



Report for ProPhotonix

on

EMC Measurements for COBRA Cure FX2

Project Number EMT17J013

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Cork,
July 2017

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1. Executive Summary

The EUT (Equipment Under Test) meets the EMC requirements of the product standard **EN 61000-6-2: 2005** Generic standards - Immunity for industrial environments and **EN 61000-6-3: 2007 +A1:2011** Generic standards - Emission standard for residential, commercial and light-industrial environments.

1.1. Emissions tests called out by the product standard

Test	Standard and year	Result	Comment
Harmonic Emissions	EN61000-3-2 (2006) + A1:2009 + A2:2009	N/A	EUT requires a DC supply
Flicker	EN61000-3-3 (2008)	N/A	EUT requires a DC supply
Conducted Emissions	EN 55016-2-1(2009) & A1(2011)	N/A	EUT requires a DC supply
Radiated Emissions	EN 55016-2-3 (2010) & A1 (2010)	Pass	-

1.2. Immunity tests called out by the product standard

Test	Standard and year	Result	Comment
Low Frequency			
Mains Dips	EN61000-4-11(2004)	N/A	EUT requires a DC supply
High Frequency			
ESD	EN61000-4-2 (2009)	Pass	-
Radiated	EN61000-4-3 (2006)	Pass	-
EFT	EN61000-4-4 (2004) and A1:2010	Pass	-
Surge	EN61000-4-5 (2006)	Pass	-
Conducted	EN61000-4-6 (2009)	Pass	-
Magnetic Field Immunity	EN61000-4-8 (2010)	N/A	-

1.3. Declaration of Conformity.

The following statement can be added to the DoC.
This equipment can be presumed to comply with the EMC Directive 2014/30/EU.

Conformity was demonstrated by meeting the following standards.

EN 61000-6-2

EN 61000-6-3

Equipment classification: Class B

2. Introduction

2.1. Time and Place

The measurements took place at the laboratories and the test site of ElectroMagnetic Technologies Ltd., (EMT), Inniscarra, Co. Cork, June to July 2017.

2.2. Typical Climatic Conditions (ESD tests)

Temperature	17°C
Relative Humidity	56%
Pressure	1020hPa

2.3. Calibration

All EMT equipment is regularly calibrated and full details can be traced through the serial number of each device.

2.4. Present

Tom O'Brien	ElectroMagnetic Technologies Ltd.
Naoise Mc Sweeney	ElectroMagnetic Technologies Ltd.

2.5. Equipment Under Test

EUT	ProPhotonix COBRA Cure FX2 LED curing light.
Comprising	EUT with 48V PSU and second tunable power supply to provide a 0 to 10 volt DC signal as dimmer control for the EUT. All power lines and signal lines were provided and consisted of shielded cabling. The device can be run in digital and analog mode. All tests here were performed with the device in analog mode only.

2.6. Manufacturer

ProPhotonix Ltd.
Little Island
Cork

2.7. Reproductions

This report shall not be reproduced, except in full, without the written permission of EMT.

The results of this report refer only to the item tested.

3. Emissions - Harmonics

3.1. Results

The test is not applicable to the EUT as it requires a DC power supply to operate.

4. Emissions - Flicker

4.1. Results

The test is not applicable to the EUT as it requires a DC power supply to operate.

5. Conducted Emissions

5.1. Results

The test is not applicable to the EUT as it requires a DC power supply to operate.

6. Radiated Emissions tests.

6.1. Test Equipment

EMT 3m site in Inniscarra, Co. Cork.
 Biconical Antenna -Eaton 94455-1 (S/N 1220)
 Log periodic Antenna - EMCO 3146 (S/N 9210-3462)
 Bi log antenna (S/N EMT#030)
 Rhode and Schwarz ESVS 30 receiver (S/N 826006/004)
 Rhode and Schwarz ESR EMI Test Receiver
 Rohde & Schwarz FSP 30 Spectrum Analyser (S/N 100025)

Belling Lee Anechoic Chamber (S/N 60512)
 Hewlett Packard 8447F amplifier. (S/N 3113A06542)

6.2. Measurements

Tests were performed in accordance with the radiated emissions aspect of EN 55016-2-3 with the limits defined in EN 61000-6-3.

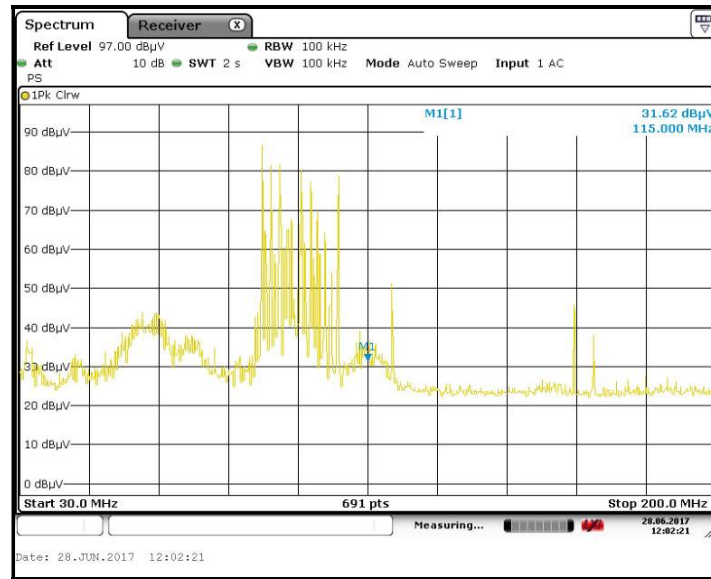
The initial check, primarily to look for narrowband frequencies, was taken in the anechoic chamber. EMT do not consider the chamber to be accurate enough for EMC purposes and the final check is taken at the OATS.

EUT was setup with signal line dimmer set to 10V. Note that a loan unit of Rhode and Schwarz ESR EMI Test Receiver was used for these measurements as the Rohde & Schwarz FSP 30 Spectrum Analyser was undergoing calibration. The traces in the graphs below do not include antenna and gain factors as a result. Quasi Peak results in the table below do include all factors and device was below the limits at all frequencies measured.

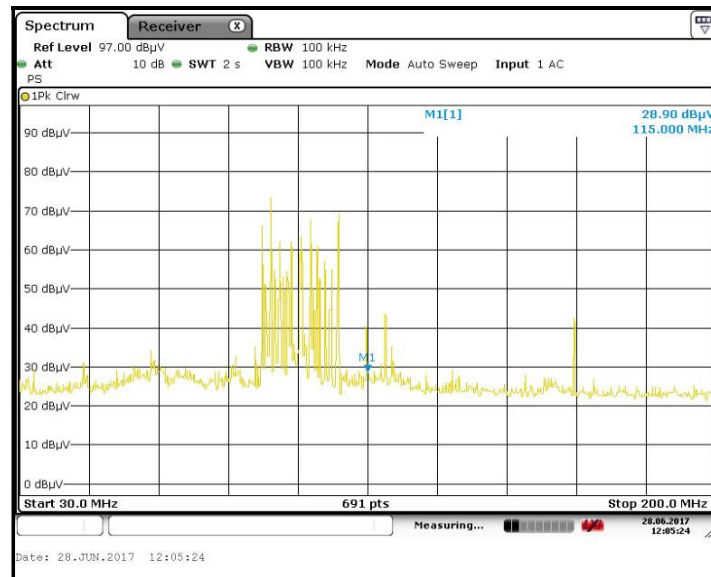
NB = Narrowband, BB = Broadband, QP = Quasi Peak

Frequency (MHz)	Level dBuV/m		Signal type	Limit dBuV	
	Hor.	Vert.		A	B
60 MHz	-	24	QP	50	40
59 MHz	6	-	QP	50	40

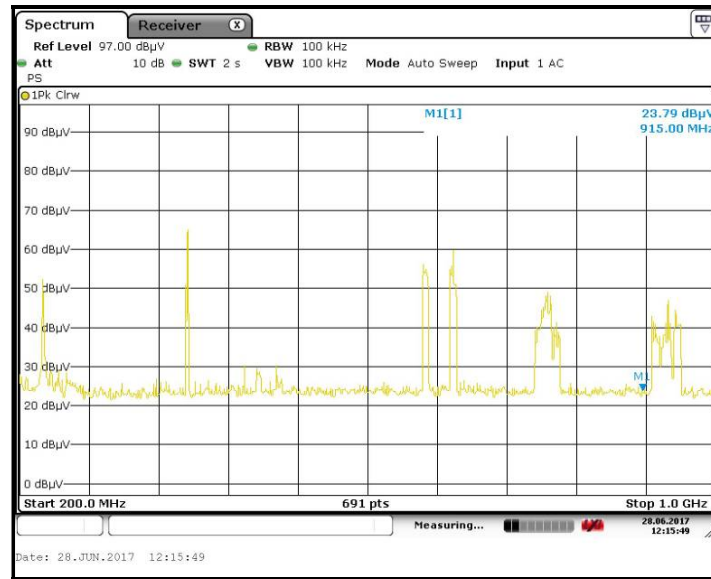
Table 1 QP Radiated emissions at 3m distance



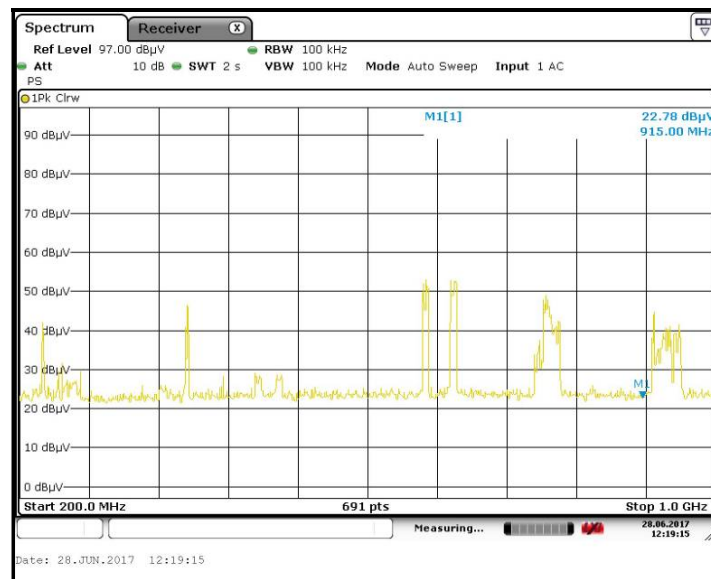
Graph 1 30 to 200MHz Vertical (without antenna and gain factors)



Graph 2 30 to 200MHz Horizontal (without antenna and gain factors)



Graph 3 200MHz to 1 GHz Vertical (without antenna and gain factors)



Graph 4 200MHz to 1 GHz Horizontal (without antenna and gain factors)

6.3. Conclusion

The EUT meets the radiated emissions requirements of EN 61000-6-3.

6.4. *Photographs*



Photo 1 VHF setup of EUT.

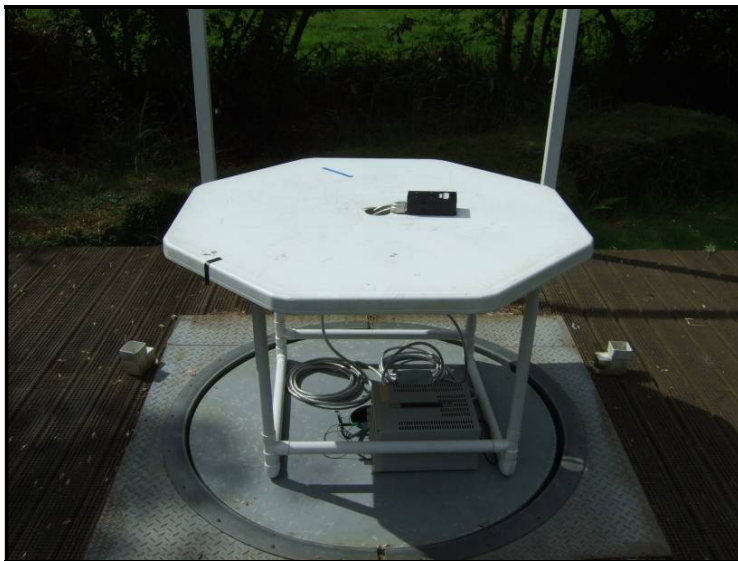


Photo 2 EUT with connected PSU in 270deg position.



Photo 3 UHF setup of EUT with antenna in vertical position.



Photo 4 UHF setup of EUT with antenna in horizontal position.

7. Immunity Testing – Voltage Dips and Variations.

7.1. Results

The test is not applicable to the EUT as it requires a DC power supply to operate.

8. Immunity Testing - Surge

8.1. Surge Test Equipment

EMT Laboratories, Inniscarra, Co. Cork

EMV UCS500N Surge generator. (S/N P1442142222)

8.2. Surge Testing Test Method

Tests were performed in accordance with the standard EN61000-4-5 with the criterion to be met defined in EN 61000-6-2.

Performance criteria allow the EUT to deviate from normal operation during application of the interference, but the unit must resume normal operation in the original state after application of the interference.

Testing was done on the 48V DC line with the EUT dimmer set to 1.6V.

Levels of interference are $\pm 500V$ Line 1 and 2 to Earth and $\pm 500V$ Line1 to Line2 (Live to neutral). The pulse repetition rate was set to 60 seconds.

Voltage	Coupling	No of pulses @ 0°, 90°, 180° & 270°	Effect
$\pm 500V$	L ₂ to L ₁	5 of each polarity	Slight dimming
$\pm 500V$	L ₂ to PE	5 of each polarity	Slight dimming
$\pm 500V$	L ₁ to PE	5 of each polarity	Slight dimming

Table 2 Surge immunity results

8.3. Comments

A slight dimming of the light was noted during the test but the EUT recovered without issue once the surge was removed.

The test was not applied to the signal lines as the test is applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 30 m.

8.4. Results

The EUT meets the surge requirements of EN 61000-6-2 provided cables <30m.

9. Immunity Testing - Fast Transient/Burst

9.1. Test Equipment

EMT Laboratories, Inniscarra, Co. Cork

EMV UCS500N Burst generator (S/N P1442142222)

9.2. Test Method, Interference Levels & Performance Criteria

Tests were performed in accordance with the standard EN61000-4-4 with the criterion to be met defined in EN 61000-6-2.

Performance criteria allow the EUT to deviate from normal operation during application of the interference, but the unit must resume normal operation in its original state after application of the interference.

EUT	Voltage	Coupling	Duration of pulsing	Effect
L	±2kV	Direct	60 secs	Slight flicker
L & E	±2kV	Direct	60 secs	No issues
N	±2kV	Direct	60 secs	No issues
N & E	±2kV	Direct	60 secs	No issues
N & L	±2kV	Direct	60 secs	No issues
L & N & E	±2kV	Direct	60 secs	No issues

Table 3 Input power cable.

EUT	Voltage	Coupling	Duration of pulsing	Effect
ALL PORTS	±1kV	Capacitive Clamp	60 secs @ 5kHz rep rate	No issues

Table 4 Input signal cable.

9.3. Comments

A slight flickering of the light was noted during the application of pulses on the live line of the DC power supply. The EUT recovered without intervention.

9.4. Results

The EUT meets the EFT requirements of EN 61000-6-2.

9.5. Photographs

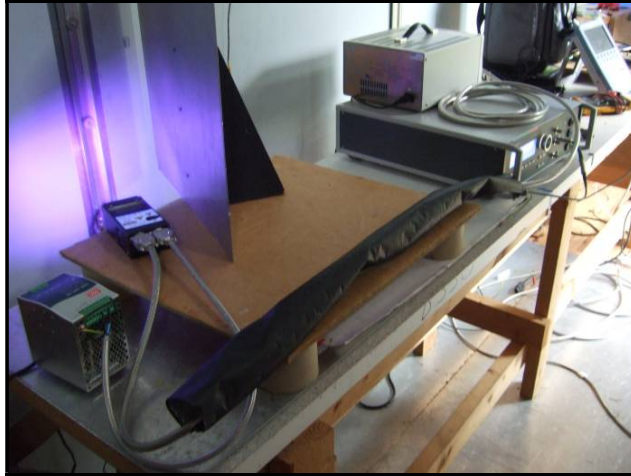


Photo 5 **Layout for EFT tests with capacitive coupling on signal line.**
(shield is placed near EUT for eye-safety)



Photo 6 **Layout for EFT tests with direct coupling on DC power lines.**

10. Immunity Testing - Conducted

10.1. Test Equipment

EMT Laboratories, Inniscarra, Co. Cork
EMT Laboratories Direct Injection box. S/N 003
Agilent E4421B Signal Generator (S/N GB39340725)
Rohde & Schwartz Oscilloscope RTO1022 (S/N 300029)
Bonn Elektronik Amplifier BSA 1010-50 (S/N 097515)
Luthi EM 101 EM Clamp (S/N 35340)

10.2. Conducted Immunity test method

Tests were performed in accordance with the conducted immunity standard EN61000-4-6 with the criterion to be met defined in 61000-6-2.

The test comprised setting up the cable to have 150Ω termination at both ends and then injecting a signal into either the direct coupler or the electromagnetic clamp (for signal cable). The power level on the E4421B AM frequency generator needed to get 10V on the cable was noted for each frequency. The power cable was then attached to the injection box and the noted levels applied to the RF port.

The EUT was set to maximum optical power (10V on signal line). The EUT was monitored via camera for eye safety.

10.3. Conducted Immunity Test results

Range	Level	Modulation	Duration	Effect
150kHz to 80MHz	10V	1k/80%	3sec	No issues

Table 5 Results of Conducted Immunity Tests on mains cable.

Range	Level	Modulation	Duration	Effect
150kHz to 80MHz	10V	1k/80%	3sec	No issues

Table 6 Results of Conducted Immunity Tests on signal cable.

10.4. Results

The EUT meets the Conducted Immunity requirements of EN 61000-6-2.

10.5. Photographs



Photo 7 EUT setup for direct injection on DC power line.

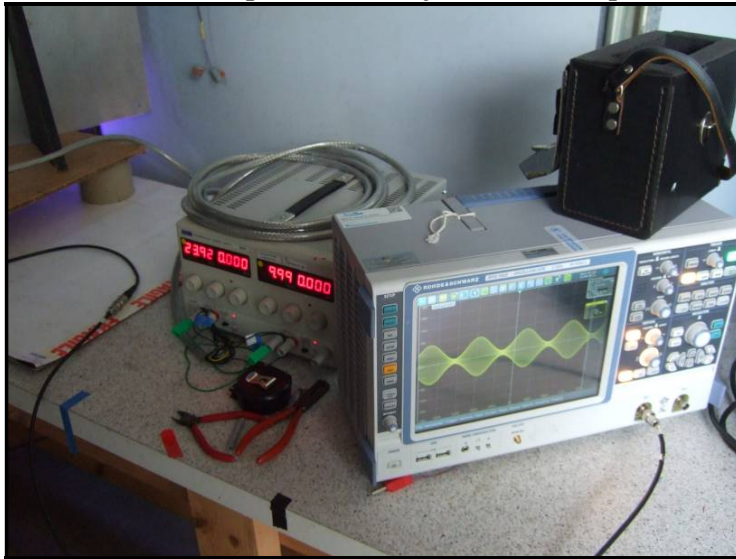


Photo 8 EUT setup showing dimmer at 9.99V and applied AM signal on scope.

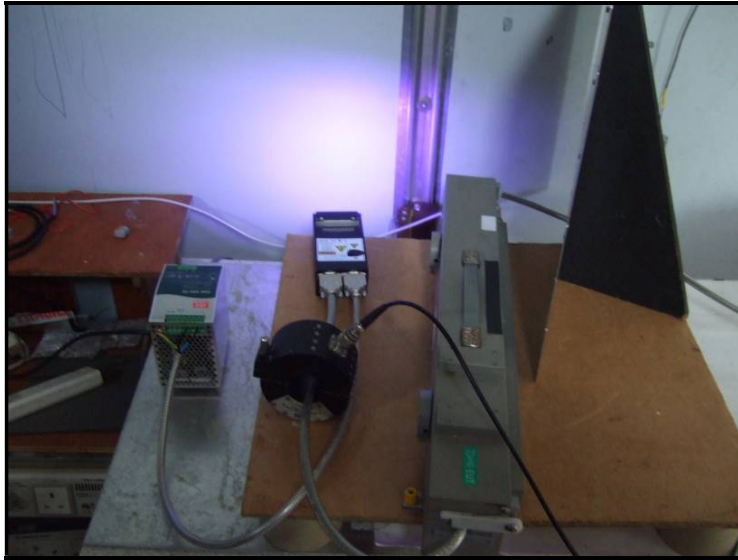


Photo 9 EUT setup using EM clamp on signal line.

11. Immunity - Radiated

11.1. Test Equipment

EMT Laboratories, Inniscarra, Co. Cork.
HP 8648A Signal Generator (S/N 3625U0058)
Radisense Field Probe (S/N 03D00370SNO-06)
Belling Lee Anechoic Chamber (S/N 60512)
Prana MT100 80MHz to 1GHz.
Teseq 800MHz to 3.1GHz Amplifier CBA 3G-050 (S/N T43858)
Rohde & Schwarz Sig, Gen. SMR 20 (1017150)
Rohde & Schwarz Oscilloscope RTO1022 (S/N 300029)
RF Spin Horn Antenna 800MHz to 3GHz (S/N 130604A10)
Biconical Antenna HK 116 (S/N 832263/011)
Schwarzbeck 9107 Spade Antenna (S/N 1216)

Distance from Antenna to EUT is 2.8m

11.2. Test Method, Interference Levels & Performance Criteria

Tests were performed in accordance with the radiated immunity standard EN61000-4-3 with the criterion to be met defined in EN 61000-6-2.

This is a substitution method and the levels were determined by first radiating the isotropic antenna after placing it in the same position as the EUT would be during the tests. After noting the power required to give RF levels of 10V/m at the EUT, the isotropic antenna was removed and replaced with the EUT where it was altered between 6 faces for both Vertical and Horizontal polarity radiation.

11.3. Measurements

Range	Level	Modulation	Duration	Effect
80MHz to 3GHz	10V/m	1k/80%	3sec	No Issues

Table 7 Radiated Immunity results for all positions and all polarities

11.1. Comments

A previous version of the device failed radiated immunity. This failure was not repeatable on the current version of the product. ProPhotonix have removed the paint coating on the inside casing of the EUT in the latest version tested.

11.2. Results

The EUT meets the Radiated Immunity requirements of EN 61000-6-2.

11.3. Photographs

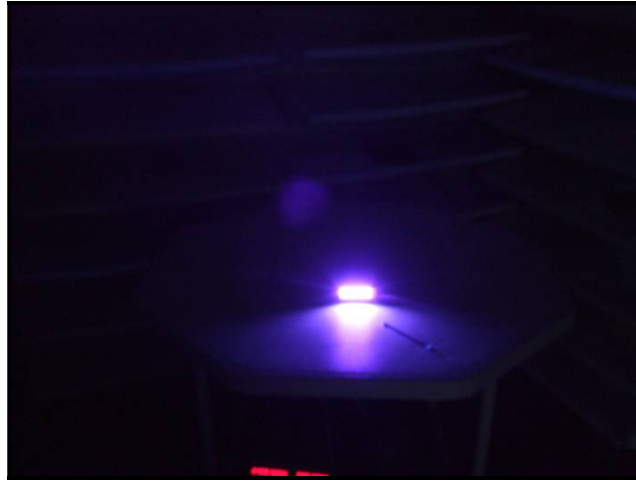


Photo 10 EUT at position 0deg.



Photo 11 EUT at position 90deg.



Photo 12 EUT at position 180deg.



Photo 13 EUT at position -90deg.



Photo 14 EUT at position Top.



Photo 15 EUT at position Bottom.

12. Immunity - Electrostatic Discharge

12.1. Test Equipment

EMT Laboratories, Inniscarra, Co. Cork.
Schaffner NSG432 ESD Gun (S/N 6909006)

12.2. Test Method

Tests were performed in accordance with the voltage dips and short interruptions standard EN61000-4-2 with the criterion to be met defined in EN 61000-6-2.

Performance criteria allow the EUT to deviate from normal operation during application of the interference, but the unit must resume normal operation in the original state after application of the interference.

Levels of interference of $\pm 8\text{kV}$ Air Discharge were applied to the points indicated on the photograph.

Levels of interference of $\pm 4\text{kV}$ Contact Discharge were applied to the points indicated on the photograph.

10 pulses of + and – polarity were applied at all the air discharge points.
10 pulses of + and – polarity were applied at all contact discharge points.
Over 200 pulses were applied in total.
Contact Discharge was also performed for horizontal and vertical coupling.

12.3. Comments

A previous device failed ESD requirements but was subsequently modified by ProPhotonix and now it is unaffected by ESD pulses per the standard EN 61000-6-2.

12.4. Results

The EUT meets the ESD requirements of EN 61000-6-2.

12.5. Photographs

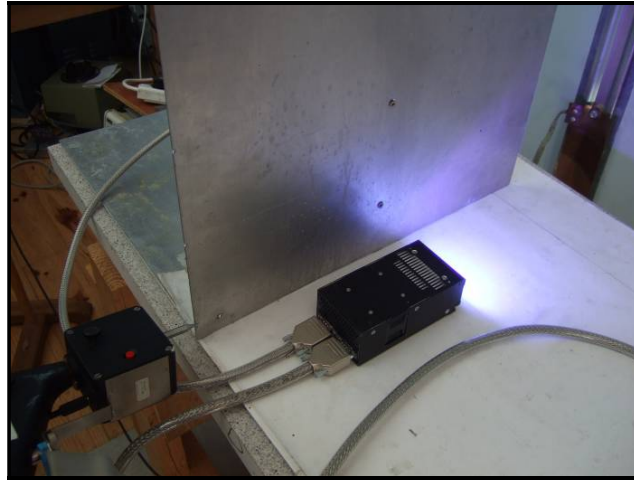


Photo 16 EUT setup during vertical coupling discharge test

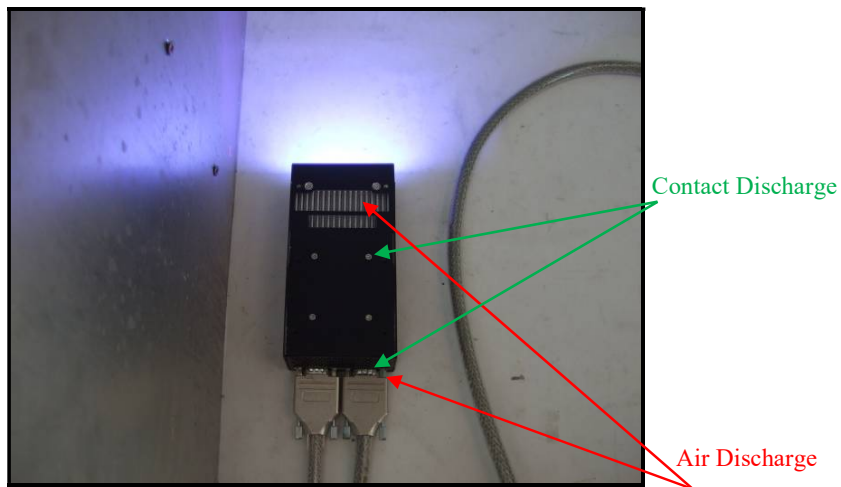
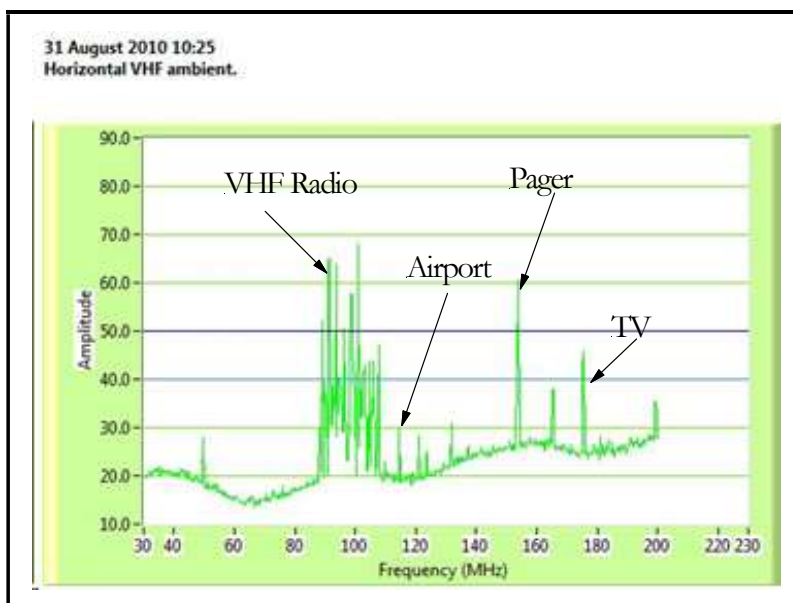


Photo 17 Discharge points

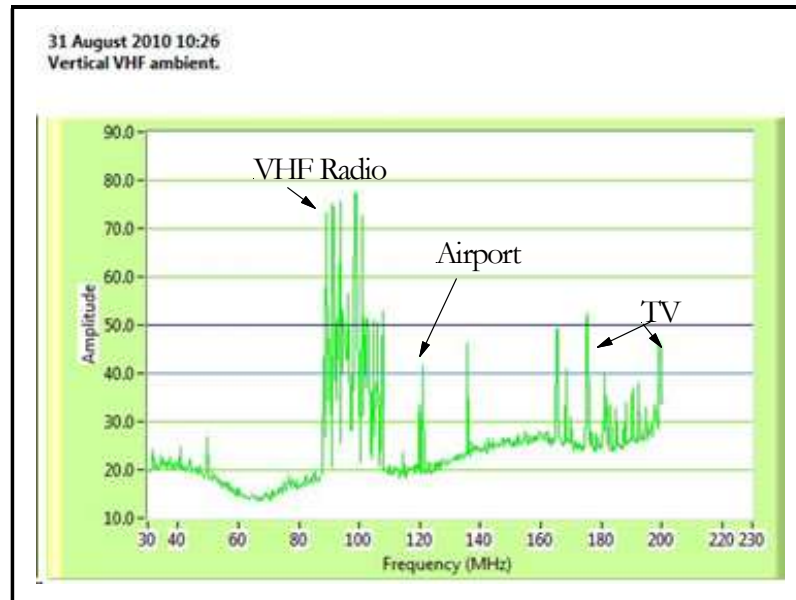
Appendices

Reading the graphs.

When viewing a graph of the signals present at an Open Area Test Site (OATS) you must first get familiar with the signals that are present all the time even when the equipment under test is not there. The principle signals at the EMT OATS site from external sources are VHF radio, Airport, Pagers, Police services and emergency services. Then there are the TV and mobile phones. Recently we have Audio and TV digital signals. Most of these external signals exceed the EMC limits, and this is necessary for people to broadcast and communicate. External signals are easily located by switching off and on the EUT. Part of EMT's expertise is knowing which signal are not from external sources but from the EUT. This is made easier by first checking the emissions from the EUT in the EMT Anechoic Chamber where there are no external signals. However for an accurate assessment of the emissions level it is necessary to measure the signal at the OATS. As some of these external signals are very stable EMT also uses them to do a brief check that no errors have crept into the measurement set up.



Graph 5 **The antenna in horizontal polarity.**



Graph 6 The antenna in vertical polarity.

Note the level differences in signals between horizontal and vertical polarities.

END OF REPORT