ISRAEL TESTING LABORATORIES
Global Certifications You Can Trust

ACCREDITED
TESTING Cert No.1152.01

DATE: 20 December 2015

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

FCC Radio Test Report

for

Orpak Systems Ltd.

Equipment under test:

Fuel Pump Nozzle Reader

NNR EXTRA LARGE+SWITCH;
NNR EXTRA LARGE*

*See customer's Declaration on page 6

Tested by: _____
M. Zohar

Approved by: _____
D. Shidlowsky

ISRAEL TESTING LABORATORIES
Global Certifications You Can Trust

ACCREDITED
TESTING Cert No.1152.01

Measurement/Technical Report for
Orpak Systems Ltd.

Fuel Pump Nozzle Reader

NNR EXTRA LARGE+SWITCH;
NNR EXTRA LARGE*

FCC ID: W8F800960060

This report concerns:	Original Grant:	X
	Class I Change:	
	Class II Change:	
Equipment type:	Spread Spectrum/Digital Device 2400-2483.5 MHz and Part 15 Low Power Transmitter Below 1705 kHz	
Limits used:	47CFR15 Section 15.209, 47 CFR15 Section 15.247	

Measurement procedure used KDB 558074 D01 v03r03 and ANSI C63.4:2003.

Application for Certification
prepared by:
R. Pinchuck
ITL (Product Testing) Ltd.
1 Bat Sheva Street
Lod, 7116002
Israel
e-mail Rpinchuck@itl.co.il

Applicant for this device:
(different from "prepared by")
Yair Elul
Orpak Systems Ltd.
31 Lechi St.
P.O.B. 1461
Bnei-Brak, 51114
Israel
Tel: +972- 3 - 577 - 6868
Fax: +972- 3 - 579 - 6310
e-mail: yairelul@orpak.com

TABLE OF CONTENTS

1. General Information

1.1 Administrative Information

Manufacturer:	Orpak Systems Ltd.
Manufacturer's Address:	31 Lechi St. P.O.B. 1461 Bnei-Brak, 51114 Israel Tel: +972-3-577-6868 Fax: +972-3-579-6310
Manufacturer's Representative:	Yair Elul
Equipment Under Test (E.U.T):	Fuel Pump Nozzle Reader
Equipment Model No.:	NNR EXTRA LARGE+SWITCH; NNR EXTRA LARGE*
Equipment Part No.:	Not Designated
Date of Receipt of E.U.T:	17.07.2014
Start of Test:	2.4 GHz transmitter – 17.07.2014 125kHz transmitter - 26.10.2015
End of Test:	2.4 GHz transmitter - 26.08.2014 125 kHz transmitter -26.10.2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. LOD 7116002 ISRAEL and I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 9978000
Test Specifications:	FCC Part 15 Subpart C

*See customer's Declaration on following page.

ORPAK Systems Ltd., 31 Lechi St., P.O.Box 1461 Bnei Brak 51114 Israel
Tel: 972-3-577-6868 • Fax: 972-3-579-6310 • www.orpak.com

Date: 29/10/15

DECLARATION

I HEREBY DECLARE THAT:

1. THE NNR XL IS IDENTICAL TO THE NNR XL + SWITCH EXCEPT FOR A MECHANICAL SWITCH.
2. THE NNR IS IDENTICAL TO THE NNR + SWITCH EXCEPT FOR A MECHANICAL SWITCH.
3. THE NNR LARGE IS IDENTICAL TO THE NNR LARGE + SWITCH EXCEPT FOR A MECHANICAL SWITCH.
4. THE DIFFERENCE BETWEEN THE NNR/NNR + SWITCH AND THE NNR LARGE/NNR LARGE + SWITCH, IS THAT THE NNR LARGE/NNR LARGE + SWITCH HAVE A LARGER HOUSING.
5. THE DIFFERENCE BETWEEN THE NNR LARGE/NNR LARGE + SWITCH AND THE NNR XL/NNR XL+SWITCH IS THAT THE NNR XL/NNR XL + SWITCH HAVE A LARGER HOUSING THAN THE NNR/NNR + SWITCH AND THE NNR LARGE/NNR LARGE + SWITCH.
6. ALL UNITS CONTAIN THE IDENTICAL 2.4 GHZ RADIO TRANSMITTER AND HAVE THE SAME RF CIRCUITRY.

Please relate to them (from an EMC/RADIO point of view) as the same product.

Thank you,
Signature: _____

Printed Name: Yair Elul
Engineering Manager
Orpak Systems Ltd.

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.), FCC Designation No. IL1005.
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-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Sites No. IC 4025A-1, 4025A-2.

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

The NNR EXTRA LARGE is an add-on device designed to be installed on the dispenser's nozzle. It is a self -powered device that does not require any connections to any other existing components of the dispenser due to its wireless nature. The NNR EXTRA LARGE has only mechanical interface to the nozzle without any wires or electronic interface to the nozzle, dispenser or any other station equipment.

The NNR EXTRA LARGE reads the vehicle information from the RFID FuelOpass (Frequency: 108 – 131 kHz) and then transmits it to the WGT over wireless channel (Frequency: 2.405-2.480 GHz).

1.4 Test Methodology

Radiated testing was performed according to the procedures in KDB 558074 D01 v03r03 and ANSI 63-4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Kfar Bin-Nun, and Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation No. IL1005.

1.6 Measurement Uncertainty

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):
± 4.98 dB

2. System Test Configuration

2.1 Justification

E.U.T. transmits at Low (108.1 kHz), Mid (125.0 kHz) and High (131.1 kHz)

Exploratory radiated emission screening was performed to determine the worst case between the NNR EXTRA LARGE and NNR EXTRA LARGE+SWITCH. According to the results below the worst case was the NNR EXTRA LARGE+SWITCH on which full testing was performed.

Unit	Frequency (kHz)	Fundamental (dBuV/m)	3rd Harmonic (dBuV/m)	7th Harmonic (dBuV/m)
NNR EXTRA LARGE	108.1	95.6	63.5	51.8
	125.0	94.6	64.1	50.5
	131.1	93.1	63.1	47.5
NNR EXTRA LARGE+SWITCH	108.1	96.5	65.5	52.1
	125.0	95.2	62.5	51.5
	131.1	95.0	65.1	48.5

Figure 1. Screening Results

Radiated emission screening was performed in 3 orthogonal orientations. The worst case orientation was the x axis.

2.2 EUT Exercise Software

No special exercise software was needed.

2.3 Special Accessories

No accessories were used.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.

2.5 Configuration of Tested System

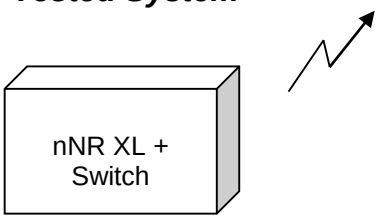

Figure 2. Configuration of Tested System

3. Test Setup Photos

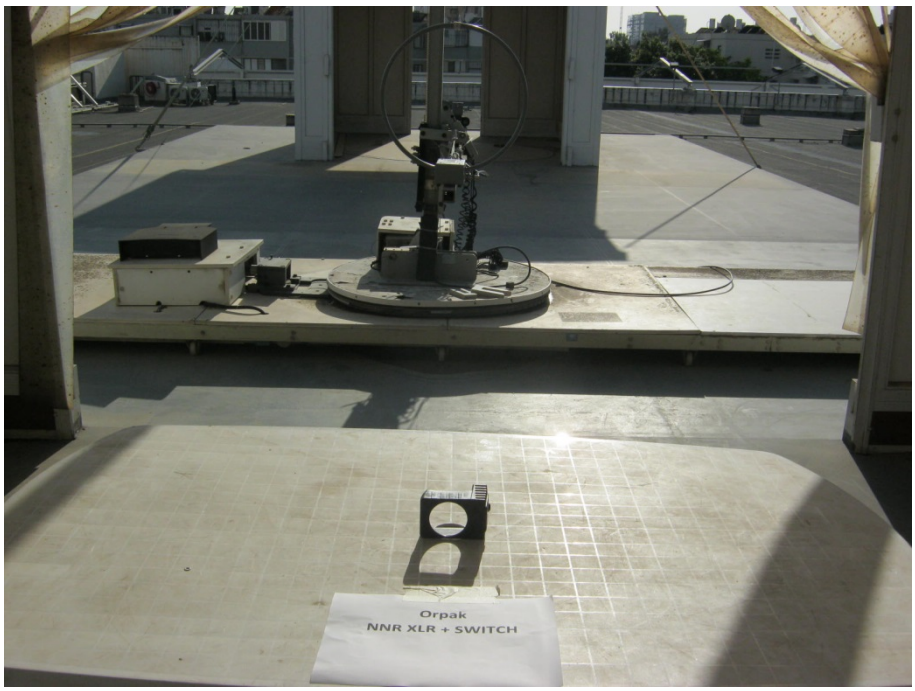

Figure 3. Radiated Emission Test Setup 125 kHz

Figure 4. Radiated Emission Test Setup 2.4 GHz

Figure 5. Radiated Emission Test Setup 2.4 GHz

Figure 6. Radiated Emission Test Setup 2.4 GHz

4. Field Strength of Fundamental (125 kHz transmitter)

4.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.209

4.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.
The EMI receiver was set to the E.U.T. Fundamental Frequency and Peak Detection.
The distance between the E.U.T. and test antenna was 3 meters.

The turntable and antenna were adjusted for maximum level reading on the EMI receiver. The loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter.

4.3 Test Results

Frequency (kHz)	Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
108.1	96.1	106.1	-10.0
125.0	94.0	105.6	-11.6
131.1	94.7	105.2	-10.5

Figure 7. Field Strength of Fundamental Test Results

The EUT met the FCC Part 15, Subpart C, Section 15.209 requirements.

JUDGEMENT: Passed by 10.0 dB

The details of the highest emissions are given in *Figure 8* to *Figure 10.*

Field Strength of Fundamental

E.U.T Description	Fuel Pump Nozzle Reader
Model Number	NNR EXTRA LARGE+SWITCH
Part Number:	Not Designated

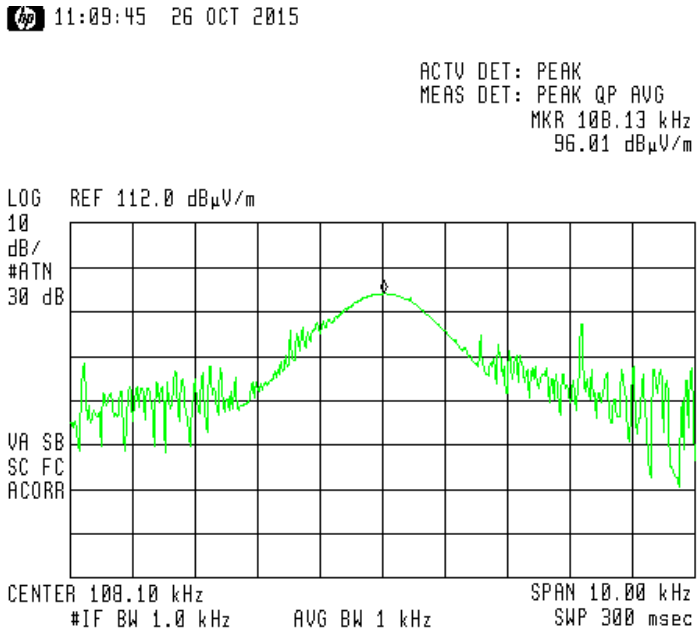

Figure 8. Field Strength of Fundamental, Low
Detector: Peak

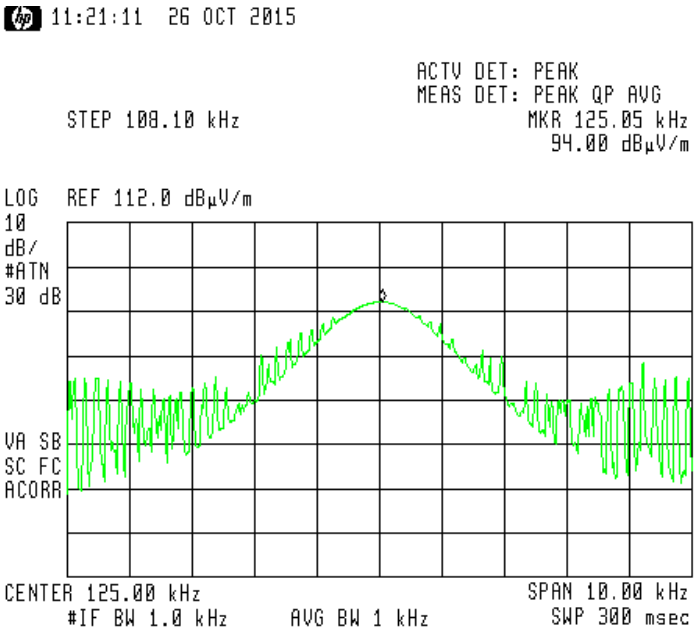

Figure 9. Field Strength of Fundamental, Mid
Detector: Peak

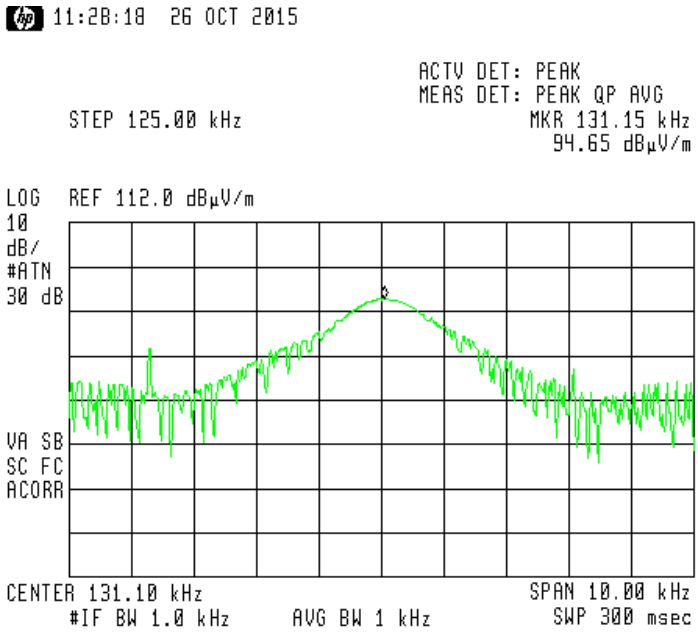

Figure 10. Field Strength of Fundamental, High Detector: Peak

4.4 Test Instrumentation Used; Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	March 11, 2015	1 year
RF Filter Section	HP	85420E	3705A00248	March 19, 2015	1 year
Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 11. Test Equipment Used

5. Radiated Emission, 9 kHz – 30 MHz (125 kHz transmitter)

5.1 Test Specification

FCC, Part 15, Subpart C, Section 209

5.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

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 2*.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are pre-loaded to the receiver.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was operated at the frequencies of 108.1 kHz, 125 kHz and 131.1 kHz. These frequencies were measured using a peak detector.

5.3 Test Results

JUDGEMENT: Passed by 6.7 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

See additional information in *Figure 12*.

Radiated Emission 9 kHz – 30 MHz,

E.U.T Description Fuel Pump Nozzle Reader
Model Number NNR EXTRA LARGE+SWITCH
Part Number: Not Designated

Specification: FCC, Part 15, Subpart C;

Antenna Polarization: Horizontal/Vertical Frequency range: 9 kHz to 30.0 MHz
Test Distance: 3 meters Detector: Peak
Operation Frequencies: 108.1 kHz,125 kHz,131.1kHz

Operation Frequency (kHz)	Frequency (kHz)	Peak Reading (dBµV/m)	Specification (dBµV/m)	Margin (dB)
108.1	540.8	60.1	99.6	-39.5
	324.3	67.0	96.6	-29.6
125.0	375.0	62.8	96.1	-33.3
	625.0	58.9	71.8	-12.9
131.1	393.5	65.4	95.8	-30.4
	1180.0	60.1	66.8	-6.7

Figure 12. Radiated Emission

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.

5.4 Test Instrumentation Used; Radiated Measurements

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	March 11, 2015	1 year
RF Filter Section	HP	85420E	3705A00248	March 19, 2015	1 year
Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 13. Test Equipment Used

5.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dBμv/m]
RA: Receiver Amplitude [dBμv]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

6. Bandwidth for 125 kHz Transmitter

6.1 Test Specification

FCC Part 2, Section 2.1049

6.2 Test Procedure

The transmitter unit was operated with normal modulation. The spectrum analyzer was set to 1 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit was measured and recorded. The BW was measured at 26dBc points.

The EUT was set up as shown in *Figure 2*, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on the modulation envelope.
The E.U.T was tested in 3 operating frequencies: 108.1 kHz, 125.0 kHz and 131.1 kHz.

6.3 Test Results

FREQUENCY (kHz)	READING (kHz)
108.1	4.70
125.0	4.70
131.1	4.65

Figure 14. Bandwidth Test Results

JUDGEMENT: Passed

See additional information in *Figure 15* to *Figure 17*.

.

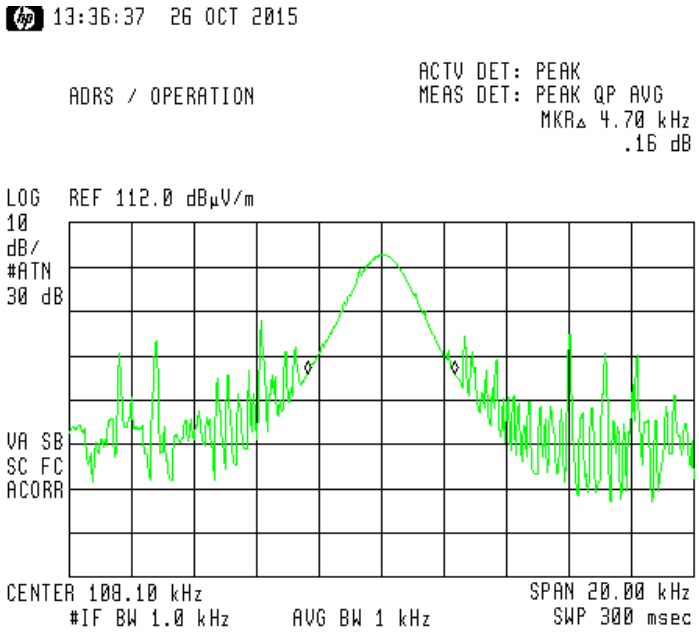

Figure 15 Bandwidth – Low Frequency (108.1 kHz)

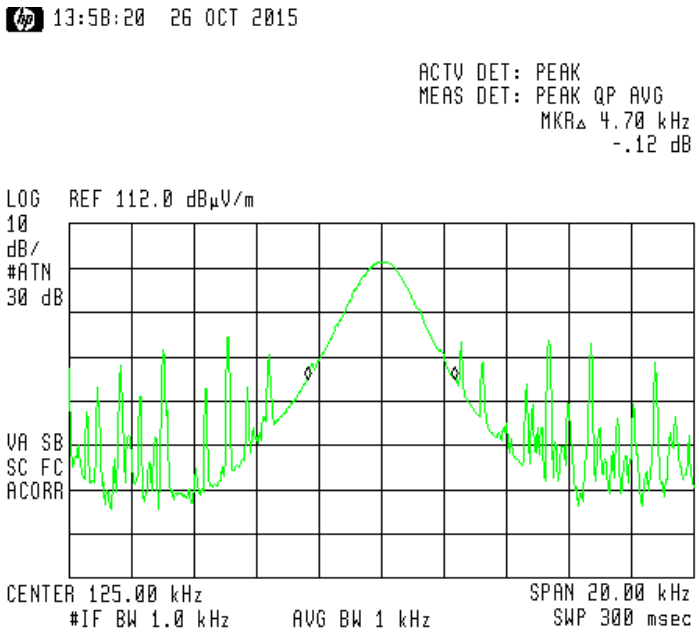

Figure 16 Bandwidth – Mid Frequency (125.0 kHz)

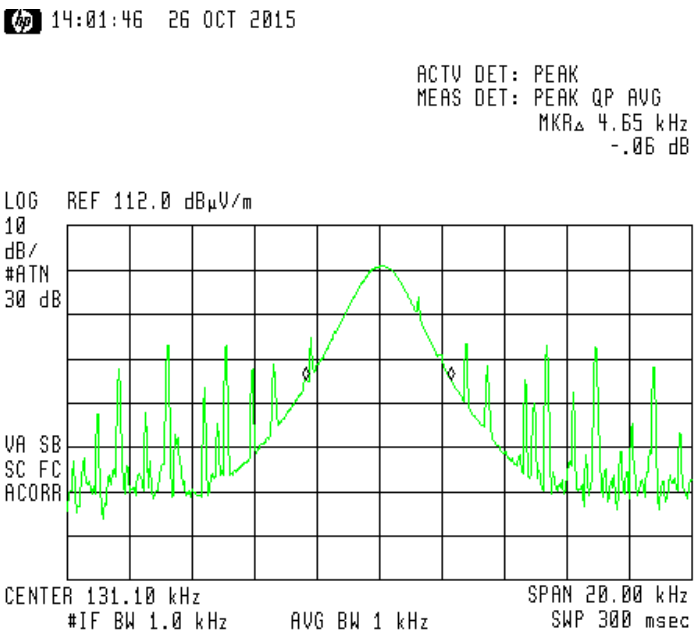

Figure 17 Bandwidth – High Frequency (131.1 kHz)

6.4 Test Equipment Used; Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	March 11, 2015	1 year
RF Filter Section	HP	85420E	3705A00248	March 19, 2015	1 year
Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 18 Test Equipment Used

7. 6dB Minimum Bandwidth 2.4 GHz Transmitter

7.1 Test Specification

F.C.C. Part 15, Subpart C: 15.247(a)(2)

7.2 Test Procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters. The transmitter unit operated with normal modulation. The EMI receiver was set to 100 kHz resolution BW. The spectrum bandwidth of the transmitter unit was measured and recorded. The test was performed to measure the transmitter occupied bandwidth. The EUT was set up as shown in Figure 2, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on modulation envelope. The E.U.T. was tested in three operating channels and frequencies (11 (2.405 GHz); 18 (2.440 GHz); 26 (2.480 GHz)).

7.3 Test Results

Operation Frequency (MHz)	**Bandwidth Reading** (MHz)	**Specification** (MHz)
2405.00	1.13	>0.5
2440.00	1.31	>0.5
2480.00	1.58	>0.5

Figure 19 — 6dB Minimum Bandwidth Test Results

JUDGEMENT: Passed

See additional information in *Figure 20* to *Figure 22*.

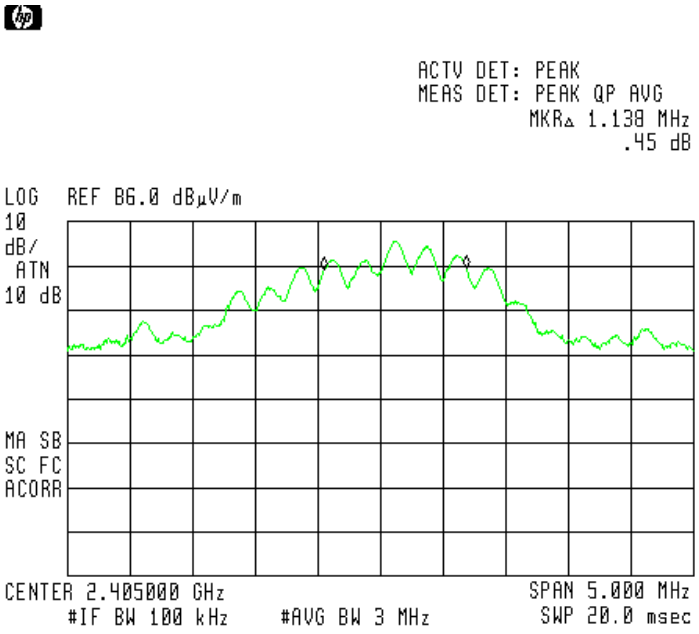

Figure 20. — 2405 MHz

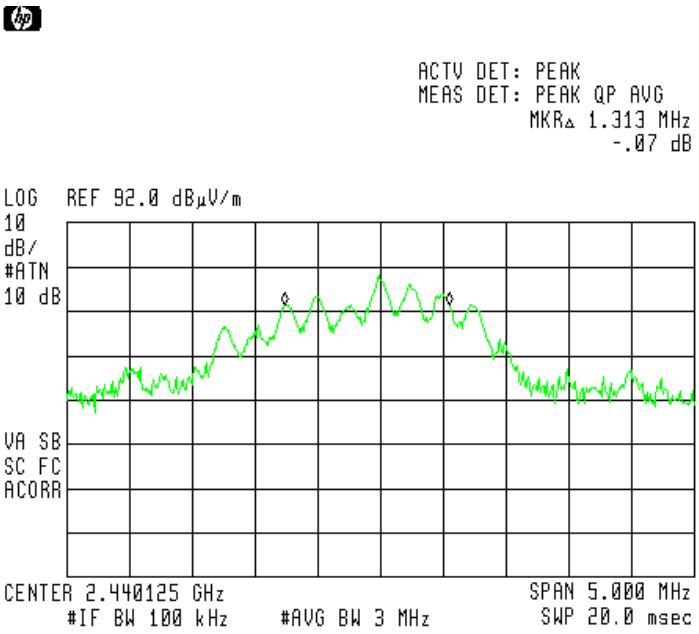

Figure 21. — 2440 MHz

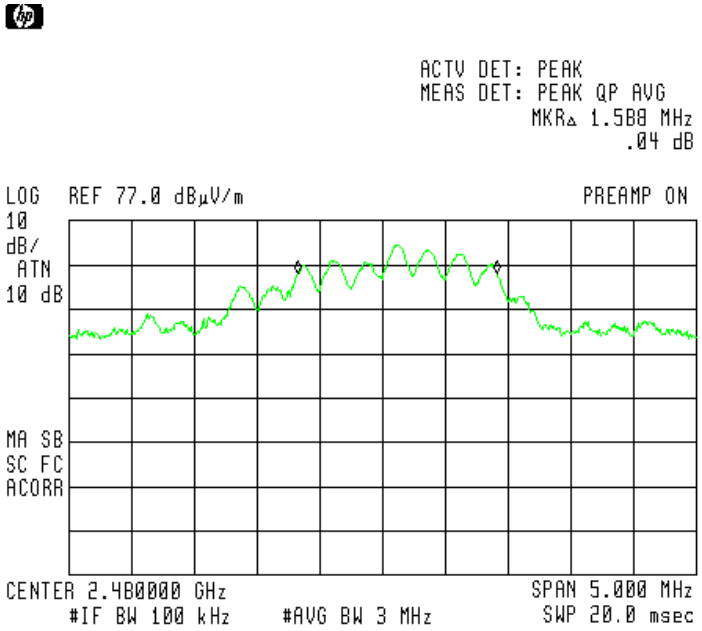

Figure 22. — 2480 MHz

7.4 Test Equipment Used, 6dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 23 Test Equipment Used

8. 26dB Minimum Bandwidth, 2.4 GHz Transmitter

8.1 Test Specification

F.C.C. Part 15, Subpart C: 15.247(a)(2)

8.2 Test Procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters. The transmitter unit operated with normal modulation. The EMI receiver was set to 100 kHz resolution BW. The spectrum bandwidth of the transmitter unit was measured and recorded. The test was performed to measure the transmitter occupied bandwidth. The EUT was set up as shown in Figure 2, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on modulation envelope. The E.U.T. was tested in three operating channels and frequencies (11 (2.405 GHz); 18 (2.440 GHz); 26 (2.480 GHz)).

8.3 Test Results

Operation Frequency (MHz)	Bandwidth Reading (MHz)
2405.00	2.94
2440.00	2.67
2480.00	3.43

Figure 24 — 26 dB Minimum Bandwidth Test Results

JUDGEMENT: Passed

See additional information in Figure 25 to Figure 27.

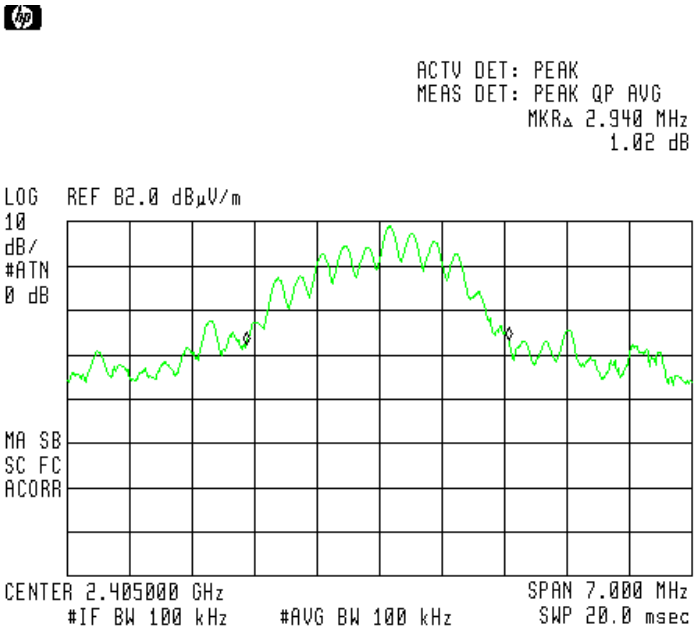

Figure 25. — 2405 MHz

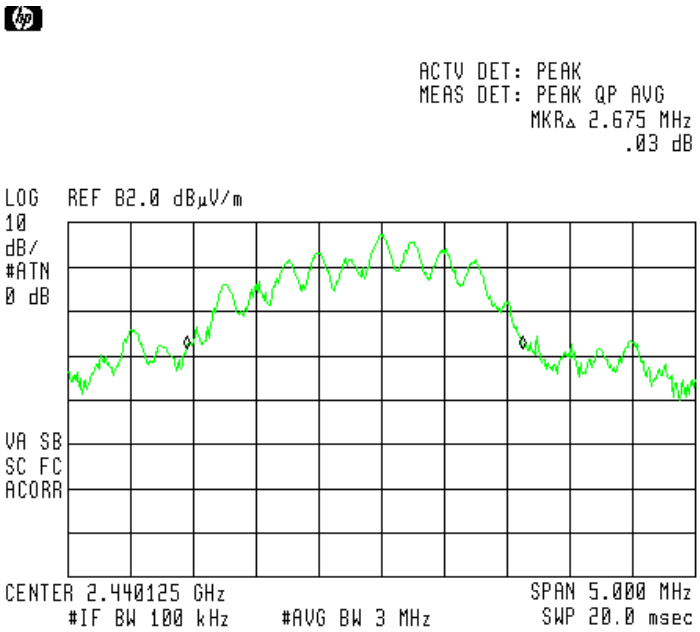

Figure 26. — 2440 MHz

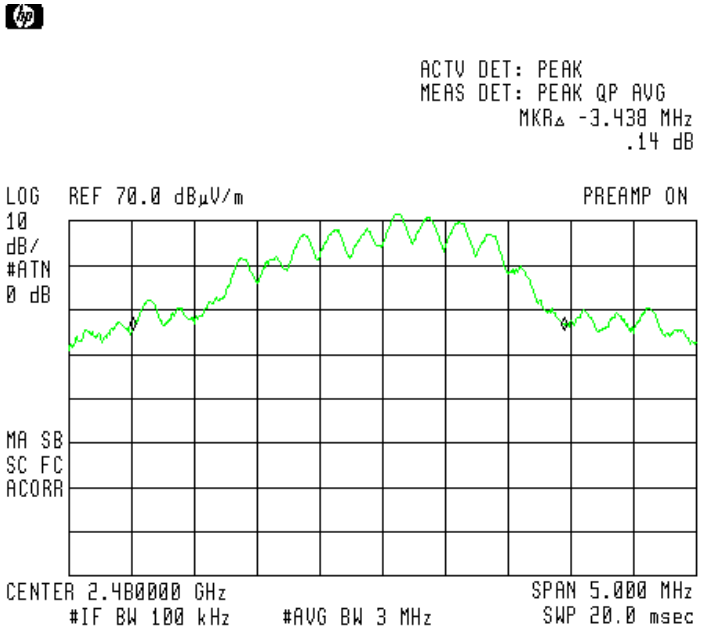

Figure 27. — 2480 MHz

8.4 Test Equipment Used, 26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 28 Test Equipment Used

9. Radiated Power Output 2.4 GHz Transmitter

9.1 Test Specification

F.C.C. Part 15, Subpart C: 15.247(b)

9.2 Test Procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters. The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in Figure 2, and its proper operation was checked.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{ [W]}$$

The E.U.T. was tested at 2405, 2440, and 2480 MHz.

9.3 Test Results

Frequency (MHz)	Polarity	E (dbµV/m)	Calculated Results (dbm)	Limit (dbm)	Margin (db)
2405	H	88.7	-6.5	30	-36.5
2405	V	94.1	-1.1	30	-31.1
2440	H	83.3	-11.9	30	-41.9
2440	V	91.6	-3.6	30	-33.6
2480	H	81.6	-13.6	30	-43.6
2480	V	88.5	-7.1	30	-37.1

Figure 29 Radiated Power Output Test Results Calculation Table

JUDGEMENT: Passed by 31.1dB

See additional information in *Figure 30* to *Figure 35*.

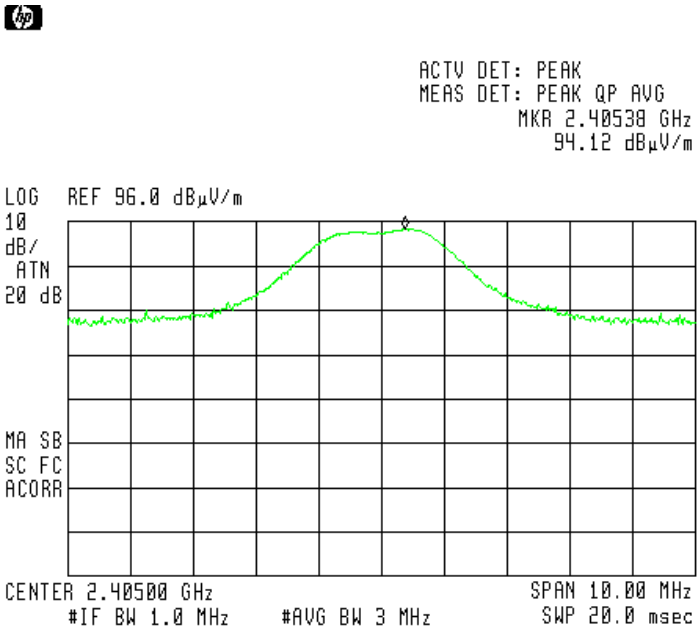

Figure 30 — 2405 MHz Vertical

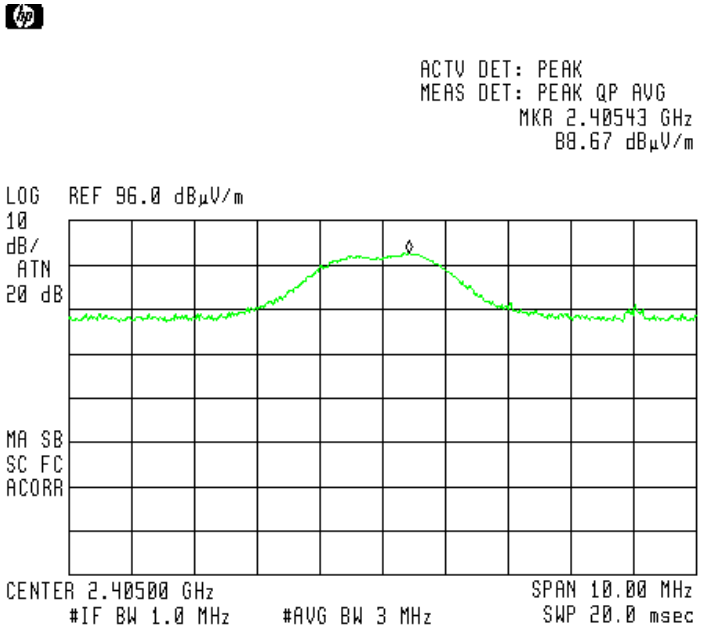

Figure 31 — 2405 MHz Horizontal

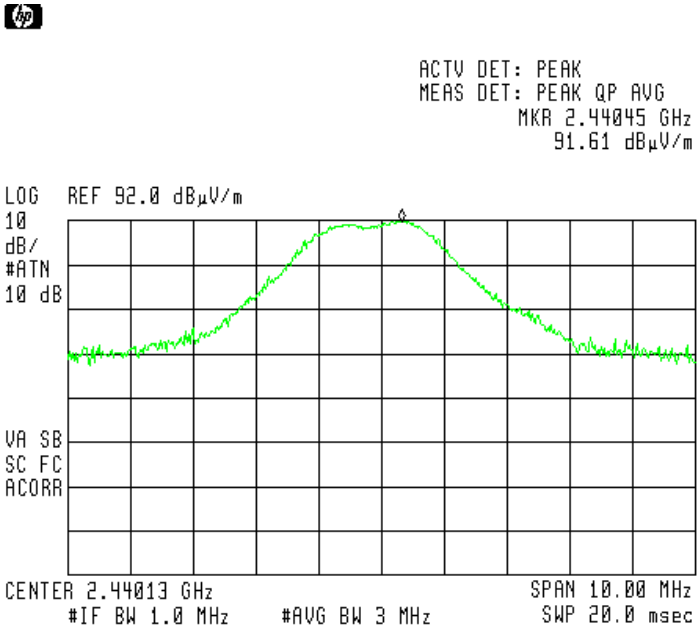

Figure 32 — 2440 MHz Vertical

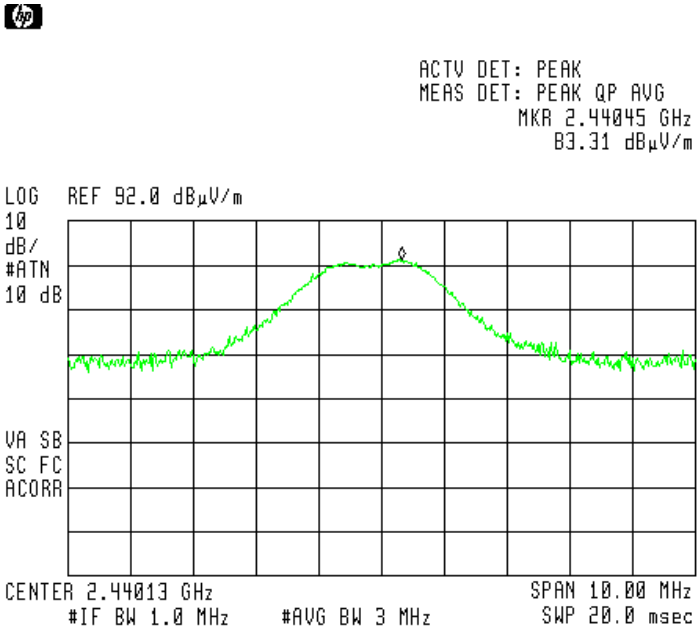

Figure 33 — 2440 MHz Horizontal

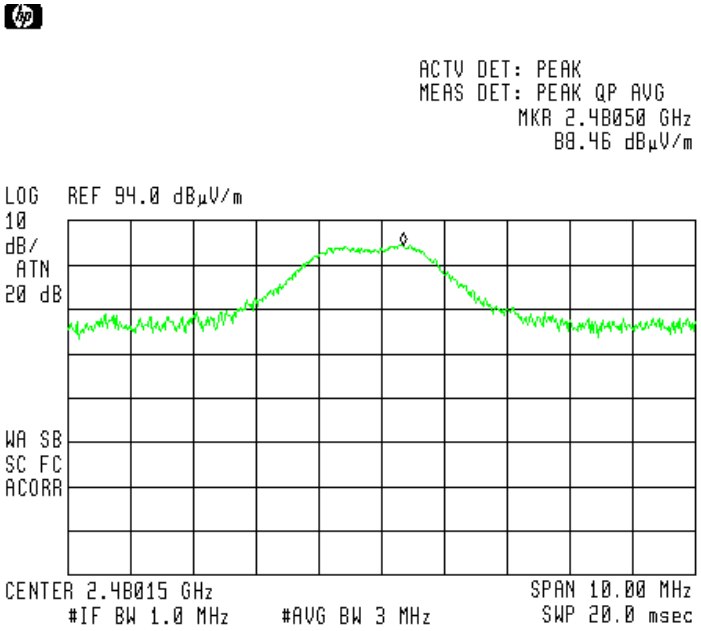

Figure 34 — 2480 MHz Vertical

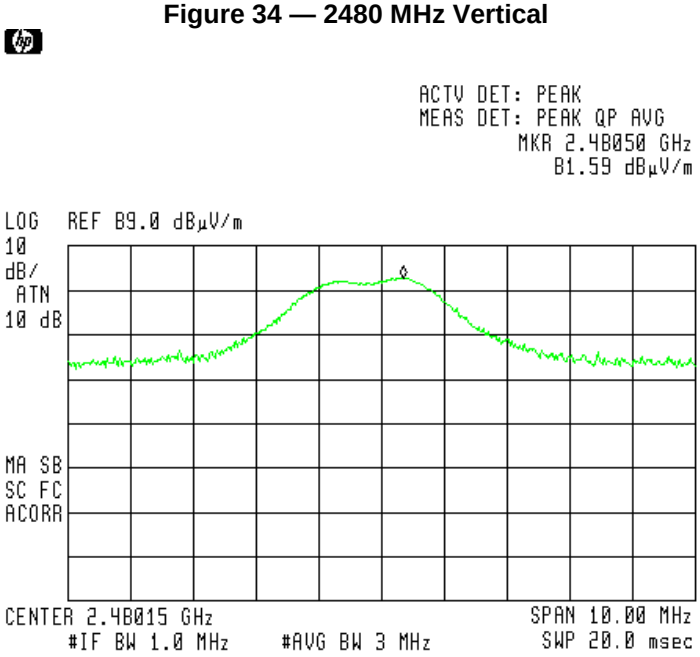

Figure 35 — 2480 MHz Horizontal

9.4 Test Equipment Used; Radiated Maximum Output Power

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 36 Test Equipment Used

10. Band Edge Spectrum, 2.4 GHz Transmitter

10.1 Test Specification

FCC Part 15 Section 15.247(d)

10.2 Test Procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.
The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in *Figure 2*, and its proper operation was checked.

The EMI receiver was adjusted to the transmission channel at the maximum radiated level. The display line was set to 20 dBc and the EMI receiver was set to the band edge frequencies.

The EMI receiver was set to 100 KHz resolution BW.
Maximum power level below 2400 MHz and above 2483.5 MHz was measured relative to power level at 2405 MHz, and 2480 MHz correspondingly.

The E.U.T. was tested in 2 operating channels and frequencies
2.405 GHz, 2.480 GHz.

10.3 Test Results

Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBuV/m)	Specification (dBuV/m)
2405	2400.00	56.4	74.1
2480	2483.50	57.0	68.5

Figure 37 Band Edge Spectrum Test Results Table

JUDGEMENT: Passed

See additional information in *Figure 38* to *Figure 39*.

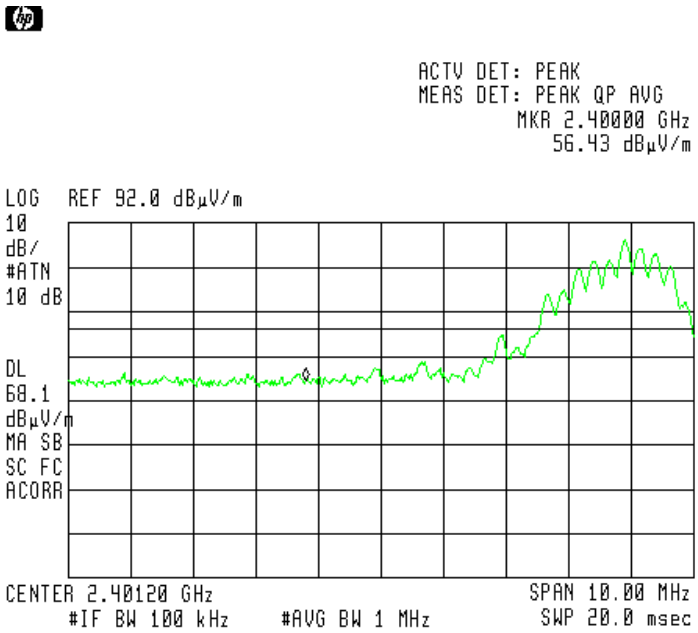

Figure 38 — 2405 MHz

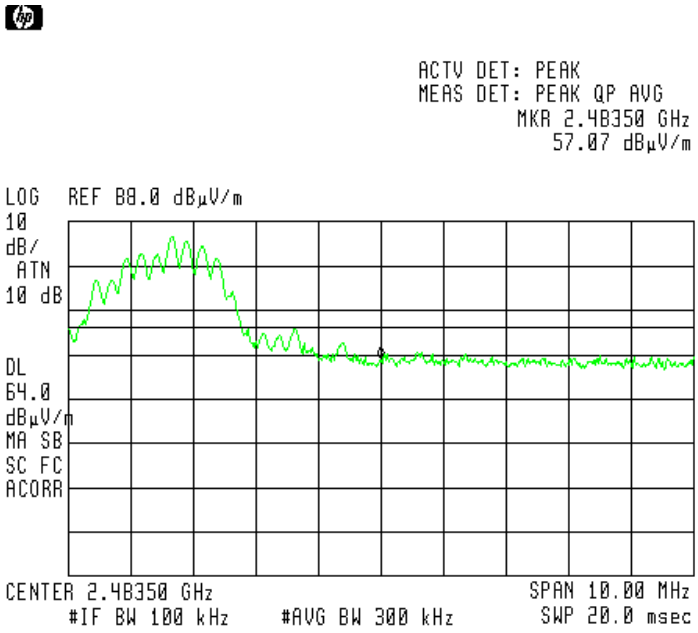

Figure 39 — 2480 MHz

10.4 Test Equipment Used; Band Edge Spectrum

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 40 Test Equipment Used

11. Spurious Radiated Emission, 9 kHz – 30 MHz (2.4 GHz Transmitter)

11.1 Test Specification

FCC, Part 15, Subpart C, Section 209

11.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2.

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 2*.

The E.U.T. highest frequency source or used frequency is 2.4 GHz.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with 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-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.
The E.U.T. was tested in three operating frequencies
2.405 GHz; 2.440 GHz; 2.480 GHz.
These frequencies were measured using a peak detector.

11.3 Test Results

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

The results for all three frequencies were the same.

All signals were below the EMI receiver background noise level which is at least 6 dB below the specification limit.

11.4 Test Equipment Used; Spurious Radiated Emission, 9 kHz–30 MHz

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Loop Antenna	EMCO	6502	9506-2950	November 4, 2013	1 Year
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 41 Test Equipment Used

11.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS:	Field Strength [dBμv/m]
RA:	Receiver Amplitude [dBμv]
AF:	Receiving Antenna Correction Factor [dB/m]
CF:	Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

12. Spurious Radiated Emission, 30 – 25000 MHz (2.4 GHz Transmitter)

12.1 Test Specification

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

12.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

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 E.U.T. highest frequency source or used frequency is 2.4 GHz.

The frequency range 30 MHz-25000 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 with 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 1-2.9 GHz, a computerized EMI receiver complying with 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 100Hz. 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 in three operating frequencies
2.405 GHz; 2.440 GHz; 2.480 GHz.

12.3 Test Results

JUDGEMENT: Passed by 2.6 dB

For additional information see *Figure 42* and *Figure 43.*

Radiated Emission

E.U.T Description	Fuel Pump Nozzle Reader
Model Number	NNR EXTRA LARGE+SWITCH
Part 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 (MHz)	Frequency (MHz)	Polarity (H/V)	Peak Reading (dBµV/m)	Peak Specification (dB µV/m)	Margin (dB)
2405.00	2390.00	H	63.7	74	-10.3
2405.00	2390.00	V	62.3	74	-11.7
2405.00	4810.00	H	57.6	74	-16.4
2405.00	4810.00	V	58.7	74	-15.3
2440.00	4880.00	H	55.8	74	-18.2
2440.00	4880.00	V	55.9	74	-18.1
2480.00	2483.50	H	57.4	74	-16.6
2480.00	2483.50	V	61.4	74	-12.6
2480.00	4960.00	H	55.9	74	-18.1
2480.00	4960.00	V	56.4	74	-17.6

Figure 42. 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 Reading" includes correction factor.

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

Radiated Emission

E.U.T Description	Fuel Pump Nozzle Reader
Model Number	NNR EXTRA LARGE+SWITCH
Part 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 (MHz)	Frequency (MHz)	Polarity (H/V)	Average Result (dBµV/m)	Average Specification (dB µV/m)	Margin (dB)
2405.00	2390.00	H	51.1	54	-2.9
2405.00	2390.00	V	51.1	54	-2.9
2405.00	4810.00	H	45.7	54	-8.3
2405.00	4810.00	V	46.0	54	-8.0
2440.00	4880.00	H	45.7	54	-8.3
2440.00	4880.00	V	45.4	54	-8.6
2480.00	2483.50	H	51.4	54	-2.6
2480.00	2483.50	V	51.3	54	-2.7
2480.00	4960.00	H	45.8	54	-8.2
2480.00	4960.00	V	46.1	54	-7.9

Figure 43. 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.

“Peak Reading” includes correction factor.

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

12.4 Test Equipment Used, Spurious Radiated Emission, 30 MHz – 25 GHz

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 44 Test Equipment Used

12.5 Field Strength Calculation 30 MHz – 1000 MHz

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[dB\mu v/m]\ \ FS = RA + AF + CF$$

FS:	Field Strength [dBμv/m]
RA:	Receiver Amplitude [dBμv]
AF:	Receiving Antenna Correction Factor [dB/m]
CF:	Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

13. Radiated Power Spectral Density, 2.4 GHz Transmitter

13.1 Test Specification

FCC Part 15 Section 15.247(e)

13.2 Test Procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.
The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in *Figure 2*, and its proper operation was checked.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The E.U.T. was tested in three operating frequencies
2.405 GHz; 2.440 GHz; 2.480 GHz.

Then the EMI receiver was set to 3 kHz resolution BW, span of 10MHz, and sweep time of 100 seconds. The spectrum peaks were located at each of the 3 operating frequencies.

Radiated peak output power levels were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{[W]}$$

13.3 Test Results

Frequency (MHz)	E (dbµV/m)	Calculated Results (dBm)	Specification (dBm)	Margin (dB)
2405.00	88.9	-6.3	8	-14.3
2440.00	87.5	-7.7	8	-15.7
2480.00	82.2	-13.0	8	-21.0

Figure 45 Radiated Power Spectral Density Test Results Table

JUDGEMENT: Passed by 14.3dB

See additional information in *Figure 46* to *Figure 48*.

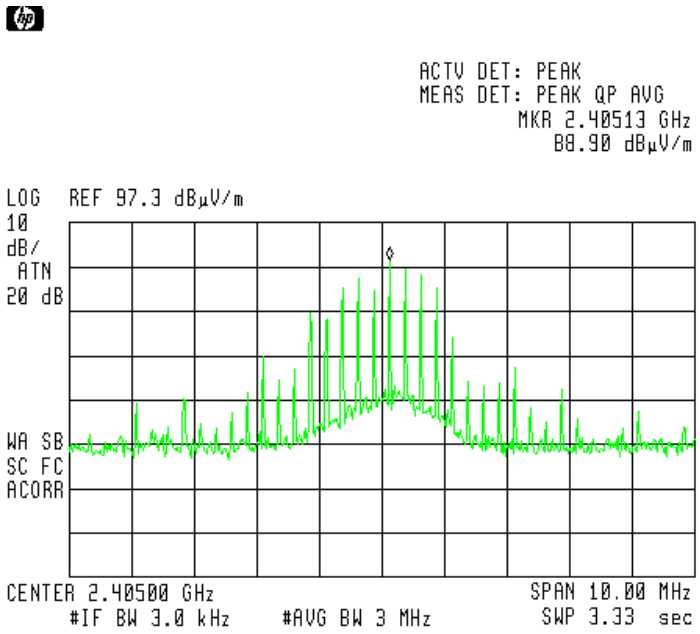

Figure 46 — 2405 MHz

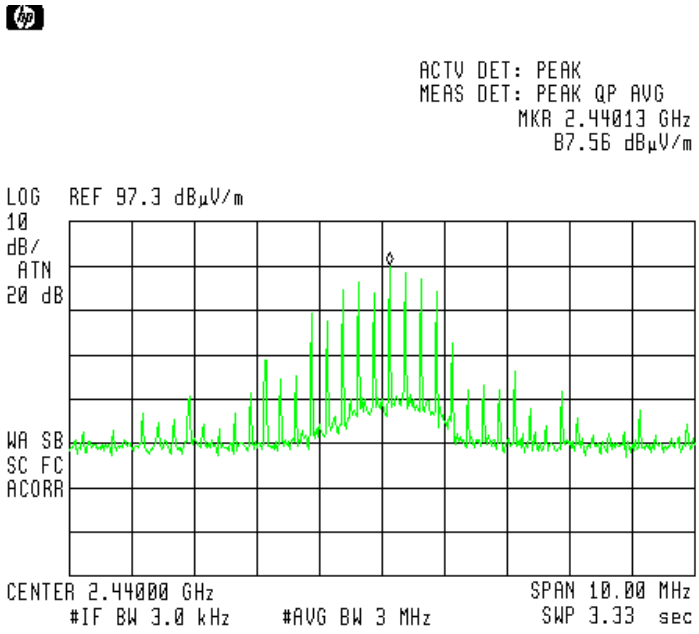

Figure 47 — 2440 MHz

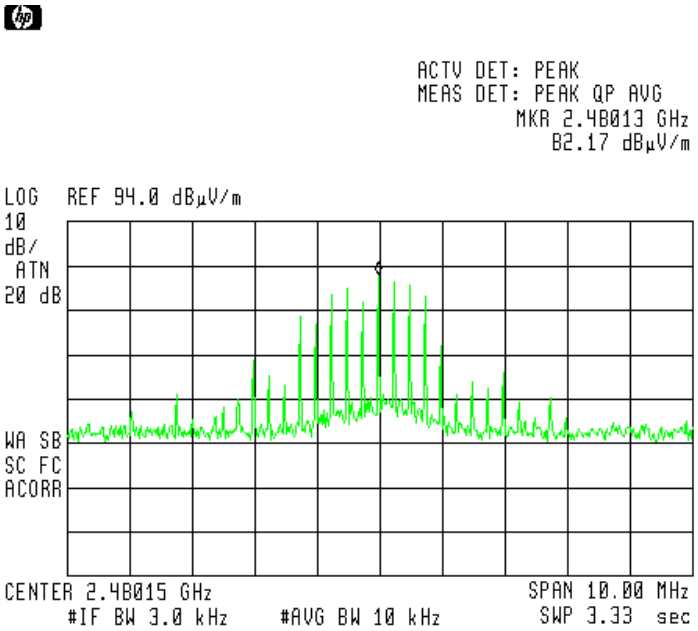

Figure 48 — 2480 MHz

13.4 Test Equipment Used; Radiated Power Spectral Density

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 Years
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	March 2, 2014	1 Year
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	December 1, 2013	2 years
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

Note - Testing on 2.4 GHz transmitter was performed from 17/07/2014 to 26/08/2014

Figure 49 Test Equipment Used

14. Antenna Gain/Information

The antenna gain is 1.9 dBi SMD

15. R.F Exposure/Safety

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 5 cm.

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1310(b)(1) Requirements

(a) FCC limits at 2440 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 = 94.1 (dbuV/m) = 0.8 mW (Calculated $P_t + G_t$)

G_T- Antenna Gain 1.9 dBi = 1.55 numeric

R- Distance from Transmitter using 5 cm worst case

(c) The peak power density is :

$$S_p = \frac{0.8}{4\pi(5)^2} = 0.0025\frac{mW}{cm^2}$$

(d) This is below the FCC limit

16. APPENDIX B - CORRECTION FACTORS

16.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)	Frequency (MHz)	Cable Loss (dB)
0.010	0.4	50.00	1.2
0.015	0.2	100.00	0.7
0.020	0.2	150.00	2.1
0.030	0.3	200.00	2.3
0.050	0.3	300.00	2.9
0.075	0.3	500.00	3.8
0.100	0.2	750.00	4.8
0.150	0.2	1000.00	5.4
0.200	0.3	1500.00	6.7
0.500	0.4	2000.00	9.0
1.00	0.4	2500.00	9.4
1.50	0.5	3000.00	9.9
2.00	0.5	3500.00	10.2
5.00	0.6	4000.00	11.2
10.00	0.8	4500.00	12.1
15.00	0.9	5000.00	13.1
20.00	0.8	5500.00	13.5
		6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

16.2 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (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

From old report

16.3 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.

16.4 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			

16.5 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