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**DATE: 12 January 2017**

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

# FCC Radio Test Report

**For**

# Orpak Systems Ltd.

**Equipment under test:**

## Outdoor Payment Terminal

## OrPAY1000
## (Zigbee 2.4GHz)

Tested by: _____

M. Zohar

Approved by: _____

D. Shidlowsky

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# Measurement/Technical Report for

## Orpak Systems Ltd.

## Outdoor Payment Terminal

# OrPAY1000

# FCC ID: W8F800927850

| | |
|---|---|
| This report concerns: | Original Grant: X<br>Class I Change:<br>Class II Change: |
| Equipment type: | Digital Transmission System |
| Limits used: | 47CFR15 Section 15.247 |

Measurement procedure used is KDB 558074 D01 v03r03 and ANSI C63.10-2013.


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# 1. General Information

## 1.1 *Administrative Information*

| | |
|---|---|
| Manufacturer: | Orpak Systems Ltd. |
| Manufacturer's Address: | 31 Lechi St.<br>P.O.B. 1461<br>Bnei-Brak, 51114<br>Israel<br>Tel: +972-3-577-6868<br>Fax: +972-3-579-6310 |
| Manufacturer's Representative: | Haim Aharon |
| Equipment Under Test (E.U.T): | Outdoor Payment Terminal |
| Equipment Model No.: | OrPAY1000, |
| Equipment Serial No.: | 1021266 |
| Date of Receipt of E.U.T: | 07.08.2016 |
| Start of Test: | 08.08.2016 |
| End of Test: | 18.08.2016 |
| Test Laboratory Location: | I.T.L (Product Testing) Ltd.<br>1 Batsheva St.,<br>Lod<br>ISRAEL 7120101 |
| Test Specifications: | FCC Part 15, Subpart C, Section 15.247 |

## 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; Site Nos. IC 4025A-1, IC 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 OrPAY 1000 is a cost-effective outdoor payment terminal installed directly onto the dispenser or wall mounted next to it for both attended and unattended activities.

The terminal's unique features have been designed to suit both retail and commercial fleet markets as an impeccable pay-at-the-pump solution for fuel card purchases, forecourt promotions, local accounts, loyalty schemes, attendant management, and much more.

In addition, OrPAY1000 has a built-in 'pump interface', allowing it to control the dispenser as well as interface directly with Orpak's forecourt controller over LAN, eliminating the need for dedicated pump interface hardware.

The OrPAY 1000 terminal is small enough to fit in any standard pump head or pedestal, yet provides an efficient and advanced user interface with its 4.3" multimedia color LCD display, 4 addressable screen keys, and a full alphanumeric vandal proof 40-key keyboard. Furthermore, the novel terminal can be part of Orpak's ForeFuel solution with its built-in WGT (Wireless Gateway).

| | |
|---|---|
| Model name | Orpay-1000 |
| Working voltage | 12.0-24.0V DC via AC/DC adapter<br>Manufactory: mean well<br>Order num: GS40A24-P1j<br>s/n : EB58E77878 |
| Mode of operation | Transceiver |
| Modulations | IEEE 802.15.4 (ZIGBEE) |
| Assigned Frequency Range | 2400.0-2483.5MHz |
| Operating Frequency Range | 2405.0-2480.0MHz |
| Transmit power | ~4.4dBm |
| Antenna Gain | +3.3dBi; +5.3dBi |
| Modulation BW | >500kHz |
| Number of antennas | 2 for diversity |

## *1.4 Test Methodology*

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r03 and ANSI C63.4: 2014. 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 Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

## 1.6 *Measurement Uncertainty*

**Conducted Emission**

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
0.15 – 30 MHz:
Expanded Uncertainty (95% Confidence, K=2):
± 3.44 dB

**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*

Testing was performed with the E.U.T's orientation in installation position as defined by the customer.
The unit was tested while transmitting at the low (2405.0MHz), mid (2440.0MHz) and high channel (2480.0MHz) in IEEE 802.15.4 technology (ZIGBEE).

Exploratory emission testing was performed with 2 antennas to determine the maximum fundamental emission.

The 2 antennas are used for diversity. The E.U.T. operates using the +3.3dBi antenna and if necessary switches automatically to use the +5.3dBi antenna.

The results are shown in the below table:

| FREQ | Antenna A (+3.3dBi) | | Antenna B (+5.3dBi) | |
|---|---|---|---|---|
| | **V** dBµV/m | **H** dBµV/m | **V** dBµV/m | **H** dBµV/m |
| 2405.0MHz | 87.6 | 88.1 | 93.9 | 95.5 |
| 2440.0MHz | 88.3 | 89.7 | 92.6 | 95.3 |
| 2480.0MHz | 87.0 | 87.1 | **95.7** | 95.4 |

**Figure 1. Screening Results**

According to above results, the worst case was with antenna B.

The E.U.T was tested with RS485 sub board.

## 2.2 *EUT Exercise Software*

No special exercise software was used.

## 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*

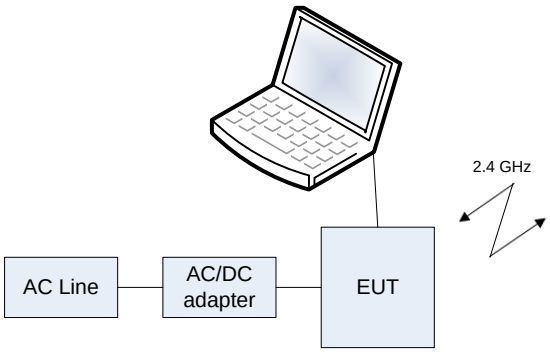


**Figure 2. Configuration of Tested System**

# 3. Conducted & Radiated Measurement Test Set-Up Photos


**Figure 3. Conducted Emission Test**


**Figure 4. Radiated Emission Test**


**Figure 5. Radiated Emission Test**

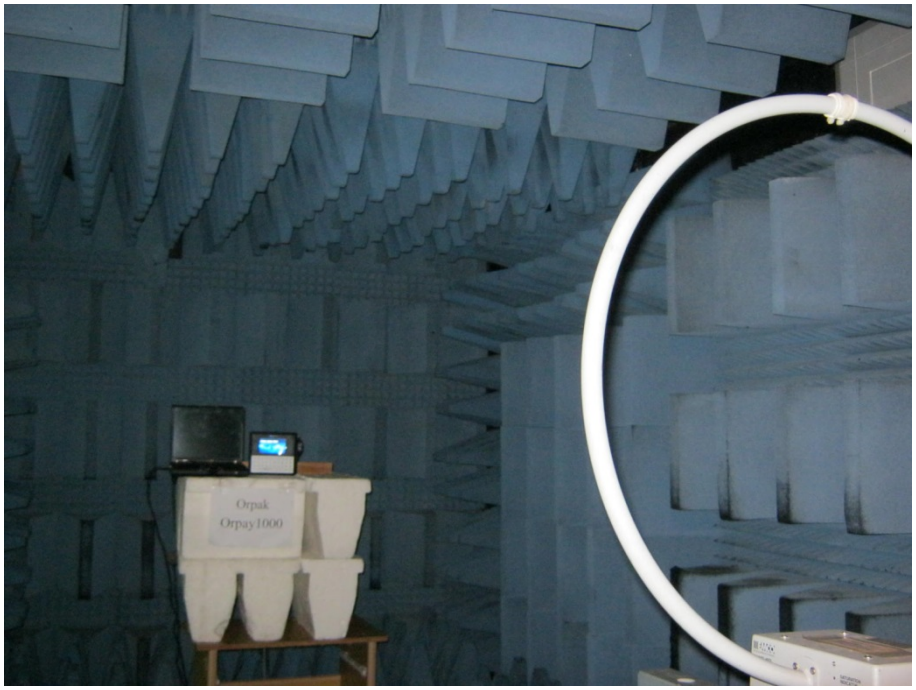


**Figure 6. Radiated Emission Test**


**Figure 7. Radiated Emission Test**

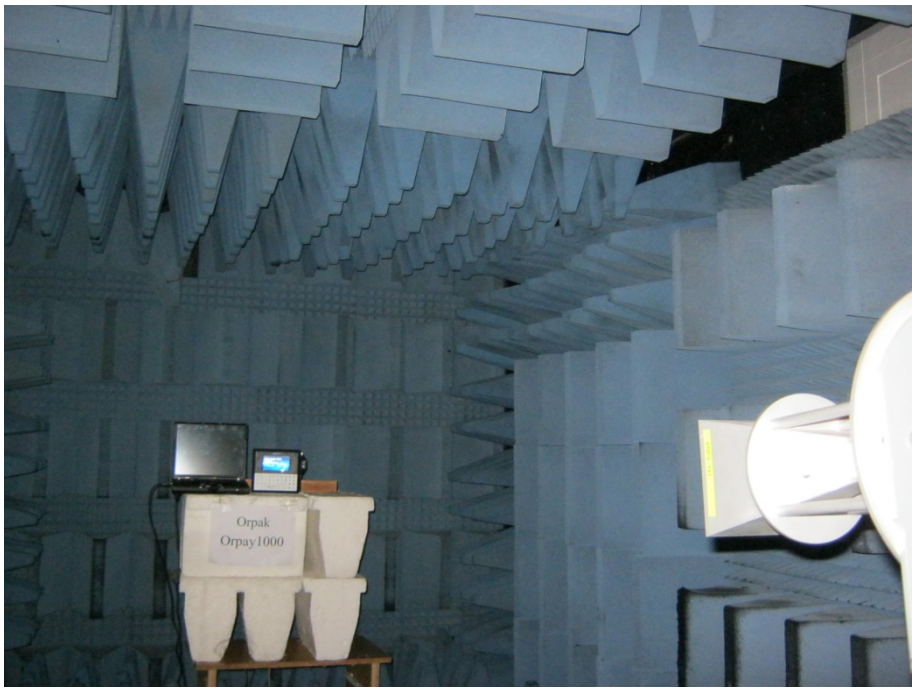


**Figure 8. Radiated Emission Test**

# 4. Conducted Emission From AC Mains

## 4.1 *Test Specification*

FCC Part 15, Subpart C, Section 15.207

## 4.2 *Test Procedure*

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 µHn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in the photograph, *Figure 3. Conducted Emission Test.*

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was tested while transmitting simultaneously at ZIGBEE, 125 kHz and 13.56 MHz.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

## 4.3 *Test Limit*

| **Frequency of emission (MHz)** | **Conducted limit (dBµV)** | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66.0 to 56.0* | 56.0 to 46.0* |
| 0.5-5.0 | 56.0 | 46.0 |
| 5.0-30.0 | 60.0 | 50.0 |

* Decreases with the logarithm of the frequency.

## 4.4 *Test Results*

JUDGEMENT: Passed by 2.76 dB

The margin between the emission levels and the specification limit is, in the worst case, 2.8 dB for the phase line at 0.41 MHz and 3.8 dB at 0.41 MHz for the neutral line.

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

The details of the highest emissions are given in *Figure 9* to *Figure 12.*

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Type | OrPAY1000 |
| Serial Number: | 1021266 |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Phase |
| Detectors: : | Quasi-peak, Average |

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

| TRACE | | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 2 | Average | 206 kHz | 44.40 | -8.95 |
| 1 | Quasi Peak | 210 kHz | 52.44 | -10.76 |
| 1 | Quasi Peak | 410 kHz | 54.88 | -2.76 |
| 2 | Average | 410 kHz | 43.09 | -4.55 |
| 1 | Quasi Peak | 450 kHz | 49.74 | -7.13 |
| 2 | Average | 454 kHz | 35.50 | -11.30 |
| 2 | Average | 1.13 MHz | 29.69 | -16.30 |
| 1 | Quasi Peak | 1.146 MHz | 40.79 | -15.20 |
| 1 | Quasi Peak | 1.554 MHz | 39.13 | -16.86 |
| 2 | Average | 1.666 MHz | 28.93 | -17.06 |
| 2 | Average | 2.178 MHz | 26.10 | -19.89 |
| 1 | Quasi Peak | 2.878 MHz | 30.83 | -25.16 |
| 1 | Quasi Peak | 4.13 MHz | 30.00 | -25.99 |
| 2 | Average | 4.182 MHz | 25.84 | -20.15 |
| 2 | Average | 10.322 MHz | 26.54 | -23.45 |
| 1 | Quasi Peak | 10.358 MHz | 30.16 | -29.83 |
| 1 | Quasi Peak | 13.57 MHz | 32.22 | -27.77 |
| 2 | Average | 13.57 MHz | 27.10 | -22.89 |
| 2 | Average | 17.682 MHz | 25.95 | -24.04 |
| 1 | Quasi Peak | 18.55 MHz | 29.13 | -30.86 |

Date: 11.AUG.2016 15:25:34

**Figure 9. Detectors: Peak, Quasi-peak, Average**

*Note: QP Delta/Av Delta 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.*

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Type | OrPAY1000 |
| Serial Number: | 1021266 |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Phase |
| Detectors: | Peak, Average |

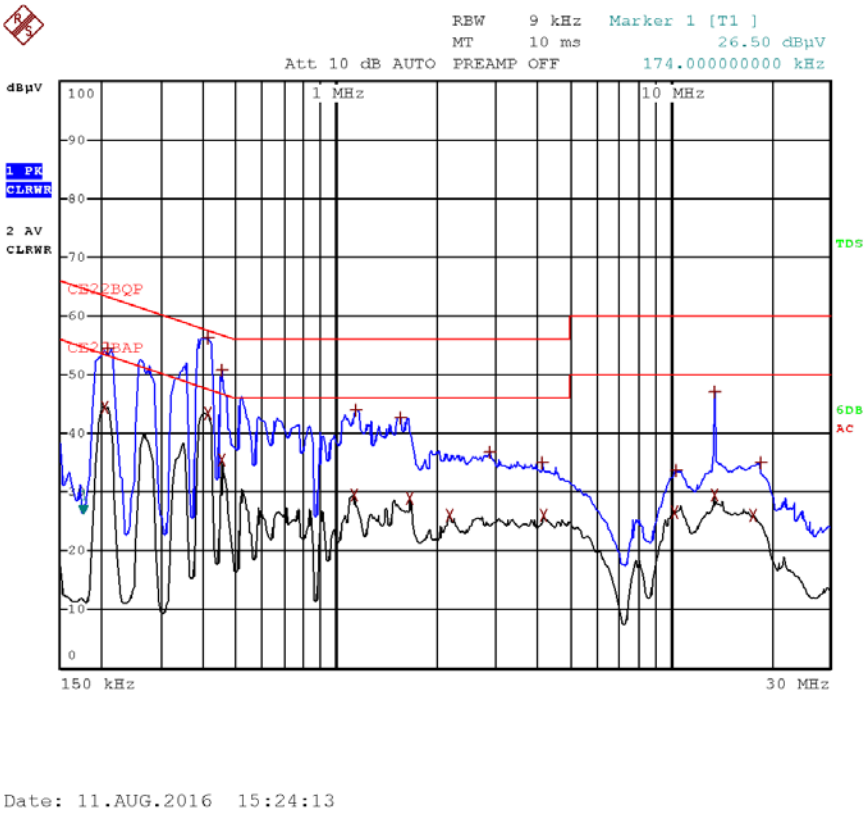


**Figure 10. Detectors: Peak, Quasi-peak, Average**

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Type | OrPAY1000 |
| Serial Number: | 1021266 |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Neutral |
| Detectors: | Quasi-peak, Average |

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

| | TRACE | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 2 | Average | 202 kHz | 43.66 | -9.86 |
| 1 | Quasi Peak | 214 kHz | 50.58 | -12.46 |
| 2 | Average | 394 kHz | 42.48 | -5.49 |
| 1 | Quasi Peak | 410 kHz | 53.88 | -3.75 |
| 1 | Quasi Peak | 450 kHz | 48.80 | -8.07 |
| 2 | Average | 454 kHz | 34.58 | -12.22 |
| 2 | Average | 1.13 MHz | 28.61 | -17.38 |
| 1 | Quasi Peak | 1.162 MHz | 39.92 | -16.07 |
| 1 | Quasi Peak | 1.554 MHz | 38.05 | -17.94 |
| 2 | Average | 1.666 MHz | 27.79 | -18.21 |
| 2 | Average | 2.178 MHz | 25.20 | -20.79 |
| 1 | Quasi Peak | 2.338 MHz | 32.25 | -23.75 |
| 1 | Quasi Peak | 4.126 MHz | 30.44 | -25.55 |
| 2 | Average | 4.25 MHz | 25.47 | -20.53 |
| 2 | Average | 10.354 MHz | 26.98 | -23.01 |
| 1 | Quasi Peak | 10.394 MHz | 30.88 | -29.11 |
| 1 | Quasi Peak | 13.566 MHz | 44.56 | -15.43 |
| 2 | Average | 13.566 MHz | 30.38 | -19.61 |
| 2 | Average | 17.746 MHz | 26.22 | -23.77 |
| 1 | Quasi Peak | 18.342 MHz | 30.49 | -29.51 |

Date: 11.AUG.2016 15:20:22

**Figure 11. Detectors: Peak, Quasi-peak, Average**

*Note: QP Delta/Av Delta 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.*

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Type | OrPAY1000 |
| Serial Number: | 1021266 |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Neutral |
| Detectors: | Peak, Average |

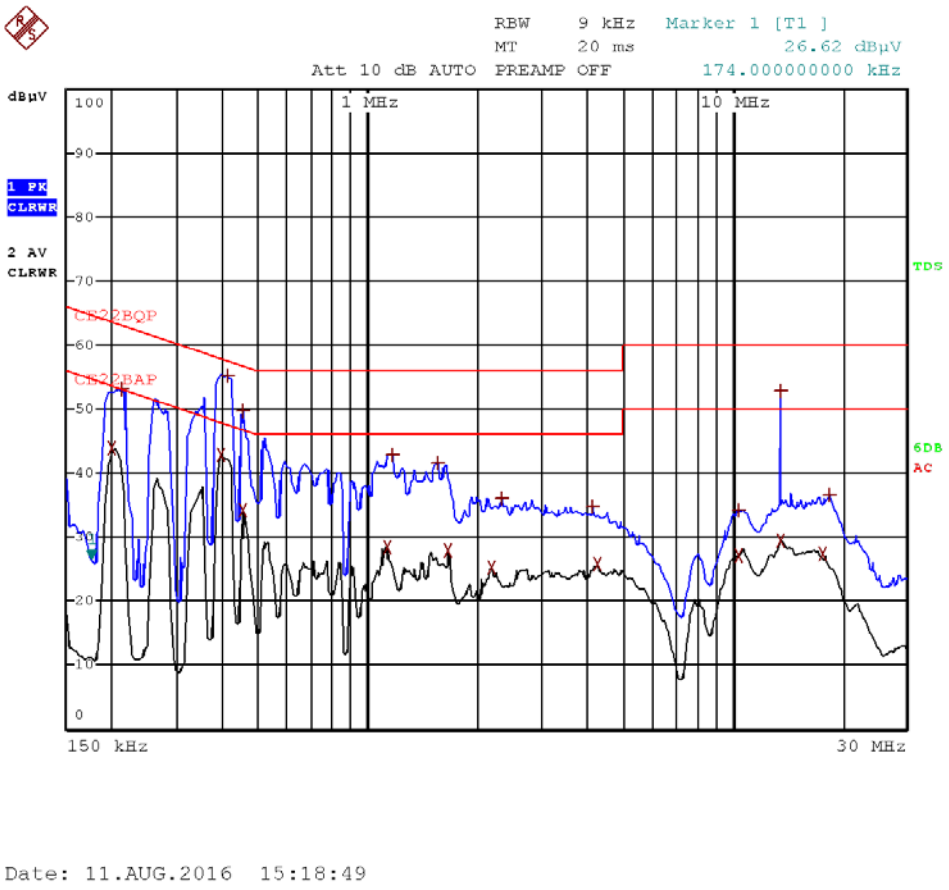


**Figure 12 Detectors: Peak, Quasi-peak, Average**

## 4.5 *Test Equipment Used; Conducted Emission*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| LISN | Fischer | FCC-LISN-25A | 127 | June 23, 2016 | June 23, 2017 |
| Transient Limiter | HP | 11947A | 3107A03041 | June 15, 2016 | June 15, 2017 |
| EMI Receiver | Rohde & Schwarz | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |

**Figure 13 Test Equipment Used**

# 5. 6 dB Minimum Bandwidth

## 5.1 *Test Specification*

FCC Part 15, Subpart C, Section 247(a)(2)

## 5.2 *Test Procedure*

(Temperature (22°C)/ Humidity (53%RH))

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

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 2*.

The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

## 5.3 *Test Limit*

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 5.4 *Test Results*

| Operation Frequency | Reading | Specification |
|---|---|---|
| (MHz) | (MHz) | (MHz) |
| 2405.0 | 1.6 | ≥0.5 |
| 2440.0 | 1.6 | ≥0.5 |
| 2480.0 | 1.6 | ≥0.5 |

**Figure 14 6 dB Minimum Bandwidth**

JUDGEMENT: Passed

For additional information see *Figure 15* to *Figure 17*.

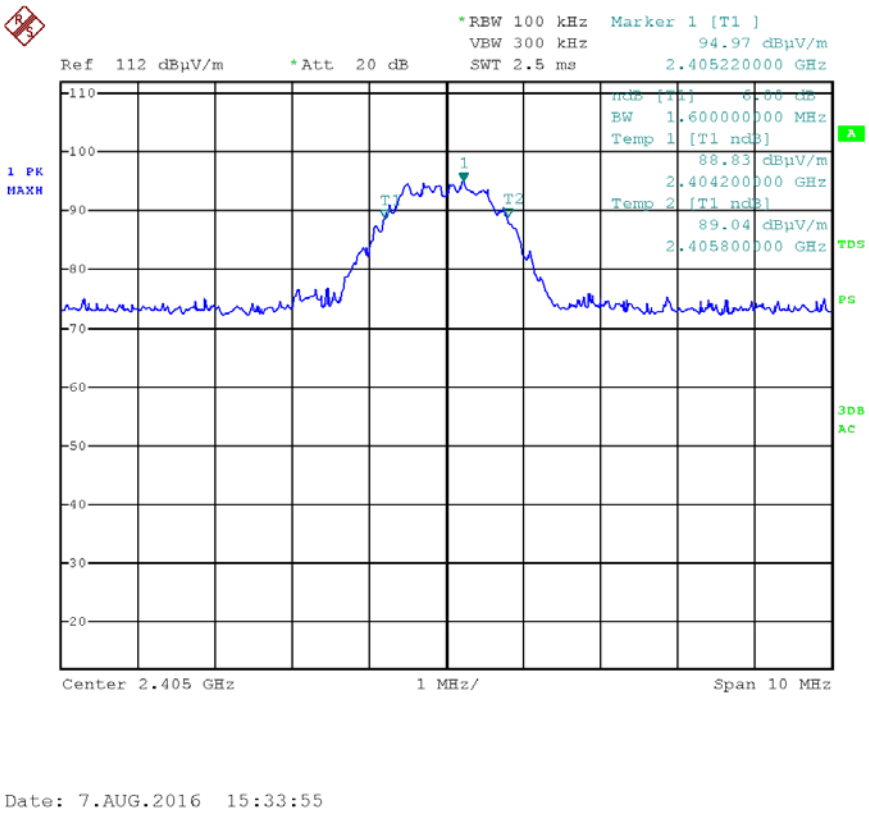


**Figure 15. – 6dB Minimum Bandwidth - 2405.0 MHz**

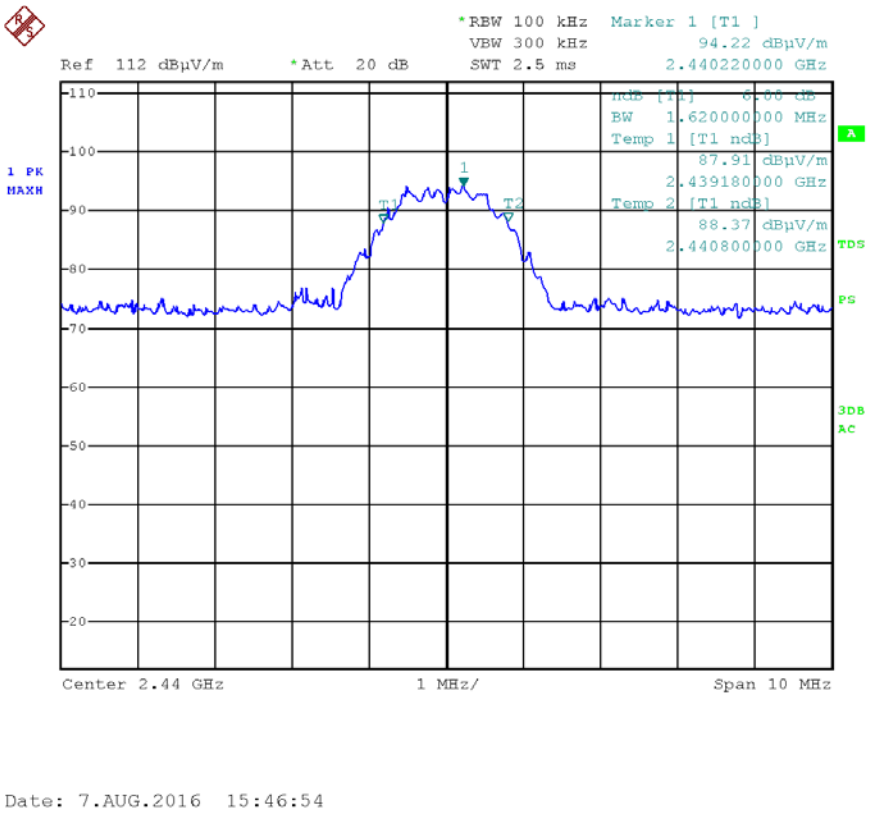


**Figure 16. 6dB Minimum Bandwidth - 2440.0 MHz**

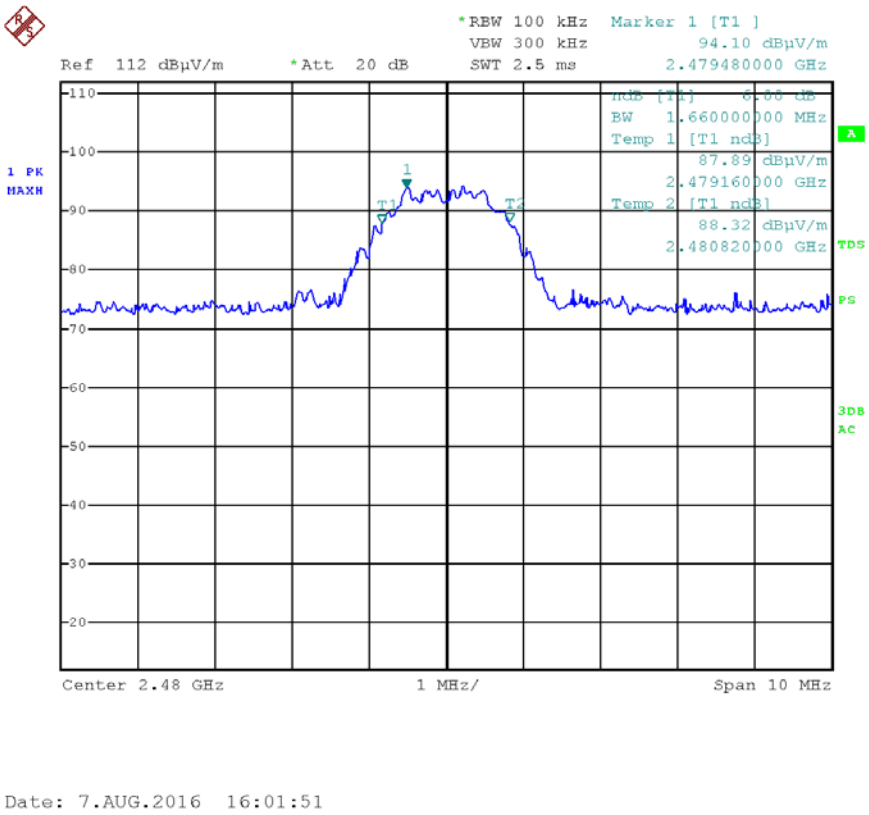


**Figure 17. 6dB Minimum Bandwidth - 2480.0 MHz**

## 5.5 *Test Equipment Used; 6dB Bandwidth*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Horn Antenna | ETS | 3115 | 6142 | May 19, 2015 | May 19, 2018 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 18 Test Equipment Used**

# 6. Maximum Transmitted Peak Power Output

## 6.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(b)(3)

## 6.2 *Test Procedure*

(Temperature (22°C)/ Humidity (53%RH))

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

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The distance between the E.U.T to the test antenna was 3m.

The configuration tested is shown in *Figure* 2.

The E.U.T was evaluated in 3 channels: Low (2405.0 MHz), Mid (2440.0 MHz) and High (2480.0 MHz).

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:

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

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

## 6.3 *Test Limit*

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt.

## 6.4 *Test Results*

| Operation Frequency | Polarization | Power | Power | Power | Limit | Margin |
|---|---|---|---|---|---|---|
| (MHz) | (V/H) | (dBuV/m) | (dBm) | (mW) | (mW) | (mW) |
| 2405.0 | V | 98.9 | 3.7 | 2.34 | 1000.0 | -997.66 |
| | H | 99.6 | 4.4 | 2.75 | 1000.0 | -997.25 |
| 2440.0 | V | 97.0 | 1.8 | 1.51 | 1000.0 | -998.49 |
| | H | 99.5 | 4.3 | 2.69 | 1000.0 | -997.31 |
| 2480.0 | V | 95.7 | 0.5 | 1.12 | 1000.0 | -998.88 |
| | H | 99.5 | 4.3 | 2.69 | 1000.0 | -997.31 |

**Figure 19 Maximum Peak Power Output**

JUDGEMENT: Passed by 997.25 mW

For additional information see *Figure 20* to *Figure 25.*

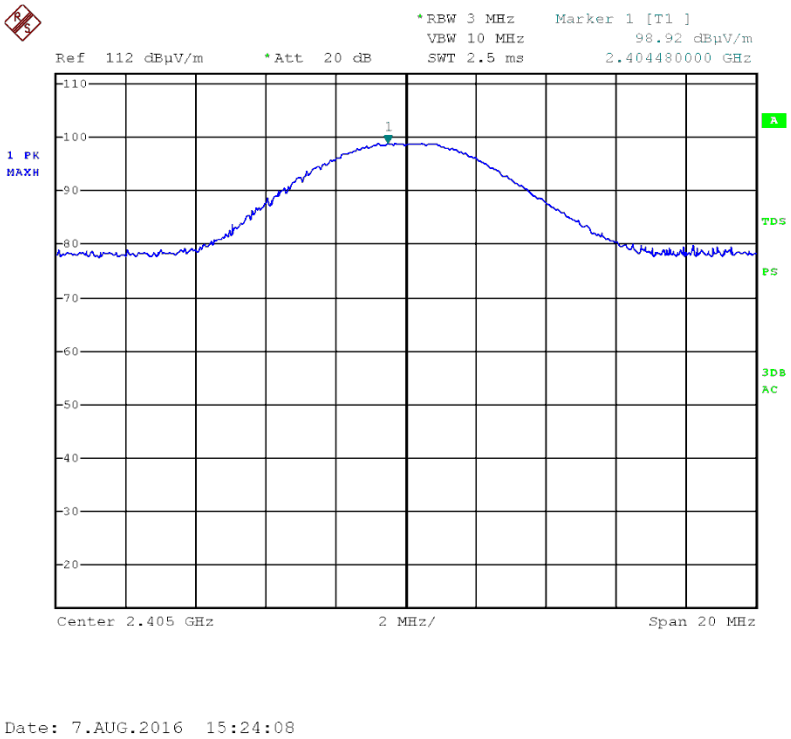


**Figure 20 Maximum Peak Power - 2405.0 MHz – Vertical**

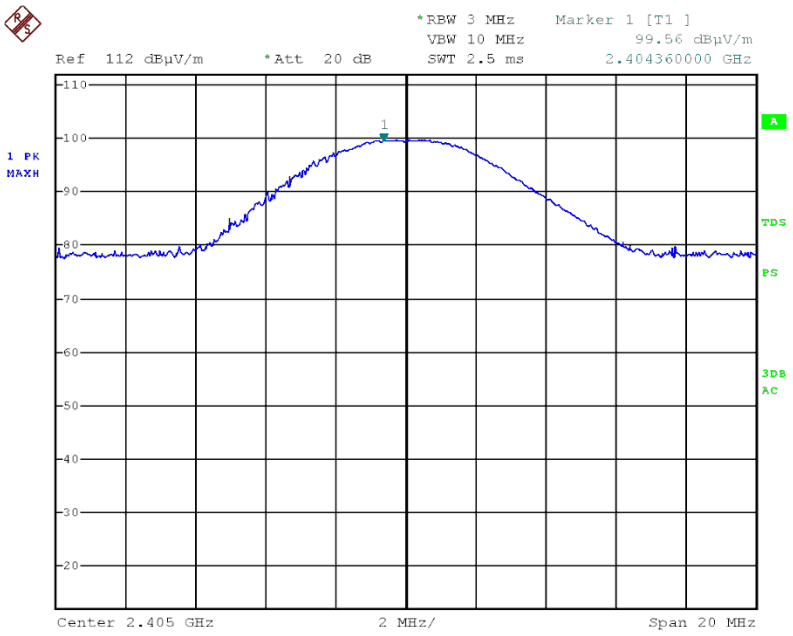


**Figure 21 Maximum Peak Power -2405.0 MHz – Horizontal**

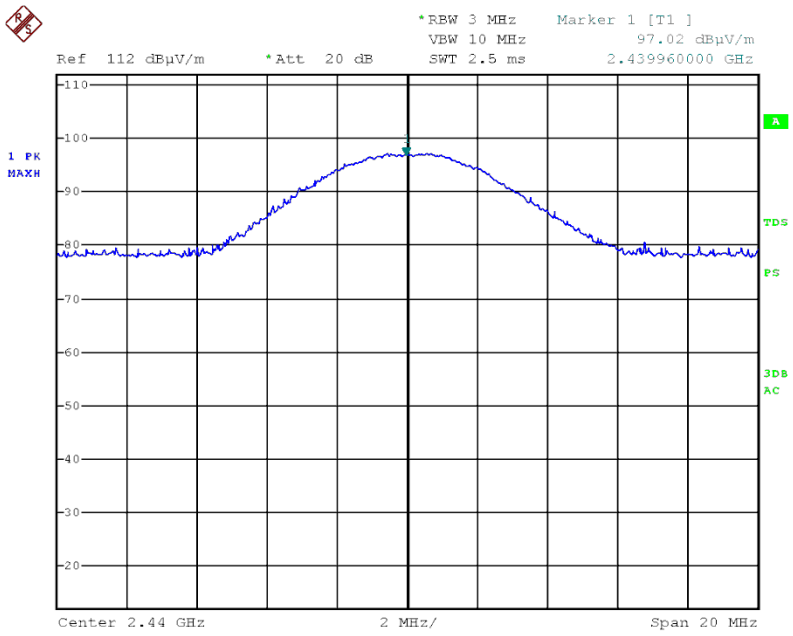


**Figure 22 Maximum Peak Power - 2440.0 MHz – Vertical**

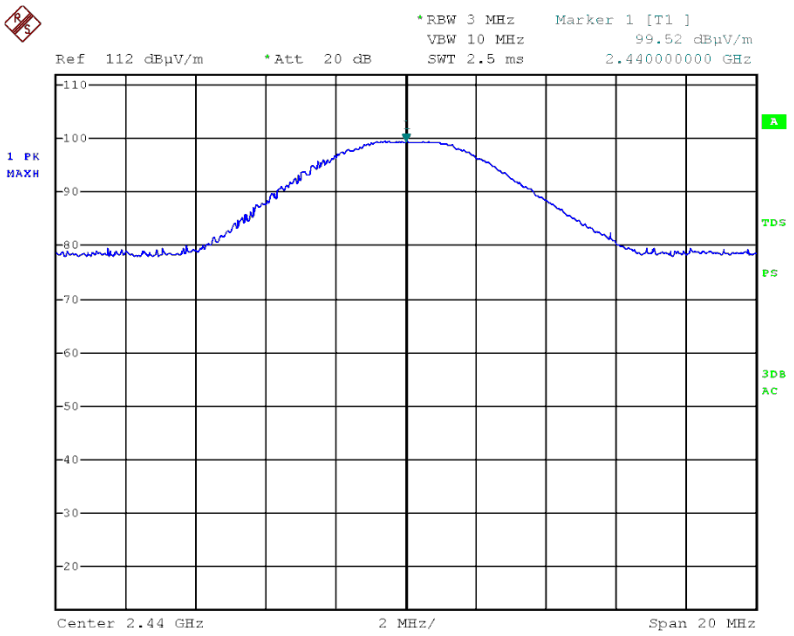


**Figure 23 Maximum Peak Power - 2440.0 MHz – Horizontal**

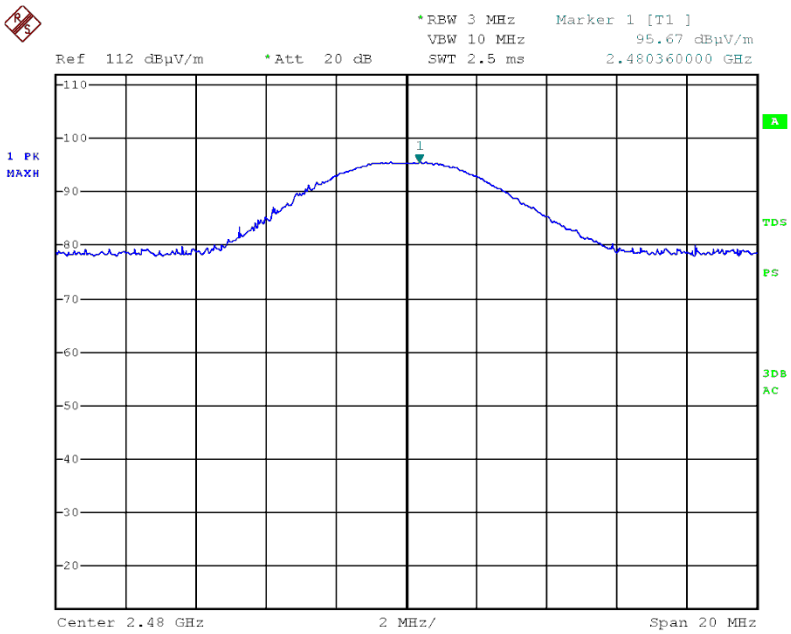


**Figure 24 Maximum Peak Power - 2480.0 MHz – Vertical**

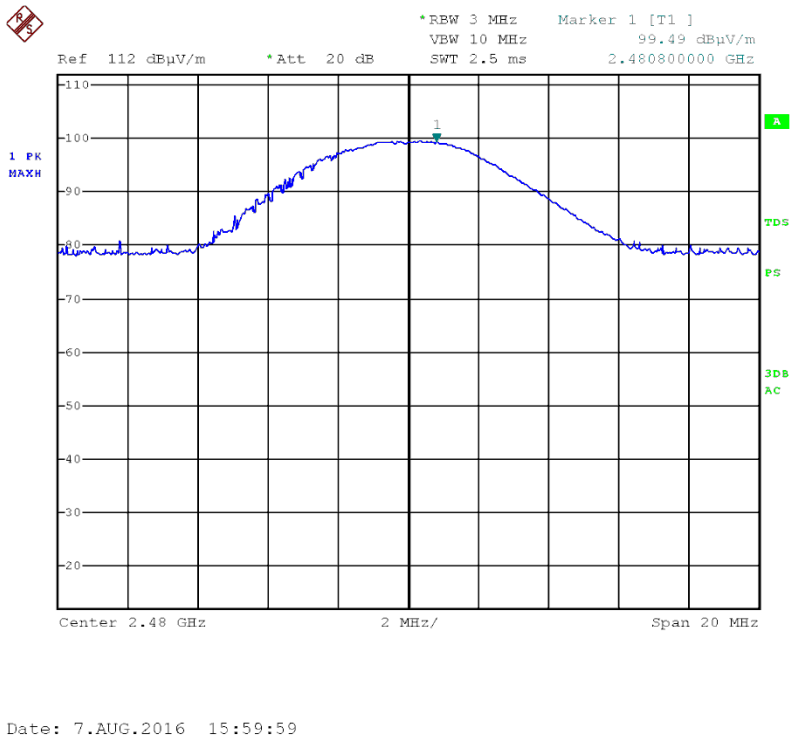


**Figure 25 Maximum Peak Power - 2480.0 MHz – Horizontal**

## 6.5 *Test Equipment Used; Maximum Peak Power Output*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Horn Antenna | ETS | 3115 | 6142 | May 19, 2015 | May 19, 2018 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 26 Test Equipment Used**

# 7. Band Edge Spectrum

## 7.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(d)

## 7.2 *Test Procedure*

(Temperature (22°C)/ Humidity (59%RH))

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

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure* 2.

The RBW was set to 100 kHz.

## 7.3 *Test Limit*

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

## 7.4 *Test Results*

| Operation Frequency | Band Edge Frequency | Spectrum Level | Limit | Margin |
|---|---|---|---|---|
| (MHz) | (MHz) | (dBuV/m) | (dBuV/m) | (dB) |
| 2405.0 | 2400.0 | 64.2 | 75.0 | -10.8 |
| 2480.0 | 2483.5 | 63.8 | 74.0 | -10.2 |

**Figure 27 Band Edge Spectrum**

JUDGEMENT: Passed by 10.2 dB

For additional information see *Figure 28* and *Figure 29.*

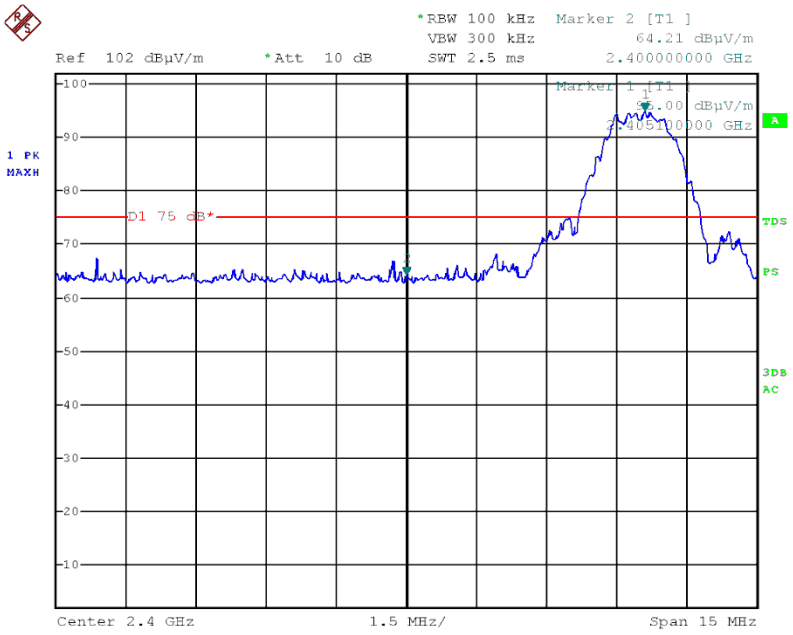


**Figure 28 —Lower Band Edge**

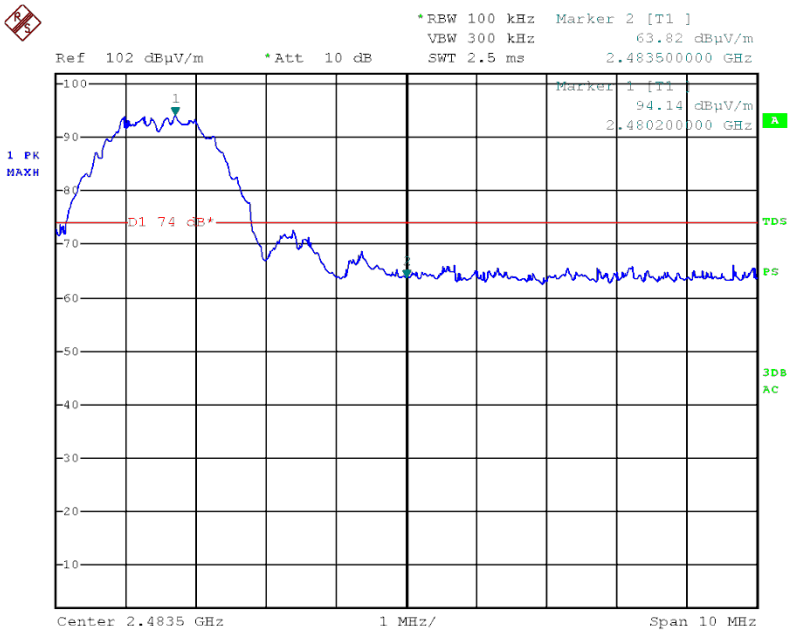


**Figure 29 —Upper Band Edge**

## 7.5 *Test Equipment Used; Band Edge Spectrum*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Horn Antenna | ETS | 3115 | 6142 | May 19, 2015 | May 19, 2018 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 30 Test Equipment Used**

# 8. Emissions in Non-Restricted Frequency Bands

## 8.1 *Test Specification*

FCC Part 15, Subpart C, Section 247(d)

## 8.2 *Test Procedure*

(Temperature (23°C)/ Humidity (60%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

**For measurements between 0.009MHz-30.0MHz:**

The E.U.T was tested inside the chamber at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

**For measurements between 30.0MHz-1.0GHz**:
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 frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

**For measurements between 1.0GHz-25.0GHz:**

The E.U.T was tested inside the chamber at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -25.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

RBW was set to 100 kHz.
The E.U.T. was operated at the low, mid and high channels (2405.0 MHz, 2440 MHz and 2480.0 MHz).

## 8.3 *Test Limit*

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

## 8.4 *Test Results*

JUDGEMENT: Passed

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

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247(d) specification.

## 8.5 *Test Instrumentation Used, Emission in Non Restricted Frequency Bands*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | HP | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 |
| EMI Receiver | HP | 8542E | 3906A00276 | March3, 2016 | March3, 2017 |
| RF Filter Section | HP | 85420E | 3705A00248 | March3, 2016 | March3, 2017 |
| Spectrum Analyzer | HP | 8564E | 3442A00275 | March 10, 2016 | March 10, 2017 |
| Biconical Antenna | EMCO | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | November 5, 2015 | November 5, 2016 |
| Log Periodic Antenna | EMCO | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna | ARA | SWH-28 | 1007 | March 30, 2014 | September 30, 2016 |
| Low Noise Amplifier Chain | HP + Miteq | AFSX4-02001800-50-8P | - | July 20, 2016 | July 20, 2017 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 31 Test Equipment Used**

## 8.6 *Field Strength Calculation*

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors", 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.

# 9. Emissions in Restricted Frequency Bands

## 9.1 *Test Specification*

FCC Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

## 9.2 *Test Procedure*

(Temperature (23°C)/ Humidity (60%RH))

**For measurements between 0.009MHz-30.0MHz:**

The E.U.T was tested inside the chamber at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

**For measurements between 30.0MHz-1.0GHz**:
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 frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

**For measurements between 1.0GHz-25.0GHz:**

The E.U.T was tested inside the chamber at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -25.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

The E.U.T. was operated at the low, mid and high channels. (2405, 2440, 2480 MHz).

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.

## 9.3 *Test Limit*

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) | Field strength (dBµV/m) | Field strength* (dBµV/m)@3m |
|---|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 | 48.5-13.8 | 128.5-73.8 |
| 0.490-1.705 | 24000/F(kHz) | 30 | 33.8-23.0 | 73.8-63.0 |
| 1.705-30.0 | 30 | 30 | 29.5 | 69.5 |
| 30-88 | 100 | 3 | 40.0 | 40.0 |
| 88-216 | 150 | 3 | 43.5 | 43.5 |
| 216-960 | 200 | 3 | 46.0 | 46.0 |
| Above 960 | 500 | 3 | 54.0 | 54.0 |

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

**Figure 32 Table of Limits**

## 9.4 *Test Results*

JUDGEMENT: Passed by 0.4dB

For the operation frequency of 2405 MHz, the margin between the emission level and the specification limit is in the worst case 2.5dB at the frequency of 2390.0 MHz, vertical polarization.

For the operation frequency of 2440 MHz, the margin between the emission level and the specification limit is in the worst case 13.0dB at the frequency of 4880.0 MHz, horizontal polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case 0.4dB at the frequency of 2483.5 MHz, horizontal polarization.

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

The details of the highest emissions are given in *Figure 33* to *Figure 34*.

# Radiated Emission

E.U.T Description Outdoor Payment Terminal
Type OrPAY1000
Serial Number: 1021266

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 0.009MHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak

| Operation Frequency | Freq. | Polarity | Peak Reading | Peak Limit | Peak Margin |
|---|---|---|---|---|---|
| (MHz) | (MHz) | (H/V) | (dBµV/m) | (dBµV/m) | (dB) |
| 2405.0 | 2390.0 | H | 63.8 | 74.0 | -10.2 |
| 2405.0 | 2390.0 | V | 63.8 | 74.0 | -10.2 |
| 2405.0 | 4810.0 | H | 56.7 | 74.0 | -17.3 |
| 2405.0 | 4810.0 | V | 57.0 | 74.0 | -17.0 |
| 2440.0 | 4880.0 | H | 58.0 | 74.0 | -16.0 |
| 2440.0 | 4880.0 | V | 57.6 | 74.0 | -16.4 |
| 2480.0 | 4960.0 | H | 59.7 | 74.0 | -14.3 |
| 2480.0 | 4960.0 | V | 59.6 | 74.0 | -14.4 |
| 2480.0 | 2483.5 | H | 70.3 | 74.0 | -3.7 |
| 2480.0 | 2483.5 | V | 67.3 | 74.0 | -6.7 |

**Figure 33. 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

E.U.T Description Outdoor Payment Terminal
Type OrPAY1000
Serial Number: 1021266

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 0.009MHz to 25.0 GHz
Test Distance: 3 meters Detector: Average

| Operation Frequency | Freq. | Polarity | Average Reading | Average Limit | Average Margin |
|---|---|---|---|---|---|
| (MHz) | (MHz) | (H/V) | (dBµV/m) | (dBµV/m) | (dB) |
| 2405.0 | 2390.0 | H | 51.3 | 54.0 | -2.7 |
| 2405.0 | 2390.0 | V | 51.5 | 54.0 | -2.5 |
| 2405.0 | 4810.0 | H | 40.8 | 54.0 | -13.2 |
| 2405.0 | 4810.0 | V | 48.2 | 54.0 | -5.8 |
| 2440.0 | 4880.0 | H | 41.0 | 54.0 | -13.0 |
| 2440.0 | 4880.0 | V | 40.5 | 54.0 | -13.5 |
| 2480.0 | 4960.0 | H | 41.5 | 54.0 | -12.5 |
| 2480.0 | 4960.0 | V | 41.1 | 54.0 | -12.9 |
| 2480.0 | 2483.5 | H | 53.6 | 54.0 | -0.4 |
| 2480.0 | 2483.5 | V | 53.0 | 54.0 | -1.0 |

**Figure 34. 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

## 9.5 *Test Instrumentation Used; Emissions in Restricted Frequency Bands*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | HP | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 |
| EMI Receiver | HP | 8542E | 3906A00276 | March 3, 2016 | March 3, 2017 |
| RF Filter Section | HP | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 |
| Spectrum Analyzer | HP | 8564E | 3442A00275 | March 10, 2016 | March 10, 2017 |
| Biconical Antenna | EMCO | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | November 5, 2015 | November 5, 2016 |
| Log Periodic Antenna | EMCO | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna | ARA | SWH-28 | 1007 | March 30, 2014 | September 30, 2016 |
| Low Noise Amplifier Chain | HP + Miteq | AFSX4-02001800-50-8P | - | July 20, 2016 | July 20, 2017 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 35 Test Equipment Used**

# 10. Transmitted Power Density

## 10.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(e)

## 10.2 *Test Procedure*

(Temperature (22°C)/ Humidity (58%RH))

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

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. . The distance between the E.U.T to the test antenna was 3m.

The configuration tested is shown in *Figure* 2.

The spectrum analyzer was set to 3 kHz RBW and VBW to 10 kHz.

The E.U.T was evaluated in 3 channels: Low (2405MHz), Mid (2440MHz) and High (2480MHz).

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:

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

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

## 10.3 *Test Limit*

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

## 10.4 *Test Results*

| Operation Frequency | Reading Spectrum Analyzer | Reading Spectrum Analyzer | Limit | Margin |
|---|---|---|---|---|
| (MHz) | (dBµV/m) | (dBm) | (dBm) | (dB) |
| 2405.0 | 89.3 | -5.9 | 8.0 | -13.9 |
| 2440.0 | 88.5 | -6.7 | 8.0 | -14.7 |
| 2480.0 | 88.2 | -7.0 | 8.0 | -15.0 |

**Figure 36 Test Results**

JUDGEMENT: Passed by 13.9dB

For additional information see *Figure 37* to *Figure 39.*

# Transmitted Power Density

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Model Number | OrPAY1000 |
| Part Number: | 1021266 |


**Figure 37 — Transmitted Power Density - 2405.0 MHz**

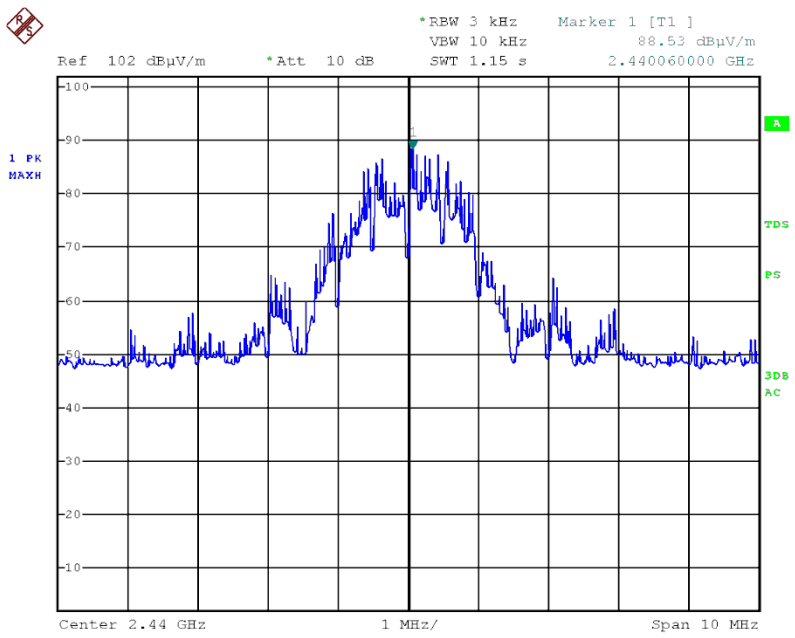


**Figure 38 — Transmitted Power Density -2440.0 MHz**

# Transmitted Power Density

| | |
|---|---|
| E.U.T Description | Outdoor Payment Terminal |
| Model Number | OrPAY1000 |
| Part Number: | 1021266 |

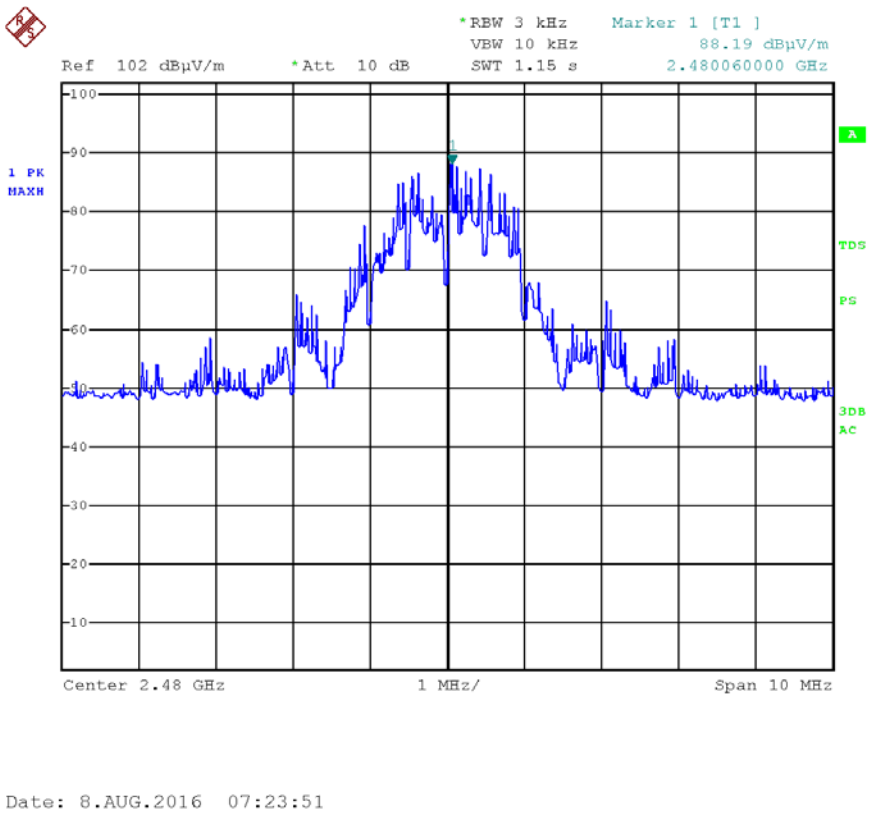


**Figure 39 — Transmitted Power Density - 2480.0 MHz**

## 10.5 *Test Equipment Used; Transmitted Power Density*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|---|---|---|---|---|---|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Horn Antenna | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |

**Figure 40 Test Equipment Used**

# 11. Antenna Gain/Information

TI antenna SWRA117D with an antenna gain of +5.3dB. It is a small size 2.4 GHz PCB antenna.

TI antenna SWRU120B with antenna gain of +3.3 dB. It is a 2.4 GHz Inverted F antenna

# 12. R.F Exposure/Safety

Typical use of the E.U.T. is as a Point of Sale Terminal

The typical placement of the E.U.T. is in a gas station. The typical distance between the E.U.T. and the user is 0.5 cm.

Section 4.3.1 and Appendix A of KDB447498 D01 V05 was used as the guidance as follows:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *· [√f(GHz)] =2.75/5 * 1.55= 0.85 this value is less than 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.

The SAR measurement is not necessary

# 13. APPENDIX A - CORRECTION FACTORS

## 13.1 *Correction factors for RF OATS Cable 35m*

***ITL #1784***

| Frequency ( MHz) | Cable loss (dB) |
|---|---|
| 10.0 | 0.3 |
| 20.0 | 0.2 |
| 50.0 | -0.1 |
| 100.0 | -0.6 |
| 200.0 | -1.2 |
| 500.0 | -2.3 |
| 1000.0 | -3.6 |

## 13.2 *Correction factors for RF OATS Cable 10m*

***ITL #1794***

| Frequency(MHz) | Cable loss(dB) |
|---|---|
| 10.0 | -0.3 |
| 20.0 | -0.3 |
| 50.0 | -0.5 |
| 100.0 | -0.7 |
| 200.0 | -1.1 |
| 500.0 | -1.8 |
| 1000.0 | -2.7 |

## 13.3 *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 |

## 13.4 *Correction factors for* *Horn ANTENNA*

***Model: 3115***

***Antenna serial number: 29845***

**3 meter range**

| f(GHz) | AF(dB/m) | GA(dB) |
|---|---|---|
| 0.75 | 25 | 3 |
| 1G | 23.5 | 7 |
| 1.5G | 26 | 8 |
| 2G | 29 | 7 |
| 2.5G | 27.5 | 10 |
| 3G | 30 | 10 |
| 3.5G | 31.5 | 10 |
| 4G | 32.5 | 9.5 |
| 4.5G | 32.5 | 10.5 |
| 5G | 33 | 10.5 |
| 5.5G | 35 | 10.5 |
| 6G | 36.5 | 9.5 |
| 6.5G | 36.5 | 10 |
| 7G | 37.5 | 10 |
| 7.5G | 37.5 | 10 |
| 8G | 37.5 | 11 |
| 8.5G | 38 | 11 |
| 9G | 37.5 | 11.5 |
| 9.5G | 38 | 11.5 |
| 10G | 38.5 | 11.5 |
| 10.5G | 38.5 | 12 |
| 11G | 38.5 | 12.5 |
| 11.5G | 38.5 | 13 |
| 12G | 38 | 13.5 |
| 12.5G | 38.5 | 13 |
| 13G | 40 | 12 |
| 13.5G | 41 | 12 |
| 14G | 40 | 13 |
| 14.5G | 39 | 14 |
| 15G | 38 | 15.5 |
| 15.5G | 37.5 | 16 |
| 16G | 37.5 | 16 |
| 16.5G | 39 | 15 |
| 17G | 40 | 15 |
| 17.5G | 42 | 13.5 |
| 18G | 42.5 | 13 |

## 13.5 *Correction factors for Log Periodic Antenna EMCO, Model 3146, Serial #9505-4081*

| Frequency [MHz] | AF [dB/m] |
|---|---|
| 200.0 | 11.47 |
| 250.0 | 12.06 |
| 300.0 | 14.77 |
| 400.0 | 15.77 |
| 500.0 | 18.01 |
| 600.0 | 18.84 |
| 700.0 | 20.93 |
| 800.0 | 21.27 |
| 900.0 | 22.44 |
| 1000.0 | 24.10 |

## 13.6 *Correction factors for Biconical Antenna EMCO, Model 3110B, Serial #9912-3337*

| Frequency [MHz] | AF [dB/m] |
|---|---|
| 30.0 | 14.18 |
| 35.0 | 13.95 |
| 40.0 | 12.84 |
| 45.0 | 11.23 |
| 50.0 | 11.10 |
| 60.0 | 10.39 |
| 70.0 | 9.34 |
| 80.0 | 9.02 |
| 90.0 | 9.31 |
| 100.0 | 8.95 |
| 120.0 | 11.53 |
| 140.0 | 12.20 |
| 160.0 | 12.56 |
| 180.0 | 13.49 |
| 200.0 | 15.27 |

## 13.7 *Correction factors for ACTIVE LOOP ANTENNA*

## Model 6502
## S/N 9506-2950

| f(MHz) | MAF(dBs/m) | AF(dB/m) |
|---|---|---|
| 0.01 | -33.1 | 18.4 |
| 0.02 | -37.2 | 14.3 |
| 0.03 | -38.2 | 13.3 |
| 0.05 | -39.8 | 11.7 |
| 0.1 | -40.1 | 11.4 |
| 0.2 | -40.3 | 11.2 |
| 0.3 | -40.3 | 11.2 |
| 0.5 | -40.3 | 11.2 |
| 0.7 | -40.3 | 11.2 |
| 1 | -40.1 | 11.4 |
| 2 | -40 | 11.5 |
| 3 | -40 | 11.5 |
| 4 | -40.1 | 11.4 |
| 5 | -40.2 | 11.3 |
| 6 | -40.4 | 11.1 |
| 7 | -40.4 | 11.1 |
| 8 | -40.4 | 11.1 |
| 9 | -40.5 | 11 |
| 10 | -40.5 | 11 |
| 20 | -41.5 | 10 |
| 30 | -43.5 | 8 |