



Electromagnetic Compatibility and Electrical Safety

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REPORT Nr: PR-18-0459

Written for: Zero Point Energy, S.L.

Related to: EMC Tests practiced on
"Monsol CcM4" AC measurement device

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1. GENERAL CONDITIONS

This report refers only and exclusively to the objects and equipments that have undergone the test.

This report does not represent or prove to be the Certification of the Product. This must be expedited by the Certification Bodies or competent Authorities.

2. GUARANTIES

CEMITEC guaranties professional discretion by all its personnel in relation with the accomplishment of the works it carries out. All the data regarding the testing as well as the equipment itself will be treated confidentially.

CEMITEC guaranties the results and conclusions contained in this report; the data presented is the result of the tests and measurements carried out with the equipment. These tests are referred to the moment and conditions indicated in this report.

3. TEST CHARACTERISTICS

3.1. TESTS CARRIED OUT

The following services were requested to the EMC division in CEMITEC:

1. Radiated Emission. Electromagnetic radiated disturbance measurement ⁽¹⁾:

Standard: EN 61326-1:2013.
Limit: EN 61326-1:2013 and UNE-EN 55011:2011, +/A1:2011
(Group 1 Class A device, enclosure port, 3 m distance measurement).
Method: UNE-EN 55011:2011, +/A1:2011.

2. Conducted Emission. Electromagnetic conducted disturbance measurement ⁽¹⁾:

Standard: EN 61326-1:2013.
Limit: EN 61326-1:2013 and UNE-EN 55011:2011, +/A1:2011
(Group 1 Class A device, AC mains power port).
Method: UNE-EN 55011:2011, +/A1:2011.

3. Immunity to Electrostatic Discharges:

Standard: EN 61326-1:2013.
Failure Criterion: B.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM04 and UNE-EN 61000-4-2:2010.
Applied to: EUT's enclosure port.

4. Radiated Immunity to RF Field.

Standard: EN 61326-1:2013.
Failure Criterion: A.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM06, and UNE-EN 61000-4-3:2007, +/-A1:2008,
+/-A2:2011.
Applied to: EUT's enclosure port.

5. Conducted Immunity to EFT/Bursts.

Standard: EN 61326-1:2013.
Failure Criterion: B.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM03 and UNE-EN 61000-4-4:2013.
Applied to: AC mains power port, I/O signal/control ports.

6. Conducted Immunity to Surges.

Standard: EN 61326-1:2013.
Failure Criterion: B.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM08 and UNE-EN 61000-4-5:2015.
Applied to: AC mains power port, I/O signal/control ports.

7. Conducted immunity to RF Field.

Standard: EN 61326-1:2013.
Failure Criterion: A.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM01 and UNE-EN 61000-4-6:2014.
Applied to: AC mains power port, I/O signal/control ports.

8. Radiated immunity to Industrial Frequency Magnetic Field.

Standard: EN 61326-1:2013.
Failure Criterion: A.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM02 and UNE-EN 61000-4-8:2011.
Applied to: EUT's enclosure port.

9. Conducted immunity to voltage dips and short interruptions ⁽¹⁾.

Standard: EN 61326-1:2013.
Failure Criterion: B and C.
Severity Level: EN 61326-1:2013 (industrial electromagnetic environment).
Method: ME.CM07 and UNE-EN 61000-4-11:2005.
Applied to: AC mains power port.

4. TESTING CONDITIONS

4.1. ENVIRONMENTAL CONDITIONS

The environmental conditions that apply to the tests described in this report were measured in the EMC laboratory of CEMITEC. The temperature, humidity and pressure levels present, were always in the most restrictive range applicable to the EMC tests practiced in the laboratory, that is represented in the following table:

| | |
|----------------------|--------------------------------|
| Temperature | Min = 15 °C Max = 30 °C |
| Relative Humidity | Min = 45 % Max = 60 % |
| Atmospheric Pressure | Min = 860 mbar Max = 1060 mbar |

4.2. EQUIPMENT USED

- Space Saver 26 H Semianechoic Chamber (CM01/14) (Serial Nr 2176)
- Rohde & Schwarz ESR26 EMI Test Receiver (CM01/10) (Serial Nr 1316.3003K26/101302)
- AFJ LT32C LISN (CM01/48) (Serial Nr 32030518104)
- ETS 3142D BiconiLog Antenna (CM01/62) (Serial Nr 00122391)
- Schwarzbeck STLP9149 Stacked LogPeriodic Antenna (CM01/50) (Serial Nr STLP9149-004)
- Agilent N5181A signal generator (CM01/06) (Serial Nr MY47071030)
- ar 150W1000 amplifier (CM01/09) (Serial Nr 300665)
- BONN BDC 0810-40/200 bidirectional coupler (CM01/76) (Serial Nr 1610792)
- ar 50S1G4A amplifier (CM01/51) (Serial Nr 0322437)
- BONN BLMA 4060-40 amplifier (CM01/72) (Serial Nr 1510518)
- Rohde & Schwarz NRVD RF wattmeter (CM01/07) (Serial Nr 1000105)
- Rohde & Schwarz URV5-Z4 voltage probe (CM01/07-01) (Nº serie 838314/039)
- DARE!! CTR1009B Radicentre test system (CM01/75)
- DARE!! RPR2006C Power Sensor (CM01/73) (Serial Nr 15I00037SN040)
- ETS-Lindgren HI-6105 electric field probe (CM01/44) (Serial Nr 00061400)

- PPM Mini Scout Video Monitoring System (CM01/12)
- DARE!! Radimation EMC tests software (CM01/56)
- Schaffner NSG 438 ESD simulator system (CM01/33) (Serial Nr 378)
- Schaffner NSG 2050 module (CM01/26) (Serial Nr 200449-521LU)
- Schaffner PNW 2225 Burst module (CM01/30) (Serial Nr 200448-529LU)
- Schaffner CDN 3425 coupling clamp (CM01/32) (Serial Nr 1943)
- Schaffner PNW 2050 pulse network (CM01/27) (Serial No. 200445-549LU)
- Schaffner CDN 133 coupling/decoupling network (CM01/59) (Serial Nr 34446)
- EM TEST CWS500C Perturbation simulator (CM01/08) (Serial Nr 1001-04)
 - EM Test 6 dB / 75W attenuator (CM01/08-01) (Serial Nr 0002143A)
 - EM Test CDN M3/32A coupling/decoupling network (CM01/08-04) (Serial Nr 9912188C)
 - EM Test F2031 EM Clamp (CM01/08-02)
 - EM Test ICD V2.36 Test Software (CM01/08-09) (Serial Nr 002024)
- Schaffner MFO 6501 Magnetic field generator (CM01/21) (Serial Nr 34278)
- Schaffner INA 702 Magnetic field Antenna (CM01/22) (Serial Nr 131)
- FLUKE 179 multimeter (CM01/47) (Serial Nr 86500139)
- Narda-STS EHP-50D magnetic field probe (CM01/69) (Serial Nr 120WX20743)
- Schaffner WIN 2050 Test Software (CM01/37) (Serial Nr 690-814A)
- SPS EMV D 15000/PAS power system (CM01/78) (Serial Nr A5887 00/1 0417 and A5887 00/2 0417)
- Isolation Transformer (CM01/15)

4.3. TESTS TIME MAP

The tests described in this report were carried out at CEMITEC's facilities.

| TEST | TESTED SAMPLE | TEST DATE | RESULT |
|---|---------------|-----------------------|--------|
| Radiated Emission ⁽¹⁾ | A | 2018/03/22 | P |
| Conducted Emission ⁽¹⁾ | A | 2018/03/26 | |
| Electrostatic Discharge Immunity | A | 2018/03/23 | P |
| Radiated RF Immunity | A | 2018/03/22 | P |
| EFT / Bursts Immunity | A | 2018/03/23 | P |
| Surge Immunity | A | 2018/02/26, 27 and 28 | P |
| Conducted RF Immunity | A | 2018/03/23 | P |
| Magnetic field Immunity | A | 2018/03/23 | P |
| Voltage dips and short interruptions Immunity | A | 2018/03/26 | P |

5. EUT IDENTIFICATION DATA

5.1. TEST PETITIONER AND EUT SUPPLIER

Name: Zero Point Energy, S.L.

Address: Calle La Gitanilla, 17, Nave 01, portón A.
29004 Málaga (Spain).

Phone: 952 02 05 80.

Contact person: José Luis Vilches.

5.2. TESTED EQUIPMENT IDENTIFICATION

Product: AC Powered device for measurement purposes connected directly to a circuit breaker. CcM4 is able to measure voltage, current, power, energy and harmonic distortion of an electrical installation.

Trade mark: Monsol CcM.

Type: CcM4.

Manufacturer: Monsol Electronic, S.L.

Address: Calle La Gitanilla, 17, Nave 01, portón A.
29004 Málaga (Spain).

The equipments tested are described in the following tables:

SAMPLE A

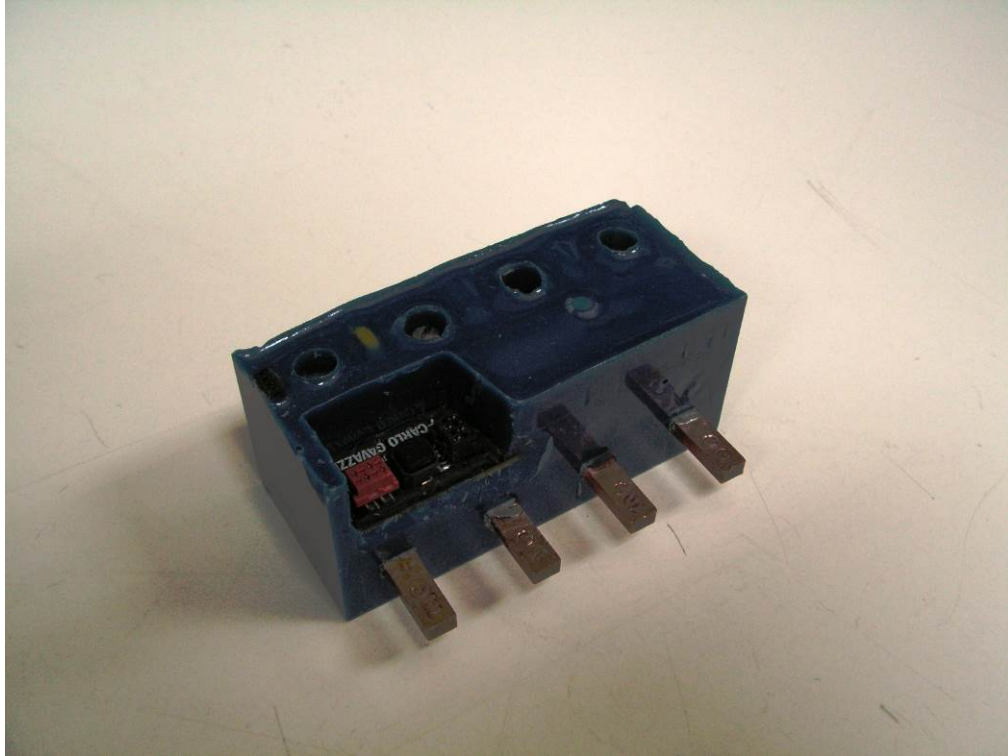
| CONTROL NUMBER | RECEPTION DATE | TRADE MARK | SERIAL NUMBER | TYPE | DESCRIPTION |
|----------------|----------------|---------------|-------------------|------|--|
| A01 | 2018/03/22 | Monsol CcM | Serie 03 N° 01 | CcM4 | AC Powered device for measurement purposes connected directly to a circuit breaker, able to measure voltage, current, power, energy and harmonic distortion of an electrical installation (EUT). |
| A02 | 2018/03/22 | --- | --- | --- | 660 Ω resistive load (AE). |
| A03 | 2018/03/22 | --- | --- | --- | Control and monitorization PC, and RS485 to USB converter (AE). |

EUT: Equipment Under Test. AE: Auxiliary Equipment, not under test

The interfaces corresponding to the tested samples are described below:

| INTERFACE Nr | TYPE/DESCRIPCIÓN | CABLE LENGTH |
|--------------|--|--------------|
| I01 | AC mains power port (400 Vac / 50 Hz) (L1+L2+L3+N) | L > 3 m |
| I02 | AC load port (connected in parallel to L3-N) | L > 3 m |
| I03 | RS485 communications port (modbus). Symmetrical, shielded line. Shielding not connected in any of the cable's sides. | L > 30 m |

5.3. TESTED SAMPLE IMAGES



5.4. TESTED EQUIPMENT MODES OF OPERATION

During the tests execution, the samples remained on the following operating modes:

- M01 mode of operation:

EUT ON, powered at 400 Vac and 50 Hz. Blue led on the EUT blinking. Auxiliary resistive load (600 Ω) connected between L3 and N. Auxiliary PC in continuous communication with the DUT, reporting its measurement data on the screen.

5.5. TESTED EQUIPMENT MONITORING CONDITIONS

The properly functioning of the EUT was checked before and after the tests.

During the immunity tests the behaviour of the DUT's led was visually checked. In addition, the information about the measurement data obtained by the DUT and provided by the auxiliary PC, was checked. Any other possible failures like communication losses, were also monitored with the PC.

5.6. PERFORMANCE CRITERIA APPLIED

- **Performance criterion A:** The DUT will work as expected during the tests. No communication losses or degradations in the behaviour of the DUT's led will be allowed during or after the tests.
- **Performance criterion B:** The DUT will work as expected after the tests. Certain degradation or loss of function will be admitted during them, provided that the EUT recovers itself after the application of the interference, returning to its original operation mode without any help from the user. The allowed degradation or loss of function would include events such as communication losses or unexpected blinkings on the DUT's led.
- **Performance criterion C:** The DUT will work as expected after the tests. Certain degradation or loss of function will be admitted during them, provided that the EUT recovers its functioning mode after the application of the interference, either by itself

or with the help of the user. The allowed degradation or loss of function would include events such as communication losses or unexpected blinkings on the DUT's led.

6. TEST RESULTS

6.1. EMISSION RESULTS

6.1.1. RADIATED EMISSION. DISTURBING RADIATED FIELD ⁽¹⁾

LIMITS OF PERMISSIBLE DISRUPTION

The applicable limit for the measurement of electromagnetic radiated disturbance on the surroundings port of the EUT, according to the standard EN 61326-1:2013 and UNE-EN 55011:2011, +/A1:2011, for Group 1 Class A devices, in the frequency range between 30 MHz and 1 GHz, and at a distance of three metres, is as follows:

| Frequency range | Limits (dBµV/m) |
|--------------------|-----------------|
| 30 MHz – 230 MHz | 50 (QP) |
| 230 MHz – 1000 MHz | 57 (QP) |

TESTING METHOD

According to the standard UNE-EN 55011:2011, +/A1:2011, for table standing equipment and 3 m distance measurement, with the exception that the antenna reached a maximum height of 2 m during the test. The measurement was carried out inside of an anechoic screened chamber.

MODES OF OPERATION

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

The sample tested was the sample A.

TEST SETUP

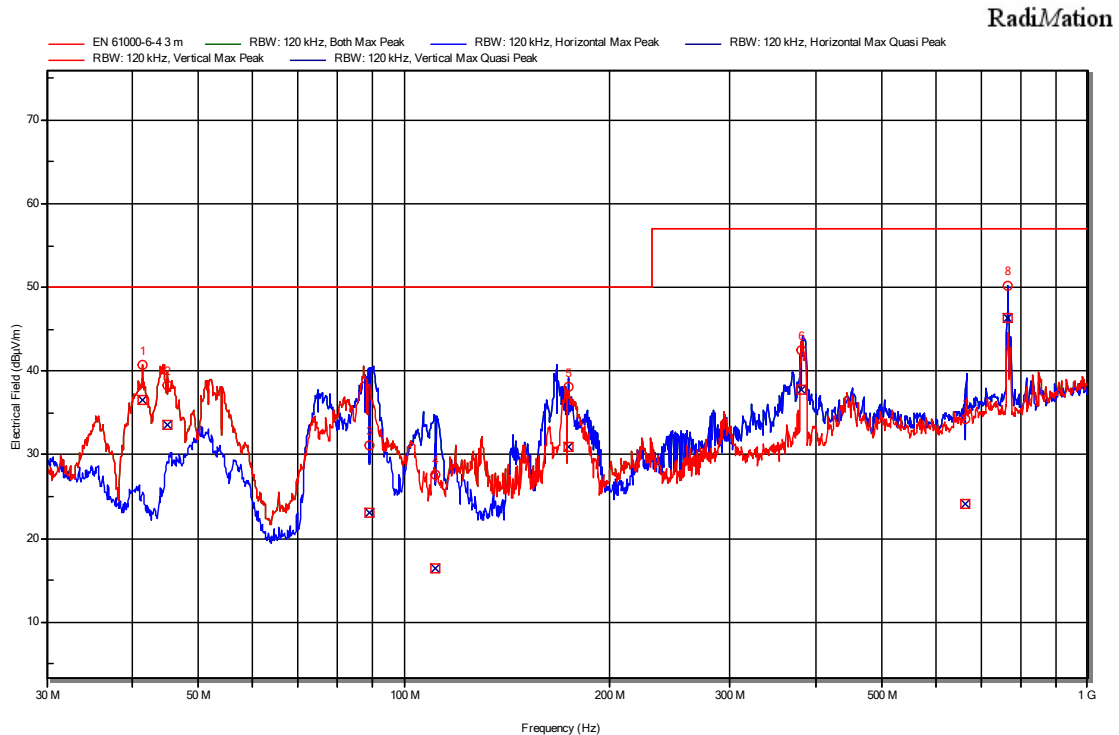


TEST RESULTS

P: Pass, F: Fail, NA:Not Applicable, NM: Not Measured

| Description | Result |
|-------------------------------------|--------|
| Radiated Emission. 30 MHz to 1 GHz. | P |

TABLES AND GRAPHICAL RESULTS



| Peak Number | Frequency | Quasi-Peak | Quasi-Peak Limit | Status | Angle | Height | Polarization |
|-------------|------------|-------------|------------------|--------|------------|--------|--------------|
| 1 | 41,37 MHz | 36,5 dBμV/m | 50 dBμV/m | Pass | 23 Degree | 1 m | Vertical |
| 2 | 45,09 MHz | 33,6 dBμV/m | 50 dBμV/m | Pass | 60 Degree | 1 m | Vertical |
| 3 | 89,04 MHz | 23,1 dBμV/m | 50 dBμV/m | Pass | 5 Degree | 1,95 m | Horizontal |
| 4 | 111,33 MHz | 16,3 dBμV/m | 50 dBμV/m | Pass | 15 Degree | 2 m | Horizontal |
| 5 | 174,15 MHz | 30,9 dBμV/m | 50 dBμV/m | Pass | 160 Degree | 2 m | Horizontal |
| 6 | 380,91 MHz | 37,7 dBμV/m | 57 dBμV/m | Pass | 95 Degree | 1,1 m | Vertical |
| 7 | 663,84 MHz | 24 dBμV/m | 57 dBμV/m | Pass | 165 Degree | 1,05 m | Horizontal |
| 8 | 763,92 MHz | 46,4 dBμV/m | 57 dBμV/m | Pass | 250 Degree | 1,05 m | Horizontal |

6.1.2. CONDUCTED EMISSION. CONDUCTED DISTURBANCE MEASUREMENT ⁽¹⁾

LIMITS OF PERMISSIBLE DISRUPTION

The applicable limit for the measurement of electromagnetic conducted disturbance on the AC mains port of the EUT, according to the standard EN 61326-1:2013 and UNE-EN 55011:2011, +/A1:2011, for Group 1 Class A devices, in the frequency range between 150 kHz and 30 MHz, is as follows:

| Frequency range | QP Limits (dBµV/m) | AVG Limits (dBµV/m) |
|-------------------|--------------------|---------------------|
| 150 kHz – 500 kHz | 79 | 66 |
| 500 kHz – 30 MHz | 73 | 60 |

TESTING METHOD

According to the standard UNE-EN 55011:2011, +/A1:2011, for table standing equipment. The measurement was carried out inside of an anechoic screened chamber.

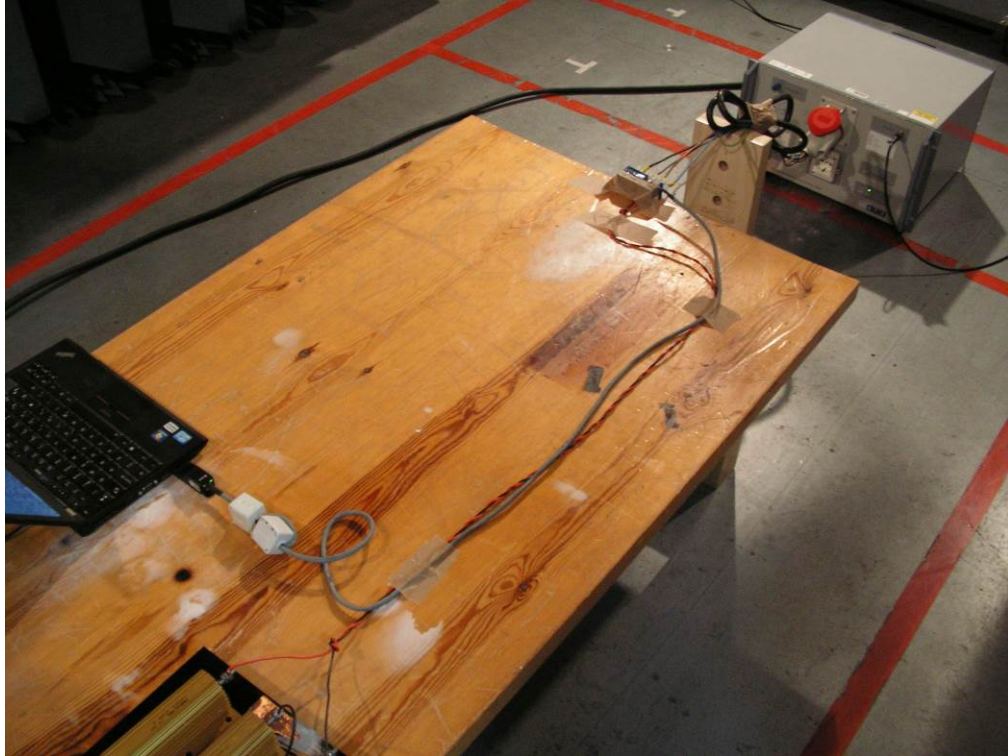
MODES OF OPERATION

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

The sample tested was the sample A.

TEST SETUP



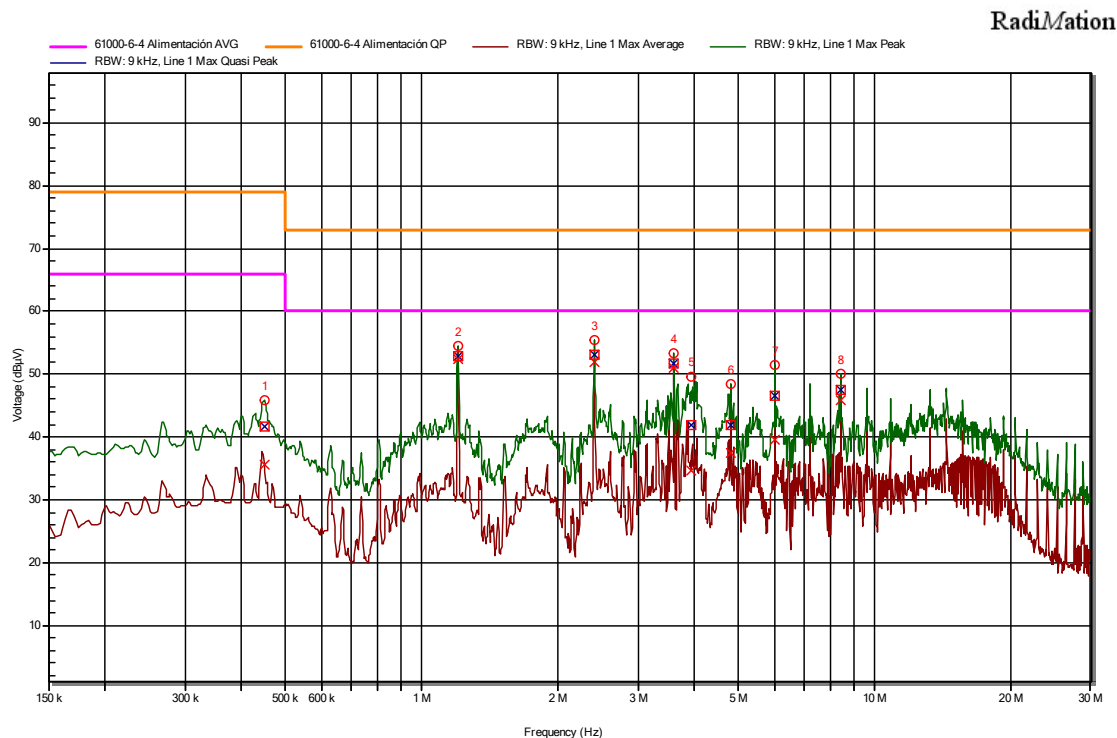
TEST RESULTS

P: Pass, F: Fail, NA:Not Applicable, NM: Not Measured

| Description | Result |
|--|--------|
| Conducted Emission. 150 kHz to 30 MHz. | P |

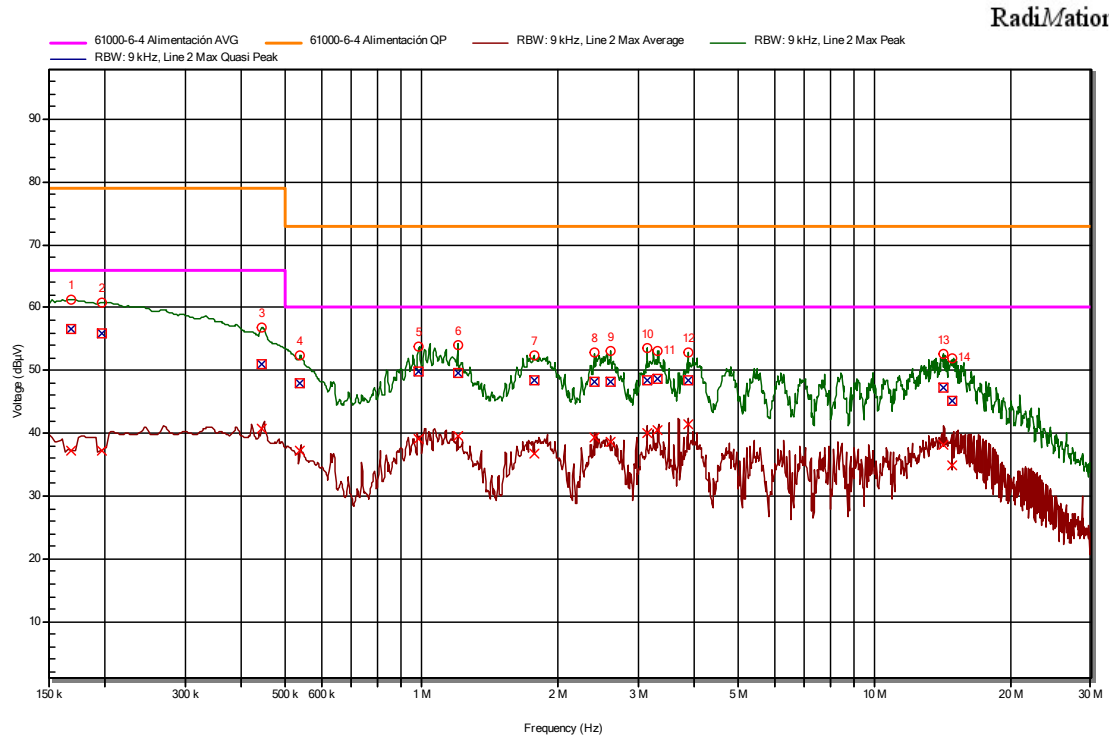
TABLES AND GRAPHICAL RESULTS

Measurement in L1



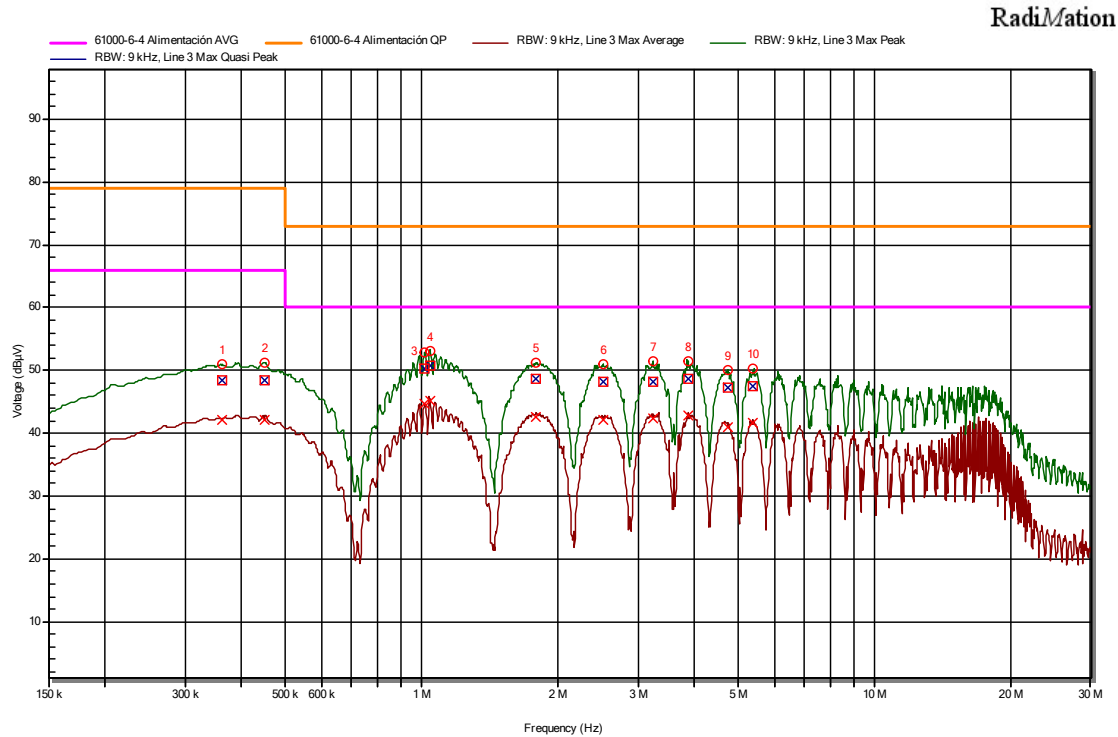
| Peak Number | Frequency | Average | Average Limit | Quasi-Peak | Quasi-Peak Limit | Status |
|-------------|------------|-----------|---------------|------------|------------------|--------|
| 1 | 449,25 kHz | 35,5 dBμV | 66 dBμV | 41,6 dBμV | 79 dBμV | Pass |
| 2 | 1,203 MHz | 52,3 dBμV | 60 dBμV | 52,9 dBμV | 73 dBμV | Pass |
| 3 | 2,405 MHz | 52 dBμV | 60 dBμV | 53,2 dBμV | 73 dBμV | Pass |
| 4 | 3,606 MHz | 50,9 dBμV | 60 dBμV | 51,6 dBμV | 73 dBμV | Pass |
| 5 | 3,932 MHz | 34,7 dBμV | 60 dBμV | 41,8 dBμV | 73 dBμV | Pass |
| 6 | 4,812 MHz | 37,5 dBμV | 60 dBμV | 42 dBμV | 73 dBμV | Pass |
| 7 | 6,011 MHz | 39,6 dBμV | 60 dBμV | 46,6 dBμV | 73 dBμV | Pass |
| 8 | 8,414 MHz | 45,9 dBμV | 60 dBμV | 47,5 dBμV | 73 dBμV | Pass |

Measurement in L2



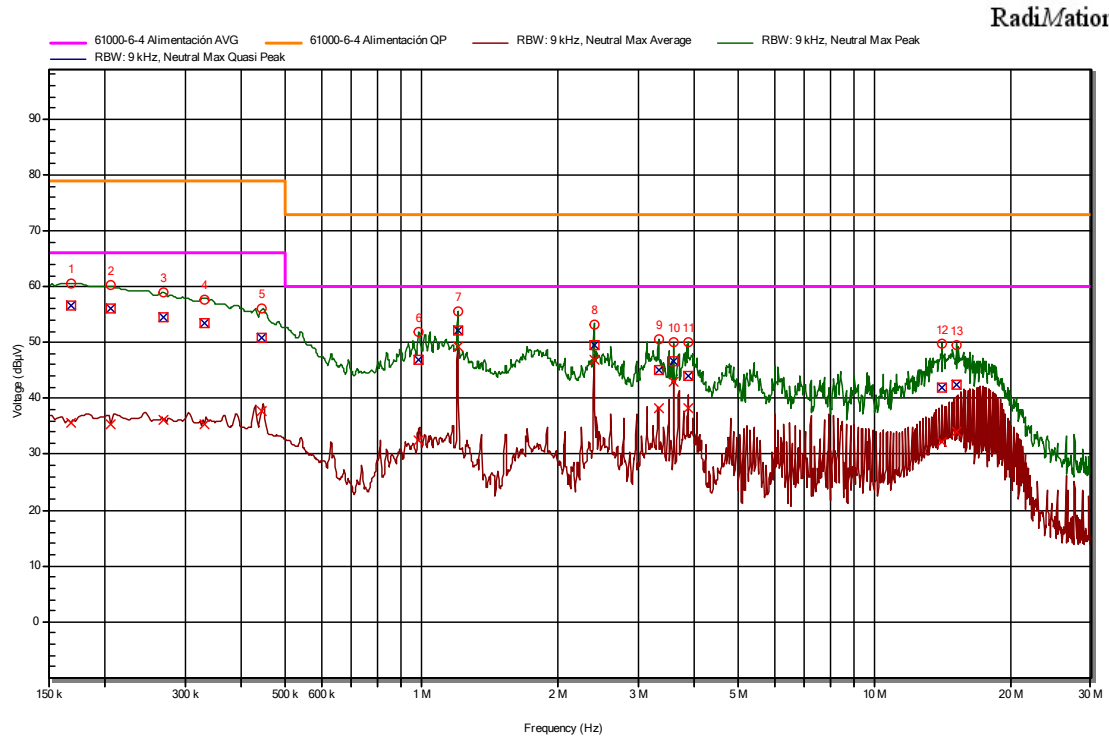
| Peak Number | Frequency | Average | Average Limit | Quasi-Peak | Quasi-Peak Limit | Status |
|-------------|------------|-----------|---------------|------------|------------------|--------|
| 1 | 168 kHz | 37,2 dBµV | 66 dBµV | 56,5 dBµV | 79 dBµV | Pass |
| 2 | 197,25 kHz | 37,1 dBµV | 66 dBµV | 55,8 dBµV | 79 dBµV | Pass |
| 3 | 444,75 kHz | 40,8 dBµV | 66 dBµV | 51,1 dBµV | 79 dBµV | Pass |
| 4 | 539,25 kHz | 37,3 dBµV | 60 dBµV | 47,9 dBµV | 73 dBµV | Pass |
| 5 | 987 kHz | 39,2 dBµV | 60 dBµV | 49,9 dBµV | 73 dBµV | Pass |
| 6 | 1,201 MHz | 39,5 dBµV | 60 dBµV | 49,6 dBµV | 73 dBµV | Pass |
| 7 | 1,772 MHz | 36,8 dBµV | 60 dBµV | 48,4 dBµV | 73 dBµV | Pass |
| 8 | 2,405 MHz | 39,2 dBµV | 60 dBµV | 48,2 dBµV | 73 dBµV | Pass |
| 9 | 2,612 MHz | 38,7 dBµV | 60 dBµV | 48,1 dBµV | 73 dBµV | Pass |
| 10 | 3,152 MHz | 40 dBµV | 60 dBµV | 48,5 dBµV | 73 dBµV | Pass |
| 11 | 3,329 MHz | 40,6 dBµV | 60 dBµV | 48,6 dBµV | 73 dBµV | Pass |
| 12 | 3,872 MHz | 41,4 dBµV | 60 dBµV | 48,5 dBµV | 73 dBµV | Pass |
| 13 | 14,219 MHz | 38,1 dBµV | 60 dBµV | 47,2 dBµV | 73 dBµV | Pass |
| 14 | 14,802 MHz | 34,8 dBµV | 60 dBµV | 45,2 dBµV | 73 dBµV | Pass |

Measurement in L3



| Peak Number | Frequency | Average | Average Limit | Quasi-Peak | Quasi-Peak Limit | Status |
|-------------|------------|-----------|---------------|------------|------------------|--------|
| 1 | 361,5 kHz | 42,1 dBµV | 66 dBµV | 48,4 dBµV | 79 dBµV | Pass |
| 2 | 449,25 kHz | 42,2 dBµV | 66 dBµV | 48,4 dBµV | 79 dBµV | Pass |
| 3 | 1,016 MHz | 44,6 dBµV | 60 dBµV | 50,4 dBµV | 73 dBµV | Pass |
| 4 | 1,043 MHz | 45,1 dBµV | 60 dBµV | 50,8 dBµV | 73 dBµV | Pass |
| 5 | 1,786 MHz | 42,5 dBµV | 60 dBµV | 48,8 dBµV | 73 dBµV | Pass |
| 6 | 2,513 MHz | 42,1 dBµV | 60 dBµV | 48,3 dBµV | 73 dBµV | Pass |
| 7 | 3,239 MHz | 42,3 dBµV | 60 dBµV | 48,3 dBµV | 73 dBµV | Pass |
| 8 | 3,872 MHz | 42,7 dBµV | 60 dBµV | 48,7 dBµV | 73 dBµV | Pass |
| 9 | 4,745 MHz | 41 dBµV | 60 dBµV | 47,2 dBµV | 73 dBµV | Pass |
| 10 | 5,402 MHz | 41,6 dBµV | 60 dBµV | 47,5 dBµV | 73 dBµV | Pass |

Measurement in N



| Peak Number | Frequency | Average | Average Limit | Quasi-Peak | Quasi-Peak Limit | Status |
|-------------|------------|-----------|---------------|------------|------------------|--------|
| 1 | 168 kHz | 35,7 dBµV | 66 dBµV | 56,6 dBµV | 79 dBµV | Pass |
| 2 | 206,25 kHz | 35,4 dBµV | 66 dBµV | 56 dBµV | 79 dBµV | Pass |
| 3 | 269,25 kHz | 36,1 dBµV | 66 dBµV | 54,5 dBµV | 79 dBµV | Pass |
| 4 | 332,25 kHz | 35,3 dBµV | 66 dBµV | 53,4 dBµV | 79 dBµV | Pass |
| 5 | 444,75 kHz | 37,7 dBµV | 66 dBµV | 50,8 dBµV | 79 dBµV | Pass |
| 6 | 984,75 kHz | 32,6 dBµV | 60 dBµV | 46,8 dBµV | 73 dBµV | Pass |
| 7 | 1,201 MHz | 49,2 dBµV | 60 dBµV | 52,1 dBµV | 73 dBµV | Pass |
| 8 | 2,405 MHz | 47 dBµV | 60 dBµV | 49,6 dBµV | 73 dBµV | Pass |
| 9 | 3,332 MHz | 38,3 dBµV | 60 dBµV | 45 dBµV | 73 dBµV | Pass |
| 10 | 3,604 MHz | 43,1 dBµV | 60 dBµV | 46,6 dBµV | 73 dBµV | Pass |
| 11 | 3,869 MHz | 38,3 dBµV | 60 dBµV | 43,9 dBµV | 73 dBµV | Pass |
| 12 | 14,039 MHz | 32,2 dBµV | 60 dBµV | 42 dBµV | 73 dBµV | Pass |
| 13 | 15,122 MHz | 34 dBµV | 60 dBµV | 42,5 dBµV | 73 dBµV | Pass |

6.2. **IMMUNITY RESULTS**

6.2.1. **IMMUNITY TO ELECTROSTATIC DISCHARGES**

TEST PLAN

➤ **MODES OF OPERATION**

The sample remained in the mode of operation M01 during the test..

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ **SAMPLE'S CONFIGURATION**

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted as a table standing equipment, being this setup the most similar to a real EUT's installation.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment:

| Discharge type | Level | Nr of discharges |
|-------------------|--|---------------------------|
| Contact discharge | $\pm 2 \text{ kV}, \pm 4 \text{ kV}$ | 10 per level and polarity |
| Air discharge | $\pm 2 \text{ kV}, \pm 4 \text{ kV}, \pm 8 \text{ kV}$ | 10 per level and polarity |

- **Performance Criteria Applied:**

Performance Criterion B.

- **Application Method:**

According to the standard UNE-EN 61000-4-2:2010 and internal method ME.CM04.

Ten discharges were applied for each test level and polarity, with 1 second interval between them.

NOTE: Only indirect contact discharges were applied to the EUT, as the device is not accesible to the user during operation.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured

| Description | Result |
|---|--------|
| Indirect Discharge. Contact discharge. Applied on the Vertical Coupling Plane, placed on the four sides of the EUT. Voltage applied: ± 2 kV and ± 4 kV. Comments: No anomalies are observed. | P |
| Indirect Discharge. Contact discharge. Applied on the Horizontal Coupling Plane, under the EUT. Voltage applied: ± 2 kV and ± 4 kV. Comments: No anomalies are observed | P |

6.2.2. IMMUNITY TO RF FIELDS

TEST PLAN

➤ **MODES OF OPERATION**

The sample remained in the mode of operation M01 during the test..

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ **SAMPLE'S CONFIGURATION**

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test.

The test was carried out inside of a semianechoic screened chamber.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment, exposing the EUT to a radiated field with the following characteristics:

| Frequency Ranges | Modulation | Test Voltage |
|-------------------|--------------|--------------|
| 80 MHz – 1000 MHz | AM 80% 1 kHz | 10 V/m |
| 1.4 GHz – 2 GHz | AM 80% 1 kHz | 3 V/m |
| 2 GHz – 2.7 GHz | AM 80% 1 kHz | 1 V/m |

In this test the frequency sweep was incremented by 1%, and the dwell time was 3 seconds. The delay time was 0 seconds.

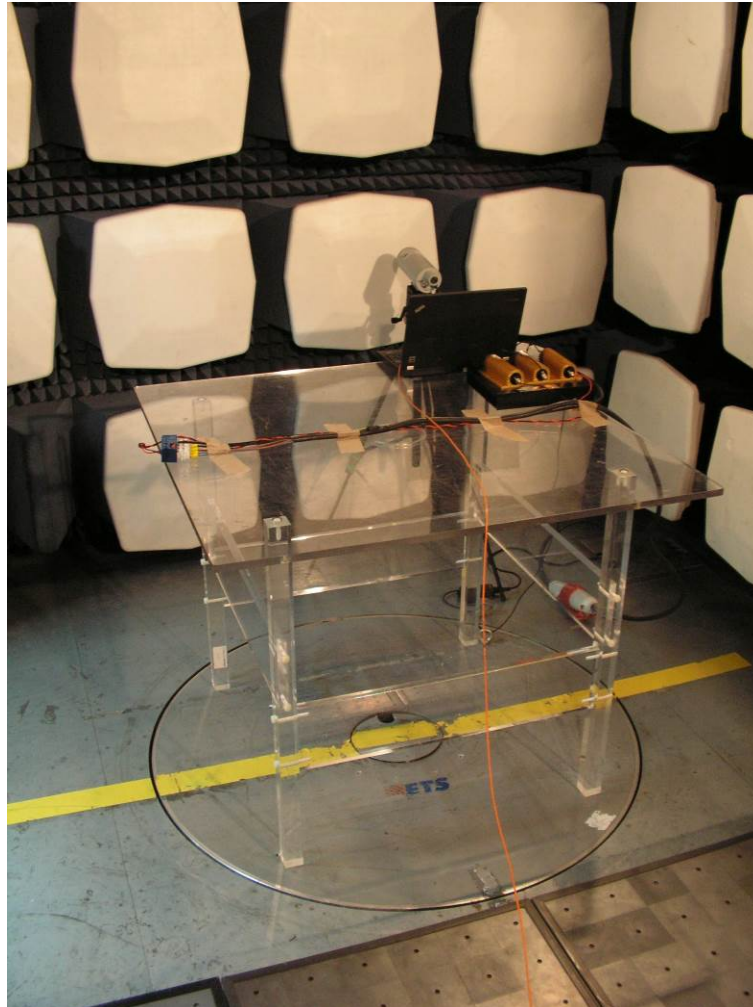
➤ **Performance Criteria Applied:**

Performance Criterion A.

➤ **Application Method:**

According to standard 61000-4-3:2007, +/A1:2008, +/A2:2011 and internal method ME.CM06.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|---|--------|
| Frequency interval: 80 MHz – 1 GHz. Field: 10 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Horizontal Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 80 MHz – 1 GHz. Field: 10 V/m. AM Modulation 80%, 1 kHz. 90°. Horizontal Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 80 MHz – 1 GHz. Field: 10 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Vertical Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 80 MHz – 1 GHz. Field: 10 V/m. AM Modulation 80%, 1 kHz. 90°. Vertical Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 1.4 GHz – 2 GHz. Field: 3 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Horizontal Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 1.4 GHz – 2 GHz. Field: 3 V/m. AM Modulation 80%, 1 kHz. 90°. Horizontal Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 1.4 GHz – 2 GHz. Field: 3 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Vertical Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 1.4 GHz – 2 GHz. Field: 3 V/m. AM Modulation 80%, 1 kHz. 90°. Vertical Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 2 GHz – 2.7 GHz. Field: 1 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Horizontal Polarization. Comments: No anomalies are observed. | P |

| | |
|---|---|
| Frequency interval: 2 GHz – 2.7 GHz. Field: 1 V/m. AM Modulation 80%, 1 kHz. 90°. Horizontal Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 2 GHz – 2.7 GHz. Field: 1 V/m. AM Modulation 80%, 1 kHz. 0° (EUT's front view). Vertical Polarization. Comments: No anomalies are observed. | P |
| Frequency interval: 2 GHz – 2.7 GHz. Field: 1 V/m. AM Modulation 80%, 1 kHz. 90°. Vertical Polarization. Comments: No anomalies are observed. | P |

6.2.3. IMMUNITY TO EFT/BURSTS

TEST PLAN

➤ **MODES OF OPERATION**

The sample remained in the mode of operation M01 during the test..

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ **SAMPLE'S CONFIGURATION**

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted as a table standing equipment, being this setup the most similar to a real EUT's installation.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment:

| Port | Repetition frequency | Level (kV) | Duration |
|--------------------|----------------------|------------|-------------------|
| AC power ports | 5 kHz | ± 2 kV | 1 minute/polarity |
| I/O signal/control | 5 kHz | ± 1 kV | 1 minute/polarity |

- **Performance Criteria Applied:**

Performance Criterion B.

- **Application Method:**

According to standard UNE-EN 61000-4-4:2013 and internal method ME.CM03.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|--|--------|
| <p>Tested interface: I01 (L1, N, PE). Direct coupling.</p> <p>Level: ± 2 kV.</p> <p>Comments: No anomalies are observed.</p> | P |
| <p>Tested interface: I02. Capacitive coupling.</p> <p>Level: ± 2 kV.</p> <p>Comments: Some error messages appear on the screen of the auxiliary PC during the application of the bursts. The device recovers itself after the interference.</p> | P |
| <p>Tested interface: I03. Capacitive coupling.</p> <p>Level: ± 1 kV.</p> <p>Comments: Some error messages appear on the screen of the auxiliary PC during the application of the bursts. The device recovers itself after the interference.</p> | P |

6.2.4. IMMUNITY TO SURGES

TEST PLAN

➤ **MODES OF OPERATION**

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ **SAMPLE'S CONFIGURATION**

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted on a 10 cm isolating platform, over the earth reference plane.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment:

| Port | Level (kV) | Nr of pulses |
|---|---|-------------------|
| AC power ports | $\pm 0.5 \text{ kV}, \pm 1 \text{ kV}, \pm 2 \text{ kV}$ (common mode) | 5 pulses/polarity |
| | $\pm 0.5 \text{ kV}, \pm 1 \text{ kV}$ (differential mode) | |
| I/O signal/control (long-distance lines) | $\pm 0.5 \text{ kV}, \pm 1 \text{ kV}$ (common mode) | 5 pulses/polarity |

- **Performance Criteria Applied:**

Performance Criterion B.

- **Application Method:**

According to standard UNE-EN 61000-4-5:2015 and internal method ME.CM08. The communication port included a shielded cable between the EUT and the auxiliary PC, but its shielding was not connected in any of the cable's sides. For this reason, the Surge pulses were going to be applied directly to the differential lines of the port. Eventhough, the normal functioning cannot be achieved

because of the impact of the CDN on the EUT, so following the recommendations of UNE-EN 61000-4-5:2015, no surge tests were applied on this line.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|--|--------|
| Tested interface: I01. (L1-L2) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L1-L3) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L1-N) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L2-L3) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L2-N) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L3-N) Z_{out} : 2 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV and ± 1 kV. Comments: No anomalies are observed. | P |
| Tested interface: I01. (L1-PE) Z_{out} : 12 Ω . Phase coupling: 0°, 90°, 180° and 270°. Level: ± 0.5 kV, ± 1 kV and ± 2 kV. Comments: No anomalies are observed. | P |

| | |
|--|---|
| <p>Tested interface: I01. (L2-PE)</p> <p>Z_{out}: 12 Ω. Phase coupling: 0°, 90°, 180° and 270°.</p> <p>Level: ± 0.5 kV, ± 1 kV and ± 2 kV.</p> <p>Comments: No anomalies are observed.</p> | P |
| <p>Tested interface: I01. (L3-PE)</p> <p>Z_{out}: 12 Ω. Phase coupling: 0°, 90°, 180° and 270°.</p> <p>Level: ± 0.5 kV, ± 1 kV and ± 2 kV.</p> <p>Comments: No anomalies are observed.</p> | P |
| <p>Tested interface: I01. (N-PE)</p> <p>Z_{out}: 12 Ω. Phase coupling: 0°, 90°, 180° and 270°.</p> <p>Level: ± 0.5 kV, ± 1 kV and ± 2 kV.</p> <p>Comments: No anomalies are observed.</p> | P |

6.2.5. IMMUNITY TO COMMON MODE RF FIELD

TEST PLAN

➤ MODES OF OPERATION

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ SAMPLE'S CONFIGURATION

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted on a 10 cm isolating platform, over the earth reference plane.

The sample tested was the sample A.

➤ The EUT was tested as a simple unit.

➤ The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment, exposing the EUT to an induced voltage with the following characteristics:

| Port | Frequency Ranges | Modulation | Test Voltage |
|---|-------------------|--------------|--------------|
| AC power ports | 0,15 MHz – 80 MHz | AM 80% 1 kHz | 3 Vrms |
| I/O signal/control (long-distance lines) | | | |

In this test the frequency sweep was incremented by 1%, and the dwell time was 3 seconds. The delay time was 0 seconds.

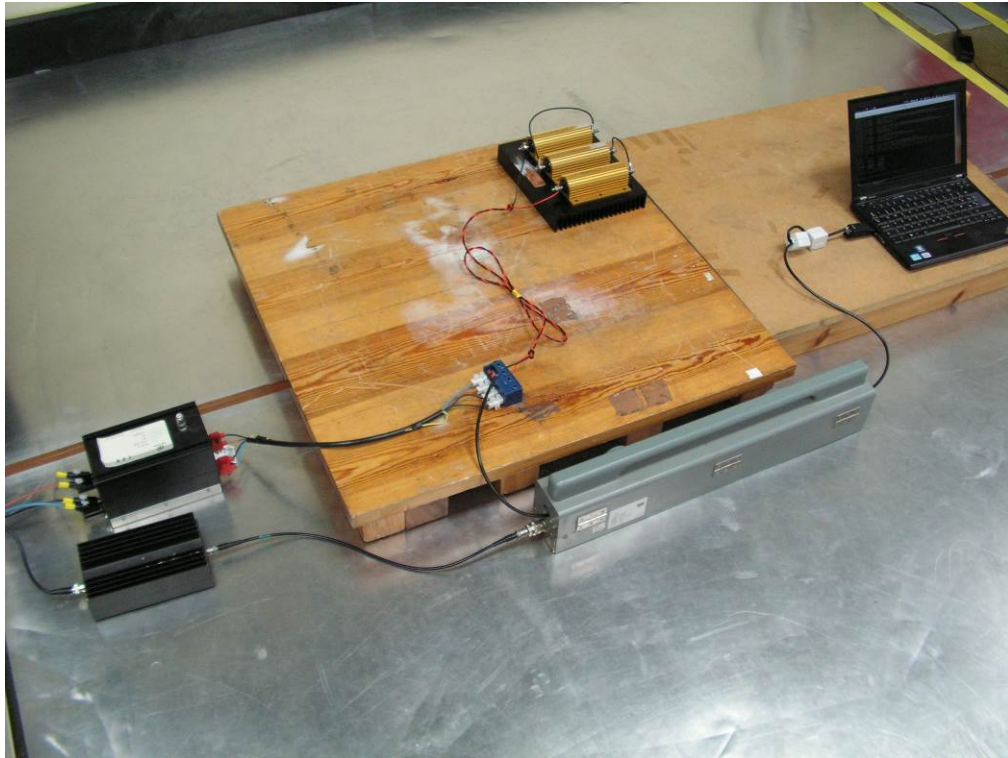
➤ Performance Criteria Applied:

Performance Criterion A.

➤ Application Method:

According to the standard UNE-EN 61000-4-6:2014 and internal method ME.CM01.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|--|--------|
| Frequency range: 0,15 MHz – 80 MHz. Field level: 3 Vrms over 150 Ω. AM modulation, 80% with 1 kHz. Tested interface: I01. Coupling through CDN. Comments: No anomalies are observed. | P |
| Frequency range: 0,15 MHz – 80 MHz. Field level: 3 Vrms over 150 Ω. AM modulation, 80% with 1 kHz. Tested interface: I02. Coupling through EM Clamp. Comments: No anomalies are observed. | P |
| Frequency range: 0,15 MHz – 80 MHz. Field level: 3 Vrms over 150 Ω. AM modulation, 80% with 1 kHz. Tested interface: I03. Coupling through EM Clamp. Comments: No anomalies are observed. | P |

6.2.6. IMMUNITY TO INDUSTRIAL FREQUENCY MAGNETIC FIELD

TEST PLAN

➤ MODES OF OPERATION

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ SAMPLE'S CONFIGURATION

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted as a table standing equipment, being this setup the most similar to a real EUT's installation.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment:

| Frequency | Level | Duration |
|-----------|--------|---------------|
| 50 Hz | 30 A/m | 1 minute/axis |
| 60 Hz | 30 A/m | 1 minute/axis |

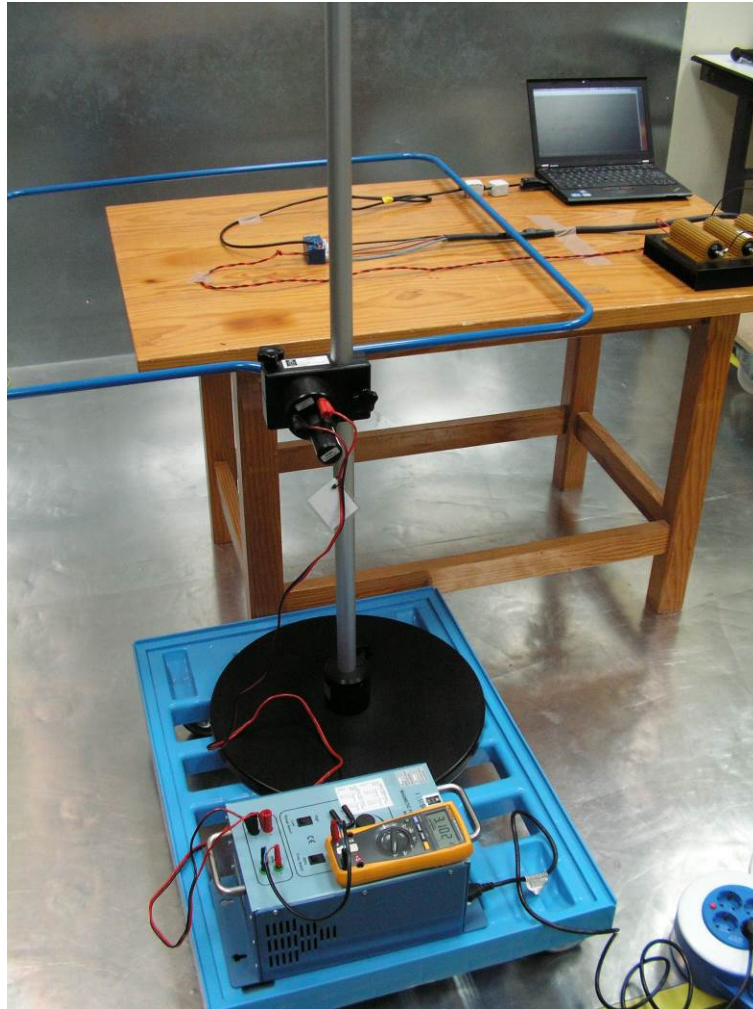
- Performance Criteria Applied:

Performance Criterion A.

- Application Method:

According to standard UNE-EN 61000-4-8:2011 and internal method ME.CM02.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|---|--------|
| Frequency: 50 Hz. Level: 30 A/m. H field orientation: X axis. Comments: No anomalies are observed. | P |
| Frequency: 50 Hz. Level: 30 A/m. H field orientation: Y axis. Comments: No anomalies are observed. | P |
| Frequency: 50 Hz. Level: 30 A/m. H field orientation: Z axis. Comments: No anomalies are observed. | P |
| Frequency: 60 Hz. Level: 30 A/m. H field orientation: X axis. Comments: No anomalies are observed. | P |
| Frequency: 60 Hz. Level: 30 A/m. H field orientation: Y axis. Comments: No anomalies are observed. | P |
| Frequency: 60 Hz. Level: 30 A/m. H field orientation: Z axis. Comments: No anomalies are observed. | P |

6.2.7. IMMUNITY TO VOLTAGE DIPS AND SHORT INTERRUPTIONS ⁽¹⁾

TEST PLAN

➤ MODES OF OPERATION

The sample remained in the mode of operation M01 during the test.

Once the equipment was turned on, approximately 5 minutes were waited until its warming up and stabilization.

➤ SAMPLE'S CONFIGURATION

The EUT was mounted according to the specifications given by the manufacturer for the mode of operation used in the test. The sample was mounted as a table standing equipment, being this setup the most similar to a real EUT's installation.

The sample tested was the sample A.

- The severity level applied was according to the standard EN 61326-1:2013 for equipment intended to be used in an industrial electromagnetic environment:

| Phenomena | Severity level | Performance criteria |
|---------------------|--|----------------------|
| Short interruptions | 0% U_{nom} during 1 period (50 Hz and 60 Hz) | B |
| | 0% U_{nom} during 250/300 periods (50/60 Hz) | C |
| Voltage dips | 40% U_{nom} during 10/12 periods (50/60 Hz) | C |
| | 70% U_{nom} during 25/30 periods (50/60 Hz) | C |

- Performance Criteria Applied:

Performance Criterion B and C.

- Application Method:

According to standard UNE-EN 61000-4-11:2005 and internal method ME.CM07.

TEST SETUP



TEST RESULTS

P: Pass, F: Fail, NA: Not applicable, NM: Not measured.

| Description | Result |
|---|--------|
| 100 % short interruptions. (0 % U_{nom} test level). Nr of repetitions: 3. Phase coupling: 0°. Duration and time between repetitions: 20 ms (10 s between repetitions). Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1). Frequency: 50 Hz. Performance criteria: B. Comments: No anomalies are observed. | C |
| 60 % voltage dips. (40 % U_{nom} test level). Nr of repetitions: 3. Phase coupling: 0°. Duration and time between repetitions: 200 ms (10 s between repetitions). Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1). Frequency: 50 Hz. Performance criteria: C. Comments: No anomalies are observed. | C |
| 30 % voltage dips. (70 % U_{nom} test level). Nr of repetitions: 3. Phase coupling: 0°. Duration and time between repetitions: 500 ms (10 s between repetitions). Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1). Frequency: 50 Hz. Performance criteria: C. Comments: No anomalies are observed. | C |

| | |
|---|---|
| <p>100 % short interruptions. (0 % U_{nom} test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 5 s (10 s between repetitions).</p> <p>Tested interface: I01 (L1-N).</p> <p>Frequency: 50 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: The DUT turns off during each short interruption and the auxiliary PC reports that the device is not connected. The DUT recovers itself after each interruption.</p> | C |
| <p>100 % short interruptions. (0 % U_{nom} test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 10 ms (10 s between repetitions).</p> <p>Tested interface: I01 (L2-N / L3-N / L1-L2 / L2-L3 / L3-L1).</p> <p>Frequency: 50 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: No anomalies are observed.</p> | C |
| | |
| <p>100 % short interruptions. (0 % U_{nom} test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 20 ms (10 s between repetitions).</p> <p>Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1).</p> <p>Frequency: 60 Hz.</p> <p>Performance criteria: B.</p> <p>Comments: No anomalies are observed.</p> | C |
| <p>60 % voltage dips. (40 % U_{nom} test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 200 ms (10 s between repetitions).</p> <p>Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1).</p> <p>Frequency: 60 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: No anomalies are observed.</p> | C |

| | |
|--|---|
| <p>30 % voltage dips. (70 % Unom test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 500 ms (10 s between repetitions).</p> <p>Tested interface: I01 (L1-N / L2-N / L3-N / L1-L2 / L2-L3 / L3-L1).</p> <p>Frequency: 60 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: No anomalies are observed.</p> | C |
| <p>100 % short interruptions. (0 % Unom test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 5 s (10 s between repetitions).</p> <p>Tested interface: I01 (L1-N).</p> <p>Frequency: 60 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: The DUT turns off during each short interruption and the application on the auxiliary PC reports that the device is not connected. The DUT recovers itself after each interruption.</p> | C |
| <p>100 % short interruptions. (0 % Unom test level).</p> <p>Nr of repetitions: 3. Phase coupling: 0°.</p> <p>Duration and time between repetitions: 10 ms (10 s between repetitions).</p> <p>Tested interface: I01 (L2-N / L3-N / L1-L2 / L2-L3 / L3-L1).</p> <p>Frequency: 60 Hz.</p> <p>Performance criteria: C.</p> <p>Comments: No anomalies are observed.</p> | C |

Development date: Noain, April 16th, 2018

Developed by: Iosu Martínez (EMC Technician)

Approved by: Ana Resano (EMC Responsible)

The indicated results exclusively refer to the sample, product or material handed over to the Laboratory, as mentioned in the corresponding section, and tested under the conditions mentioned in the procedures and norms quoted in this document.

The Laboratory keeps record of the uncertainties of the quantitative tests that require doing so.

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