757

Figure 44 20 dB Bandwidth

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

11.3 Test Equipment Used.

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

12. Band Edge Spectrum

[In Accordance with section 15.247(c)]

12.1 Test procedure

Enclosed are spectrum analyzer plots for the lowest operation frequency (2401.0 MHz) and the highest operation frequency (2478.0 MHz) in which the E.U.T. is planned to be used.

The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable. The spectrum analyzer was set to 100 kHz resolution BW. Maximum power level below 2402 MHz and above 2481 MHz was measured relative to power level at 2402 MHz and 2481 MHz correspondingly.

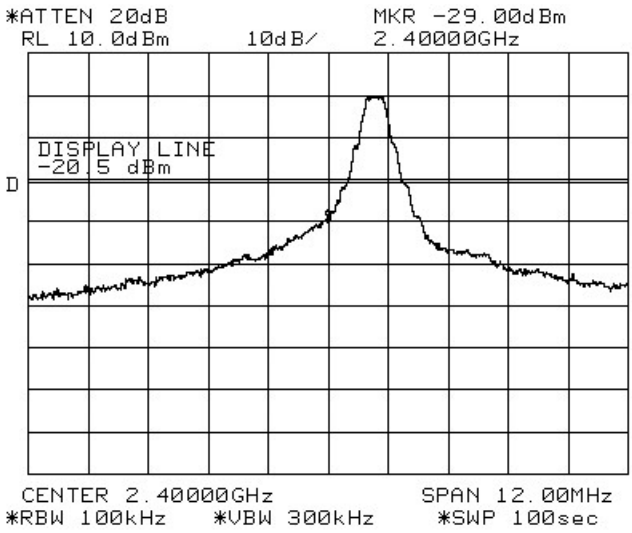


Figure 45 — F_{low}

Band Edge Spectrum

E.U.T Description	Wireless Nozzle Reader
Type	WNR 2.4 GHz
Serial Number:	Not Designated

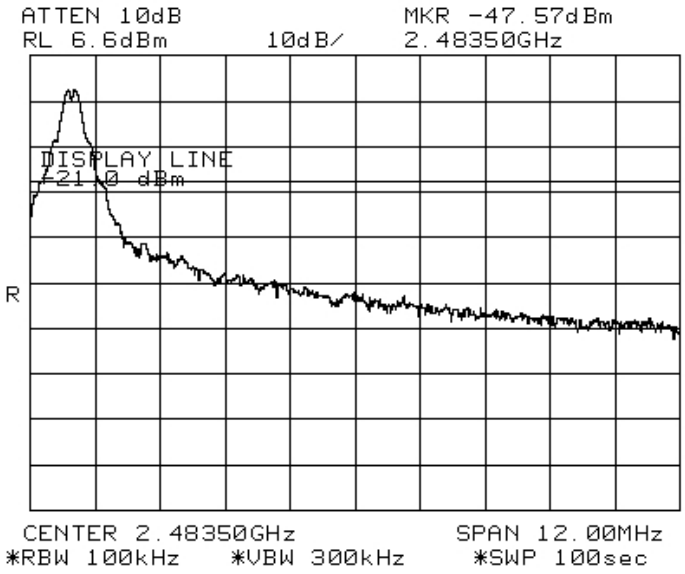


Figure 46 — F_{high}

12.2 Results table

E.U.T Description: Wireless Nozzle Reader
Model No.: WNR 2.4 GHz
Serial Number: Not Designated
Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBm)	Specification (dBc)	Margin (dB)
2401.0	2400.00	-29.0	20	-8.5
2478.0	2483.50	-47.57	20	-26.6

Figure 47 Band Edge Spectrum

JUDGEMENT: Passed by 8.5 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 03.09.08
Typed/Printed Name: A. Sharabi

12.3 Test Equipment Used.

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 48 Test Equipment Used

13. R.F Exposure/Safety Calculation

The typical placement of the E.U.T. is on a fuel pump nozzle. The typical distance between the E.U.T. and the user in the worst case application,
is <10 cm.

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1307(b)(1) Requirements

(a) FCC limits at 2442 MHz is: $1\frac{mW}{cm^2}$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

P_t- Transmitted Power 1.23 mW (Peak) = 0.9dBm

G_T- Antenna Gain, 0 dBi

R- Distance from Transmitter using 1cm worst case

(c) The peak power density is:

$$S_p = \frac{1.23}{4\pi(1)^2} = 0.097\frac{mW}{cm^2}$$

(d) The duty cycle of transmission in actual worst case is 8%.

The average power is:

$$P_{AV} = \frac{1.23 \times 1.08}{100} = 0.013mW$$

(e) The averaged power density of the E.U.T. is:

$$S_{AV} = \frac{0.013}{4\pi(1)^2} = 1.05 \times 10^{-3}\frac{mW}{cm^2}$$

.

14. APPENDIX A - CORRECTION FACTORS

14.1 Correction factors for CABLE

from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3
20.0	0.6
30.0	0.8
40.0	0.9
50.0	1.1
60.0	1.2
70.0	1.3
80.0	1.4
90.0	1.6
100.0	1.7
150.0	2.0
200.0	2.3
250.0	2.7
300.0	3.1
350.0	3.4
400.0	3.7
450.0	4.0
500.0	4.3
600.0	4.7
700.0	5.3
800.0	5.9
900.0	6.3
1000.0	6.7

FREQUENCY (MHz)	CORRECTION FACTOR (dB)
1200.0	7.3
1400.0	7.8
1600.0	8.4
1800.0	9.1
2000.0	9.9
2300.0	11.2
2600.0	12.2
2900.0	13.0

NOTES:

1. The cable type is RG-214.

2. The overall length of the cable is 27 meters.

3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".

14.2 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

1. The cable type is RG-8.

2. The overall length of the cable is 10 meters.

14.3 Correction factors for CABLE

from spectrum analyzer to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.

2. The cable is used for measurements above 2.9 GHz.

3. The overall length of the cable is 10 meters.

12.6 Correction factors for LOG PERIODIC ANTENNA

Type LPD 2010/A
at 3 and 10 meter ranges.

Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	12.5
400.0	15.4
500.0	16.1
600.0	19.2
700.0	19.4
800.0	19.9
900.0	21.2
1000.0	23.5

Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.8
400.0	15.3
500.0	15.6
600.0	18.7
700.0	19.1
800.0	20.2
900.0	21.1
1000.0	23.2

NOTES:

1. *Antenna serial number is 1038.*
2. *The above lists are located in file number 38M3O.ANT for a 3 meter range, and file number 38M100.ANT for a 10 meter range.*
3. *The files mentioned above are located on the disk marked "Radiated Emission Test EMI Receiver".*

14.4 Correction factors for LOG PERIODIC ANTENNA

Type SAS-200/511
at 3 meter range.

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
1.0	24.9
1.5	27.8
2.0	29.9
2.5	31.2
3.0	32.8
3.5	33.6
4.0	34.3
4.5	35.2
5.0	36.2
5.5	36.7
6.0	37.2
6.5	38.1

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
7.0	38.6
7.5	39.2
8.0	39.9
8.5	40.4
9.0	40.8
9.5	41.1
10.0	41.7
10.5	42.4
11.0	42.5
11.5	43.1
12.0	43.4
12.5	44.4
13.0	44.6

NOTES:

1. *Antenna serial number is 253.*
2. *The above lists are located in file number SAS3M0.ANT for a 3 meter range.*
3. *The files mentioned above are located on the disk marked "Antenna Factors".*

14.5 Correction factors for BICONICAL ANTENNA

Type BCD-235/B, at 3 meter range

FREQUENCY (MHz)	AFE (dB/m)
20.0	19.4
30.0	14.8
40.0	11.9
50.0	10.2
60.0	9.1
70.0	8.5
80.0	8.9
90.0	9.6
100.0	10.3
110.0	11.0
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13.0
180.0	13.5
190.0	14.0
200.0	14.8
210.0	15.3
220.0	15.8
230.0	16.2
240.0	16.6
250.0	17.6
260.0	18.2
270.0	18.4
280.0	18.7
290.0	19.2
300.0	19.9
310	20.7
320	21.9
330	23.4
340	25.1
350	27.0

NOTES:

1. Antenna serial number is 1041.

2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".

14.6 Correction factors for Double-Ridged Waveguide Horn

Model: 3115, S/N 29845
at 3 meter range.

FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)	FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)
1.0	24.8	5.4	10.0	38.8	11.4
1.5	26.1	7.6	10.5	38.9	11.8
2.0	28.6	7.7	11.0	39.0	12.1
2.5	29.8	8.4	11.5	39.6	11.8
3.0	31.4	8.4	12.0	39.8	12.0
3.5	32.4	8.7	12.5	39.6	12.5
4.0	33.7	8.6	13.0	40.0	12.5
4.5	33.4	9.9	13.5	39.8	13.0
5.0	34.5	9.7	14.0	40.2	13.0
5.5	35.1	9.9	14.5	40.6	12.9
6.0	35.4	10.4	15.0	41.3	12.4
6.5	35.6	10.8	15.5	39.5	14.6
7.0	36.2	10.9	16.0	38.8	15.5
7.5	37.3	10.4	16.5	40.0	14.6
8.0	37.7	10.6	17.0	41.4	13.4
8.5	38.3	10.5	17.5	44.8	10.3
9.0	38.5	10.8	18.0	47.2	8.1
9.5	38.7	11.1			

14.7 Correction factors for Horn Antenna

Model: SWH-28
at 1 meter range.

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4

14.8 Correction factors for Horn Antenna

Model: V637

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
26.0	43.6	14.9
27.0	43.7	15.1
28.0	43.8	15.3
29.0	43.9	15.5
30.0	43.9	15.8
31.0	44.0	16.0
32.0	44.1	16.2
33.0	44.1	16.4
34.0	44.1	16.7
35.0	44.2	16.9
36.0	44.2	17.1
37.0	44.2	17.4
38.0	44.2	17.6
39.0	44.2	17.8
40.0	44.2	18.0

14.9 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2